THE FISHERIES OF THE CUBAN INSULAR SHELF: CULTURE HISTORY AND REVOLUTIONARY PERFORMANCE

by

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M.A., Simon Fraser University, 1970

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The Fisheries of the Cuban Insular Shelf: Culture History and Revolutionary Performance

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This dissertation is a case study of the fisheries of the insular shelf of the Cuban archipelago. It examines the history of a group of small-boat fisheries that in the last 35 years has been subject to rapid and sustained modernization, and evaluates the responses of Cuban governments to the environmental and development challenges presented by the exploitation of local marine resources.

The dissertation traces the occupation of the archipelago and the exploitation of its marine resources by its early inhabitants. It examines the cultural discontinuity consequent upon the arrival of the Spaniards at the beginning of the sixteenth century and the subsequent neglect of the fishery for much of the colonial period. It then documents and evaluates its modern development.

Perhaps the most important question to be addressed is whether a command economy based on central planning and state ownership of the means of production can do better than capitalist economies in overcoming the peculiar problems inherent in the exploitation of fish resources. More specifically, the dissertation presents an evaluation of the degree of success achieved by Cuban collectivist organization in the exploitation and management of the marine resources of the insular shelf in the years since the revolution of 1959.

The dissertation is organized in six parts. Part I reviews some theoretical questions relevant to the description and evaluation of fisheries. Part II provides a description of the physical and biological bases of the Cuban shelf fisheries. In Part III, the exploitation of shelf resources by aboriginal peoples and during the colonial and republican periods is described. Part IV
deals with the organizational change and expansion of the shelf fisheries in the post-revolutionary period until the mid-1970s. Part V describes the impact on the fisheries of the introduction of 200 nm fishing zones in the world ocean, and the first real attempt to utilize the potential advantages of state ownership of the means of production. It also evaluates the success of the Cuban response to a new and difficult reality by means of a critical examination of each of the major sectors of the shelf fishery.
DEDICATION

To my family and friends, especially to Sarah, for their forebearance and support.
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PART I
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CHAPTER 1
INTRODUCTION

This dissertation is a case study of the fisheries of the insular shelf of the Cuban archipelago. It examines the history of a group of small-boat fisheries that in the last 35 years has been subject to rapid and sustained modernization, and evaluates the responses of Cuban governments to the environmental and development challenges presented by the exploitation of local marine resources.¹

The exploitation of fish resources in countries with market economies has historically been fraught with problems. This has been widely attributed to the fugitive nature of these resources which have historically been exploited in common by fishers. As a result, fisheries have been subject to massive externalities; and market failure has been the exception rather than the rule. Solutions to the problem have usually involved governments, acting as central authorities, imposing regulation on the fisheries in an attempt to simulate the results that a properly functioning market would bring about. The record of success has been decidedly mixed and the "Tragedy of the Commons" has been a widespread characteristic of capitalist fisheries. Perhaps the most important question to be addressed in this dissertation is whether a command economy based on central planning and state ownership of the means of production can do better in overcoming the peculiar problems inherent in the exploitation of fish resources. More specifically, the dissertation presents an evaluation of the degree of success achieved by Cuban

¹ Fisheries in distant waters, an important component of Cuban fisheries development since the early 1960s, and those in the Cuban Exclusive Economic Zone outside of the insular shelf, are considered only incidentally in this dissertation.
collectivist organization in the exploitation and management of the marine resources of the insular shelf in the years since the revolution of 1959.

The development of fisheries in Cuba has not been a focus of interest for researchers so this evaluation is embedded in a much fuller historical account of the fisheries of the insular shelf. In the Spanish language, there is only one recent published attempt at a comprehensive treatment, consisting of a series of articles extracted from a doctoral dissertation (Baisre, 1987). The fishery is also conspicuous by its almost complete absence in the voluminous English-language literature on Cuba. This dissertation attempts to fill this gap. It traces the occupation of the archipelago and the exploitation of its marine resources by its early inhabitants. It examines the cultural discontinuity consequent upon the arrival of the Spaniards at the beginning of the sixteenth century and the subsequent neglect of the fishery for much of the colonial period. It then documents and evaluates its modern development. This is the first attempt at such a comprehensive history of the fishery written by a non-Cuban and it is hoped that it will provide a work of reference for later researchers.

In 1990, the latest year for which published statistics are available, Cuban coastal fisheries produced 61 000 mt of fish, about 31% of the total Cuban catch for that year (Benjamín and Baisre, 1991: 106). However, the significance of this economic sector was belied by the relatively modest catch. It occupied an important place in the Cuban economy in generating hard currency earnings for the country through exports to countries such as Japan, France, Spain and Canada. The most valuable fisheries within the coastal zone were those for lobster (Cuba is the world's second largest producer of spiny lobster after Australia) and shrimp, followed by those for tuna, crab, various shellfish and fin fish.
The fisheries took place in the shallow waters of the Cuban insular shelf, a coastal shelf of varying but mostly modest width, surrounding the archipelago. The physical nature of the shelf has restricted the introduction of large scale industrial catching techniques into this zone. As a result, fishing activities in 1990 were conducted mainly by a small-boat fleet using a large variety of gear and techniques. The industry employed some 14 000 fishers and an additional 4 000 workers in processing and support services (Báez, 1991b: 170), and fishing operations were based in 43 fishing ports mainly located close to fishing grounds on the shelf.

If anything is to be learned from the Cuban successes and failures in the management of the shelf fisheries, there is some urgency in considering this topic. While the Cuban economy has not yet been subject to the massive transformations that have recently occurred in other socialist countries such as the former U.S.S.R., China and Vietnam, there has recently been increasing internal and external pressure on the government of the Republic to effect fundamental changes in the economic system. If the Cuban command economy possesses advantages in the exploitation of marine resources, there is a danger that these will be discarded in a move to introduce market mechanisms.

1.1 RESEARCH

The research upon which this dissertation is based involved extensive library searches, interviews and field work in Cuba, Canada and the United States. A lengthy trip to Cuba in the fall of 1989 piqued my interest in Cuban fisheries and some preliminary library research and visits to fishing ports were undertaken during that time. Eighteen additional weeks, specifically directed to this research, were spent in Cuba in 1990, 1991 and 1993. (Some of
the problems involved in carrying out this research in Cuba are described in Appendix I). In 1991, visits to fishing ports at Batabanó and La Coloma in the province of Pinar del Río, and a trip on a shrimp trawler were made. A subsequent visit to Caibarién on the northeast coast in 1993 provided the opportunity for observation of lobster fishing operations.

Interviews were conducted in Cuba with officials in the Ministry of the Fishing Industry (Ministerio de la Industria Pesquera, MIP) and with personnel in fishing combines, with biologists specializing in lobster, shrimp and scale fisheries and with specialists in fishing gear. In Miami and Key West, additional interviews were conducted with Dr. José Suárez Caabro, a fisheries biologist important in the pre-revolutionary period, with René Buesa Más, a lobster biologist and former head of the Cuban Fisheries Research Centre (Centro de Investigaciones Pesqueras, C.I.P.), and with a fisher who had recently crossed the Strait of Florida on a raft.

My initial interest in the Cuban shelf fisheries derived from a more general one about fisheries, stimulated by a personal background of several years as a deckhand on fishing vessels on the west coast of Canada. The wider significance of Cuban fisheries as a case study of the performance of a command economy in dealing with common pool marine resources came later from Professor Parzival Copes of Simon Fraser University in two courses on fisheries economics.

1.1.1 Bibliographic Research

Obtaining bibliographic information of the shelf fisheries presented some difficulty. Firstly, as noted earlier, there is little more than cursory treatment of the fishing industry in the English language literature on Cuba. Secondly, while initial bibliographic research in Cuba identified more than
600 articles and reports with relevance to the shelf fisheries, the
overwhelming majority of them consisted of very specialized biological
studies. In spite of this, a great deal of useful information was obtained from
them. Lastly, a source of some frustration was the existence of a number of
papers cited in recent Cuban publications on the fishery which were,
however, unpublished and circulated only among employees of the Ministry.
They were often not held in the MIP library and were, therefore, unobtainable.

1.1.2 Statistics

There is a great deal of controversy, especially in the North American
literature, about both the accuracy and the interpretation of Cuban economic
None of this has touched directly on the fishing industry which, as I have
pointed out, has generally been ignored by English-speaking researchers.
With respect to the accuracy of statistics this may be a disadvantage to my
research in that no independent evaluation of fishery statistics has been
carried out. With respect to interpretation, on the other hand, it is probably
an advantage since amongst those North Americans who study Cuba there
exists a profound polarization of views which seems to leave little room for
dispassionate research (Zimbalist and Brundenius, 1989). This is not to
suggest that the present research will be value-free but it will attempt to
concentrate on primary sources and may thereby avoid some of the excesses of
ideological prejudice that exist elsewhere in the literature.

Statistics of catches by weight and value as well as those for fish
production, imports and exports, for Cuba as a whole, are published by the
Food and Agriculture Organization of the United Nations (FAO). No
distinction is made between the shelf fisheries and distant water fisheries but catches for each may be distinguished, to some extent, by examining statistics by species. This information is supplied to the FAO by the Cuban government. Such FAO statistics by country are useful. However, an interest in this dissertation is geographical variation in fisheries and processing within the country of Cuba. Statistics were therefore required on the basis of regions and, if possible, individual fishing ports and enterprises. Unfortunately, such statistics are not now published in Cuba. Until 1977, catch statistics for each fishing establishment were published within the industry in the form of monthly resumés.¹ In the mid-1970s, fishing combines were created and given the responsibility for the collection of statistics. Publication was at the level of the combine without reference to individual fishing establishments within them. This made obtaining data by regions difficult not only for foreign researchers but also for Cuban scientists and administrators. In an attempt to deal with this situation and to supply accurate catch statistics by fishing establishment, two Cuban researchers examined those published statistics which existed and, in addition, visited combines and establishments (García-Arteaga y Claro, 1987). The result of their work was a 915 page compilation of shelf fishery catch statistics by species, or group of species, containing monthly totals by establishment, combine and zone for the period 1959-1985. According to the authors, publication was not possible because of the large quantity of statistics and the limited number of users.

I found a copy of this report in the library of the Institute of Oceanology in Havana. However, since the statistics that it contains are not "official", permission could not be obtained to have them mechanically copied. Parts

¹ I was not able to find any of these resumés.
were copied by hand. There being insufficient time to copy monthly totals, all statistics obtained are annual ones. Annual catch statistics for the period 1959-1985 were entered into a computer database: 31 tables by species and zone; and seven tables by groups of species (fish, crustaceans, molluscs, etc.) and establishment. These statistics proved to be of fundamental importance to this research. They were supplemented by information from various specialized MIP reports.

1.2 OUTLINE OF THE DISSERTATION

The dissertation is organized in six parts. The remainder of Part I reviews some theoretical questions relevant to the description and evaluation of fisheries. Part II provides a description of the physical and biological bases of the shelf fisheries. In Part III, the exploitation of shelf resources by aboriginal peoples is described. This is followed by an examination of the development of the shelf fisheries in the colonial and republican periods. This part of the thesis ends with an attempt to provide an accurate description of the fisheries in the immediate pre-revolutionary period, at the end of their capitalist development phase. Part IV deals with the organizational change and expansion of the shelf fisheries in the post-revolutionary period until the mid-1970s. Part V describes the impact on the fisheries of the introduction of 200 nautical mile (nm) fishing zones in the world ocean, overfishing in the previous period and the first real attempt to utilize the potential advantages of state ownership of the means of production. It also evaluates the success of the Cuban response to a new and difficult reality by means of a critical examination of each of the sectors of the shelf fishery. Part VI, the conclusion, reviews the findings of the dissertation.
CHAPTER 2

ANALYTICAL FRAMEWORK

In this chapter the analytical framework to be employed in this study of the fisheries of the Cuban insular shelf will be outlined. Since much of the audience to which it is addressed, both in North America and in Cuba, is likely to be unfamiliar with some of the concepts to be employed, especially in fisheries economics, these are reviewed in some detail. The ultimate objective is to provide a language with which to describe the fisheries, and a set of conceptual tools which may be employed in evaluating their development.

2.1 BIOECONOMIC THEORY

The bioeconomic model and its refinements have been central to the analysis of fisheries since the publication of seminal papers by H. Scott Gordon in 1953 and 1954 and Milner B. Schaefer in 1954 and 1957. In a general way, the model, often called the Gordon-Schaefer model, brings together the biological and economic aspects of the fishery, but it does more. It gives a reasonable account of two distinctive characteristics that, in combination, distinguish the fishery from other economic activities. The first derives from the lack of property rights specification to marine resources. In the literature of fisheries economics, fish stocks have been characterized as common property resources to which access, until recent times, has commonly been open. In such a situation, fishers are free to enter the fishery and free to catch as many fish as they possibly can in competition with other fishers. No fisher will have any interest in conserving the resource since any small fish he
returns to the water to grow larger will likely be taken by a competitor. The original fisher, then, will have gained no benefit. Thus, as Copes (1981b: 113) has noted, "In this scramble for fish the stocks are often badly depleted and occasionally threatened with outright destruction." The second distinctive characteristic of fishing derives from the fact that the supply of wild fish is limited by the natural carrying capacity of the oceans. "Fish cannot be produced in the same way as a washing machine or a loaf of bread" (Hartwick and Olewiler, 1986: 244). With the exception of cases such as the salmon fishery on Canada's west coast in which stock enhancement has been pursued, human activity cannot significantly increase the productivity of wild fish populations. However, if the number of fish removed from a population by fishing and natural mortality becomes too large, the reproductive ability of the population may be affected, to the extent that the number of fish growing large enough to be caught by fishing gear will decline. In other words, recruitment will fall.\(^1\)

There follows a synopsis of the bioeconomic model of fisheries. It is based principally, but not exclusively, on accounts in Copes (1978, 1981b, 1986c), Gulland (1977), Hartwick and Olewiler (1986), Parsons (1993), Pauly (1979a, b), and Tyler and Gallucci (1980).

2.1.1 The Biological Basis

Models of fish population dynamics may be divided into two groups. The first, dynamic pool models (e.g. Beverton and Holt, 1957), consider the structure of the fish population with respect to such characteristics as its age distribution. They tend to be complex and require a great deal of data. The

\(^1\) Recruitment may be defined as "the number of fish of a single year group entering the exploitable phase of a stock in a given period by growth of smaller individuals" (Royce, 1972: 221).
second, logistic growth or surplus yield models (e.g. Schaefer, 1954, 1957), consider the fish population as a whole and examine changes in the total biomass over time.¹ This type of model is more suitable for the analytical purposes of this dissertation and will be employed here.

2. 1. 1. 1 The surplus yield model. We may begin examination of the model by considering a population of fish fully occupying an environmental niche and in balance with other species. As Schaefer (1957: 672) has noted, "an outstanding characteristic of populations of fishes ... is that they tend to remain in dynamic balance ... Over any reasonably long period of time, losses from the population must be balanced by accessions to the population." If such a population were subject to a catastrophic event, such as an epidemic disease, such that the mortality rate became higher than the rate of recruitment, the size of the population would decrease. If, after the disease had run its course, the population had been reduced to almost zero, there would be more food available to each surviving fish (assuming that no other species had, in the meantime, occupied the niche). Each fish, then, will grow quickly and increase its reproductive output and a higher proportion of juveniles will survive. As a result, the population as a whole will grow in numbers and increase in weight until it reaches the environmental carrying capacity, after which growth will cease. The rate of growth in biomass varies with time and is described by a logistics curve such as in Fig. 2.1A.² From the figure, it can be seen that the initial rate of growth is slow, it then increases to a maximum at P, before, theoretically, becoming zero at K, the environmental carrying capacity. The explanation for these changes in the rate of growth is

¹ Biomass is the aggregate weight of the fish population measured at a point in time (Hartwick and Olewiler, 1986: 243). In these models, the biomass referred to is that of the part of the population recruited to the fishery. It does not include eggs, larvae and small juveniles.
² Fig. 2.1 is adapted from Pauly (1979: 14).
A. Logistics Growth Curve

B. Biological Productivity Curve
that, initially, since there are only a few fish to put on weight, the total biomass will increase only slowly. However, as fish numbers increase and each fish puts on weight, the biomass will grow at a more rapid rate until it reaches a maximum at K/2. Thereafter, the growth rate will decrease because, since the population is larger and the food supply finite, the impact of declining food abundance per individual fish will become an increasingly important constraint. In addition, "older fish convert a smaller part of the food they eat into new flesh" (Pauly, 1979b: 13). It can be seen, then, that the population has fought back from its decrease in numbers by increasing its rate of productivity until it once again has reached the environmental carrying capacity. This process is called "pure compensation" or "compensatory density-dependence" (Tyler and Gallucci, 1980: 114).

If net growth is plotted against population size in a "biological productivity curve" (Fig. 2.1B), it can be seen that it will be low both when the biomass is small and when it is close to the environmental carrying capacity, and that it will be at a maximum at the intermediate point, K/2. The ideal curve shown here approximates a second degree parabola but it should be noted that the real world is both complex and subject to change so that the curve may vary in shape among fish stocks and may change over time. Whatever its precise shape, its significance for fishing is that "if during any year man removes an amount equal to the natural annual increase, then the population abundance will remain unaltered" (Gulland, 1977: 70). That is, if members of the population are removed by fishing, a greater quantity of resources will be available to the survivors. Each fish, having more food available to it, will grow at a faster rate and increase its reproductive output.

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1 It should be noted that there are circumstances in which fish populations find it difficult, or are unable, to compensate as described above. This is called depensation.
Growth, life expectancy, the number of times that an individual fish spawns, and the survival rates of young fish will all increase. In other words, the harder the population is fished, the harder it will compensate by increasing its productivity.

Theoretically, the removal of the surplus yield can be repeated year after year on a sustainable basis. In addition, we have seen from Fig. 2.1B that maximum net growth is achieved at a population level, $K/2$, equal to half of the environmental carrying capacity. Thus if the population were fished down to this level, a maximum sustainable yield, or MSY, could be obtained from it (Fig. 2.2A). The idea that a level of effort could be found at which a maximum amount of fish could be obtained from a stock in perpetuity, became an extremely important one in fisheries management and will be examined in more detail later in this chapter.

2.1.1 Yield-effort relationship. Since we will now introduce fishing to the model, we will replace "population" with the term "stock" which is more widely employed in fisheries management and which may be defined as "a population of fish, either of one species or of a number of species, occupying a particular area and living independent of other populations of that species (or those species)" (Kesteven, quoted in Gulland, 1974: 2). As Copes (1991) has noted, the concept of stock deals with the necessity of defining a group of fish that are to be managed by human beings. Since a major objective of management is to ensure the reproductive continuity of the stock, it should coincide, ideally, with a unique breeding population of fish.

As fishing begins on a stock, the relationship between the amount of fishing effort and the yield or catch measured in metric tons is illustrated in Fig. 2.2A which demonstrates the annual catch that will be obtained after
FIG. 2.2. Yield-Effort Relationships

A.

B.

C.

Effort/Time Period (Vessel-Years)

Annual Yield (MT)

Effort/Time Period (Vessel-Years)

Annual Yield (MT)
applying a particular level of effort for a sufficient number of years.\(^1\) In other words, in the long run, a particular relationship between the catch and the fish stock will be established: "provided the catches are not too great, the decline in abundance is not continual. After a time, the population will reach a new equilibrium, at which time the same catches can be maintained indefinitely year after year" (Gulland, 1977: 70).

Following Copes (1981b: 114) the relationship between yield and effort may be described as follows. When harvesting of the stock begins, effort is low and the catch will be small. Initially, because a large biomass is still available, as effort increases, so will catches. However, while effort increases the corresponding increase in catch will be less than proportional to it for three possible reasons. Firstly, as the number of vessels and total effort increases, the standing stock will be reduced so that the catch per-unit-of-effort (CPUE) will decline. Secondly, if the fishing gear being used (e.g. small mesh nets) catches small fish before they can grow to an optimal size, the size at which that year class has reached its maximum weight, the rate of weight recovery of the stock will decrease over time. This is called growth overfishing. Lastly, reduction in the stock will decrease spawning activity which may cause a decline in the number of juvenile fish produced and reaching maturity, resulting in recruitment overfishing. Thus with increasing effort, the yield curve may be expected to rise at a declining rate.

---

\(^1\) Fig. 2.2 was adapted from Copes (1978: 22, 29 and 31). Fishing effort may be defined in two ways (Cunningham, Dunn and Whitmarsh, 1985: 14-15): "Nominal fishing effort refers to the volume of resources devoted to fishing, quantified either as monetary or physical units. (It) may be represented by a single input such as time spent fishing, or as an amalgam of inputs that can include all the labour and capital used to exploit the fishery." In practice, it is often measured using some standard unit, such as the vessel-year, which encompasses both fishing capacity and the time spent fishing. Effective fishing effort, on the other hand, "refers to fishing mortality, usually measured as the biomass of fish extracted by fishing, expressed as a proportion of the mean population." Nominal effort is shown on the x-axis of Fig. 2.2.
until a "maximum sustainable yield" is reached (AB). Beyond this point further increases in the level of annual effort will result in lower total annual catches. If effort continues to increase, the yield will reach zero at an effort level of G. In its simplest form the model predicts that this level of effort in the long-run will result in the extinction of the stock. In fact, the yield curve often will not return to zero because, for example, some proportion of the stock may remain beyond the reach of fishing gear in sanctuaries inaccessible to fishing, or the selectivity of gear may be such that fish will have reached maturity and spawned before they become vulnerable to it. In either case, the result will be a "modified" Schaefer curve as shown in Fig. 2.2B. In terms of both models, biological overfishing may be defined as fishing at a level of effort greater than that required to obtain MSY.

It is important to note at this point that the curve shown in Fig. 2.2A refers to a stock subject to self-regulation. Its renewal, in other words, is dependent on the proportion of the population left unharvested to perpetuate itself (Schaefer, 1957: 671). However, some stocks are non-self-regulating:

the amount which is available to be used each year is determined by natural phenomena other than the magnitude of the resource itself, and the amount used in any given year has no effect on the amount which will be available for use during the next year (Schaefer, 1957: 671).

In other words, such stocks have such high levels of fecundity that a small spawning stock is sufficient to produce very large numbers of juveniles. Recruitment, in such stocks, is determined by some factor or factors other than the size of the adult population. In the case of the rock lobster of South Australia, for example, the number of recruits is determined by the availability of shelter from predators (Copes, 1978). The yield curve for such a
stock will, like the one shown in Fig. 2.2A, rise to MSY at a decreasing rate but then, with continued increases in effort, will asymptotically approach this limiting level (Fig. 2.2C). On the face of it, such a stock could not be subject to biological overfishing as defined above. However, it should be noted that if it is fished so hard that too few spawning fish remain, the stock may be incapable of producing enough juveniles to reach the environmental carrying capacity and may therefore be converted into a self-regulating stock.

2.1.2 The Economic Basis

The behaviour of the long-run yield curve beyond MSY, with a decreasing catch in spite of increases in effort, helps to explain one aspect of the peculiar nature of the fishery as an economic activity. Now we turn to an explanation of why effort in a fishery may continue to increase in spite of such decreases in yields. The model to be described here is both simplified and static\(^1\) but it will adequately serve the analytical purposes of this dissertation.

We may examine how this occurs by means of Fig. 2.3. If a constant price for fish is assumed, the yield curve may be converted into a revenue curve by multiplying the weight of the catch by the price per unit weight of fish. When this is done it can be seen that the maximum sustainable yield also produces the maximum sustainable revenue from fishing. A cost curve may also be introduced. It is assumed that the fishing fleet consists of identical vessels with standard costs and standard fishing operations. The cost of fishing will therefore be proportional to the amount of fishing effort and will be represented by a straight line from the origin sloping upwards to the right.

\(^1\) The model does not take account of the discount rate. It assumes that the present real value of any claim on fish caught in a future time period is the same as its real value as determined in that future time period.
FIG. 2.3. Relationship between Fishing Effort and Catch
Costs, it should be noted, include all opportunity costs including a "normal" reward for labour and a "normal" return to capital invested.

From Fig. 2.3, which depicts the situation in a fishery to which access is open, it can be seen that while effort is at a level below \( OD \), fishers will earn revenues greater than all of their costs. The additional net return, measured by the vertical distance between the revenue and cost curves, is called the "resource rent." It is made possible by the fact that fish are "a free gift of nature" (Copes, 1981b: 116) with a landed value that may exceed the cost of capture.\(^1\) It will attract additional fishers to the fishery until effort level \( OD \) has been reached. At this point, all potential resource rent will have been dissipated and, since only normal returns will be available, there will no longer be an incentive for additional fishers to enter the fishery. This point is called the open-access equilibrium.\(^2\) "It is evident that open access to a common property fishery resource generally results in non-optimal conditions of exploitation. In terms of economic theory, we may speak of 'market failure' or 'misallocation' of the factors of production" (Copes, 1981b: 117). It may be further noted that when the open-access equilibrium lies to the right of MSY, not only is the potential resource rent dissipated but biological overfishing results.

From Fig. 2.3, it can be seen that the maximum economic rent is obtained at an effort level, \( OK \), lower than that required to obtain MSY.\(^3\) The catch obtained at this level of effort came to be called the maximum economic yield (MEY) by economists. Fishing at any level of effort higher than this,

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1 Copes (1981: 116) formally defines resource rent in a resource extracting industry as representing "the value of goods obtained by mankind (measured by revenue) over and above the value of resources expended (measured by costs of production)."

2 In fact, as a result of the optimism for which fishers are notorious ("highliner illusion") it is quite possible for effort to expand beyond the open-access equilibrium to a situation where not only resource rent but also normal returns are dissipated in part.

3 Fig. 2.3 is adapted from Copes (1981: 115).
then, came to be considered as economic overfishing.

2.1.3 Fisheries Objectives

The concepts of maximum sustainable yield and maximum economic yield have both been employed as objectives in the management of fisheries. The strictly biological concept of MSY became popular after World War II. Its attraction to fisheries managers was summed up by Larkin (1977: 1): "Any species each year produces a harvestable surplus, and if you take that much and no more, you can go on getting it for ever and ever (Amen)." However, MSY became subject to increasing criticism in the 1960s. It had two main weaknesses. Firstly, it assumes that fish stocks are stable. However, with environmental perturbations, the abundance of most fish stocks will vary from year to year, independent of the amount of fishing pressure to which they are subject, and the yield curve will not likely be a stable one. This problem can be dealt with by employing the average of a bundle of curves so that the concept may still be useful. A second and more serious weakness, noted by many fisheries economists in the 1950s and 1960s, was that MSY considers only biological factors and assumes that the objective of extracting a maximum sustainable amount of biomass is a valid one. It does not take account of the value of the catch nor of the cost of obtaining it.

Maximum economic yield (MEY) was designed to overcome the second weakness of MSY by putting a calculation of value into both the cost and revenue sides of fishing operations. It redefined the optimal level of effort in a fishery to that which would obtain the maximum difference between the value of the catch and the cost of catching it. MEY, in turn, came to be criticized for emphasizing economic efficiency at the expense of social considerations.
In the mid-1970s, some fisheries theorists began to consider that fisheries objectives should include, as well as biological conservation and economic efficiency, such factors as fishers' incomes and employment levels. The result was the concept of Optimum Yield or Optimum Sustainable Yield (OSY) which has been defined as "MSY modified by relevant economic, social, environmental and other factors" (Cunningham et al: 106). It has been subject to criticism as a result of its imprecision and openness to a variety of interpretations. Copes, for example, has argued that if MEY is based in social cost-benefit analysis, rather than on strictly market considerations, it can be employed to show the most desirable outcome from society's point of view. The problem according to this view, is not intrinsic to the concept of MEY but arises from the economists' narrow interpretation of it. Conceptually, however, OSY does provide a reminder to those involved in fisheries that factors other than biological and economic ones must be taken into account in managing the fishery.

In spite of the differences between them, all three of the major fisheries objectives outlined above agree that the optimum level of effort in a fishery is not that which would result from the open-access equilibrium. In the next section, we will examine in a general way the options available to fisheries managers to avoid this situation.

2.2 THE TRAGEDY OF THE COMMONS

Analysis of the problems involved in the use of common property in fisheries may be subsumed, along with analyses of water, forest, soil and other resources, under the rubric "Tragedy of the Commons", as a result of a paper published in 1968 by Garrett Hardin. His analysis of overpopulation using a grazing commons as an analogy struck a chord which has reverberated
through many disciplines.

Hardin used the analogy of a common pasture with limited capacity, to which cattle herdsmen have open access. While the number of herdsmen and cattle are below the carrying capacity of the meadow, there is no problem. However, if the number of cattle approaches the carrying capacity, there is a potential for resources to become scarce. The individual herder, being rational, seeks to maximize his gain by adding an additional animal to his herd. "Since the herdsman receives all of the proceeds from the sale of the additional animal, the positive utility is almost +1... Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision-making herdsmen is only a fraction of -1" (Hardin 1968: 162). But, as Hardin notes, all other herdsmen reach the same conclusion with the result that, by following their individual rationality, herdsmen destroy the common pasture. "Freedom in a commons brings ruin to all" (Hardin 1968: 162). In the literature of fisheries economics, this characteristic is expressed as an externality, in that every fisher who takes a fish from the sea imposes a cost on his fellow fishers by reducing the resource. As Ostrom has noted, "The paradox that individually rational strategies lead to collectively irrational outcomes seems to challenge a fundamental faith that rational human beings can achieve rational results" (Ostrom, 1990: 5).

Hardin (1978) suggested that there were only four possible pure political-economic systems that could be applied to solving the problem of the commons: private enterprise, in which the environment is utilized by the individual and the proceeds go to the individual; socialism, in which the environment is utilized by the group and the proceeds go to the group; a system of commons, in which the environment is utilized by the group and the proceeds go to the individual; and altruism, in which the environment is
utilized by the individual and the proceeds go to the group. The last of these alternatives, altruism, is not considered a realistic alternative: "The persistent dream of freedom is 'he suicidal dream of a state in which individual conscience is the only coercive force" (Hardin, 1978: 314). Hardin has been depicted, perhaps unfairly, as also dismissing the commons out of hand as a viable alternative (See, for example, Ostrom, 1990: 9). However, in considering alternative political systems to deal with the commons problem, he made a distinction between ecosystems that were being exploited at a level at, or below, the environmental carrying capacity. Where the population was below the environmental carrying capacity, he believed that the commons might, in fact, be a better option than any of the others.

The situation changes however, if the population is greater than the environmental carrying capacity. In this case, a system of commons would be disastrous and Hardin believed that it must be renounced. Two alternatives remain. Either a manager must be appointed to administer the commons or it must be divided into parcels of private property. The first of these alternatives is socialism and the second is private enterprise but Hardin notes that they share a common characteristic in that neither can be introduced on an individual basis. "if ruin is to be avoided in a crowded world, people must be responsive to a coercive force outside their individual psyches, a 'Leviathan' to use Hobbes' term" (Hardin, 1978: 314). In terms of the model, a central authority, would either have to apportion the commons into private parcels or appoint a manager who would "decide who can use the meadow, when they can use it and how many animals can be grazed" (Ostrom, 1990: 9). In terms of the real world, Hardin called for abandonment of all commons, and their replacement by "managements that are either private or socialistic or a mixture of the two" (1978, 314) but requiring, in any case, a central
authority. As noted previously, fish are a fugitive resource and cannot be apportioned, like grazing land, in private parcels.\(^1\) As a result, the approaches to fisheries management in countries with market economies, as we will see in section 2.2.1, have tended to be "socialistic" in Hardin's terms.

### 2.2.1 Fisheries Management Under the Control of a Central Authority

Early attempts to deal with the "tragedy" saw the central authority employing fishery regulations to act as a "handicapper" on fishing effort by such means as restricting fishing times and prohibiting or limiting the use of efficient vessels and gear types.\(^2\) In extreme cases the fishery could be closed completely. The objective of such regulations was to avoid the depletion of fish stocks by making it difficult for fishers to catch too many fish. In this they were often successful but by their nature they also prevented fishers from utilizing their vessels optimally.

#### 2.2.1.1 Limited entry

In the face of persistent problems, central authorities began to consider more radical measures of fisheries "rationalization" in the 1960s. The objectives were to eliminate open-access by limiting entry to the fishery and reducing the fleet size to an optimal level by removing vessels from it. The first major attempt at rationalization in the world occurred in the salmon fishery in British Columbia. The vehicle was the "Davis Plan" which attempted to rationalize the fishery by means firstly of freezing entry to it, and then by instituting a "buy-back" programme designed to remove vessels and fishers from the fishery. For a variety of reasons,

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\(^1\) Some sedentary species such as oysters may represent an exception.

\(^2\) An extreme example of restriction of fishing times is found in the British Columbia roe herring fishery in which the total fishing time available to seine vessels during the fishing season decreased from 2,328.5 hours in 1975 to 17.8 hours in 1985. (Brown and Joyce, 1985). Examples of gear restrictions are the prohibition of the use of fish traps in the British Columbia salmon fishery and the prohibition on the use of seine net drums in the west coast U.S. salmon fishery.
especially the fact that licences were made transferable, the buy-back programme took out only about 5% of the total fleet capacity and the Davis Plan was declared a failure (Copes, 1994).

Even in new fisheries, limited entry by itself may not be successful in providing an optimal level of effort. A simple restriction on the number of vessels does nothing to prevent fishers from improving the harvesting capacity of vessels and gear, a process called "capital stuffing" (Crutchfield, 1979). Copes (1986c) has examined this and other problems in the prawn and lobster fisheries of South Australia, both of which were subject to limited entry from their inception.

2. 2. 1. 2 Quota management. In the face of the perceived lack of success in rationalizing fisheries by means of limited entry, other options began to be considered in the 1970s. During that decade a ground swell of support grew for the introduction of quota management in the form of individual quotas (IQs) or individual transferable quotas (ITQs) into fisheries.

Marine resources, with the exception of such sedentary species as some shellfish, are "fugitive" resources (Copes, 1980: 125) that cannot be easily "fenced". Quota management schemes have tended, as a consequence, to establish an optimal total allowable catch (TAC) which is then shared amongst a limited number of licenced fishers in the form of individual quotas. There are at least three major potential advantages deriving from the fact that fishers know in advance how much fish they may catch in a given season. Firstly, it would eliminate the "race for fish" with its accompanying damaging competition and distortion of inputs. Secondly, effort would be spread throughout the fishing season to make the best use of the capital invested and to obtain the best prices in the market. Thirdly, because they have a guaranteed quota which can be taken at any time during the season,
fishers would no longer have to fish in unsafe conditions. An additional theoretical advantage would accrue to the individual quota fishery if all or part of the quota is made transferable (ITQ). In such a case, the more skilled fishers (highliners) will buy up unused parts of the quotas of those with lesser skills and will, therefore, be able to operate more efficiently. They will, over time, be able to adjust their quota amount optimally to fit the capacity of vessel and gear. Less efficient fishers, on the other hand, will gain by selling their quota and leaving the fishery. Rationalization of the fishery will therefore take place without the necessity for a buy-back programme.

Proponents of quota systems promoted them on the basis that they would introduce quasi-property rights into the fishery "commons" (Parsons, 1993: 195) and would thereby eliminate the externalities to which its exploitation was subject.\(^1\) This was a seed which fell on fertile ground. The late 1970s and 1980s marked the accession to power of a number of governments espousing "smaller" government, de-regulation of economic activities, and a renewal of free-enterprise by means of "privatization". The logic of individual quotas seemed to fit very nicely with this ideological position and, "By 1983 the economic community had clearly embraced individual quotas as the means to deal with open access fisheries. Governments, both in Canada and elsewhere, were experimenting with the approach in selected fisheries" (Parsons, 1993: 194).

The millennium in fisheries management had apparently arrived. However, Copes (1986a) foresaw at least 14 potential problems in fisheries managed by individual quotas. The three most important of these relate to

\(^1\) It may be pointed out that the transferable licence in a limited entry fishery may be bought and sold in the same way that quotas are in a quota fishery and also, therefore, gives the fisher a quasi-property right. This parallel aspect of limited entry licencing has not been widely acknowledged by proponents of quota systems.
enforcement, "high grading" and unstable stocks. With respect to the first, policing a quota system may be relatively easy in industrial fisheries where large vessels (e.g. deep-sea trawlers) deliver fish to a limited number of landing points. However, in a small-scale fishery with a large number of vessels with innumerable potential landing points, there may be a temptation for fishers to catch more than their assigned quota and to sell the extra fish illegally in a process called "quota busting".

The second potential problem derives from quality considerations. The value of fish often varies per unit weight, according to characteristics desired by the market. For example, it may vary by the size of the fish. In some fisheries, such as that for chinook salmon on Canada's west coast, prices are higher for larger than for smaller fish, while in others, such as the halibut fishery in the same region and in spiny lobster fisheries throughout the world, smaller sizes are desired, and are therefore of higher value. Additional characteristics such as firmness of the flesh, sexual maturity and appearance may also be taken into consideration in setting prices. Such variations are important because quotas are usually given in terms of weight and fishers, keeping quality considerations in mind, will try to fill them up with the most valuable fish. They will do so by discarding less valuable fish in a process called "high grading". This wastes resources. In addition, both high grading and quota busting result in the subsidiary problem of "data fouling". Fishers will not, of course, report illegally caught fish and there is rarely a requirement to report discards\(^1\) so that the level of fishing mortality may be much higher than recorded in landing statistics. If fisheries scientists cannot take this into account accurately they may set the TAC too high, with

\(^1\) Even if there were a requirement for reporting discards, it is difficult to conceive of fishers weighing unwanted fish before throwing them back into the sea.
consequent danger to the stock.

The third problem derives from the central importance of setting the TAC accurately at the beginning of each authorized time period (commonly a fishing season). This may be done fairly successfully in fisheries, such as those for long-lived species (e.g. ground fish in temperate waters), where stocks are relatively stable. It would be much more difficult, if not impossible, with respect to stocks (e.g. herring and Penaeid shrimps) which show great instability from year to year.

Individual quota management systems were introduced in the 1980s into fisheries in a number of countries including Iceland, Australia and Canada. The first thorough-going application has been in New Zealand where ITQs were introduced into offshore fisheries in 1984 and extended to most others in 1986 (McGillivray, 1990; Pearse, 1991). According to Parsons (1990: 678), the New Zealand experiment in ITQs management has been widely praised. Pearse (1991: 2), for example, is a supporter: "I view New Zealand's quota management system as a promising first step. Indeed it has made New Zealand the world leader in fisheries management systems."

However, recent evaluations have indicated that the programme is not without problems. "In the short term the system has not improved, and has perhaps, hindered, stock conservation. The economic impact is unclear" (Parsons, 1993: 678). Copes (1995: 17) noted that "ITQ protagonists have found enough successful features to justify their continuing support. Most, however, seem ready to concede that there are more practical problems with quota management than were previously acknowledged."

2.2.2 The Commons Re-examined

The mixed results of the management strategies described above have
led some resource analysts to re-examine Hardin's dismissal of the commons option. Such analysts have criticized the conceptualization of the commons inherent in the "tragedy" paradigm on two main grounds: that it confuses the relationship between common property and open-access, and that it is based upon erroneous assumptions about human motivation and social organization.

The "tragedy of the commons" model, according to these critics, assumes that access to the commons is open to all who desire it. Economists Ciriacy-Wantrup and Bishop (1977: 715) contend that this has rarely been the case and that, in fact, commons have usually been the property of a group of co-equal owners such as a tribe, a community or a village. Studies of traditional societies have led anthropologists to support this criticism: "In true common property situations, rights of access or use are shared equally and are exclusive to a defined group of people" (McCay and Acheson 1987: 8). It is clear that if access is controlled by the group of co-equal owners over-exploitation of the commons may be avoided. There is, then, no inevitability to the "tragedy of the commons" and the problem should be re-conceptualized as a "tragedy of open access" (McGoodwin, 1990: 95).

Hardin's assumptions concerning human motivations and social organization have also been subject to criticism. As noted above, the "tragedy" results from commoners acting individualistically out of rational self-interest. Arguing against the primacy of such self-interest, Berkes reviewed many fisheries and came to the conclusion that "There is evidence from small-scale community-based fisheries that fishermen may voluntarily limit their take" (Berkes, 1985: 200). From most of the examples cited by Berkes, however, it is clear that the individual fisher limits his take, not out of some altruistic or conservationist motive but because he is constrained to
do so by peer pressure or some form of community control.

This leads to a more cogent criticism that deals with Hardin's picture of human relationships. In the model, individual commoners are conceptualized as operating in the commons without reference to fellow commoners, except as competitors. Few, if any, human beings have the ability to act so freely: "it is clear in real-life situations that few users of common property are so unencumbered by social restraints that they can behave as selfishly as the model predicts" (McGoodwin, 1990: 93). Field studies by anthropologists in many parts of the world such as Turkey (Berkes, 1986), the Philippines (Cruz, 1985), Mexico (McGoodwin, 1989); New Jersey (McCay, 1989) and Maine (Acheson, 1975) support this contention. McGoodwin (1984) has reviewed studies of fisheries in which management by a central authority is absent. He found evidence of cooperation amongst fishers in local fisheries in the form of "active self-regulation" including control over access, restrictions on types of gear, information management and other means. The conclusion is drawn that, in traditional fisheries and even in some contemporary local fisheries, "individual interests are often subservient to the collective interests of a community" (Berkes, 1985: 204). Thus, whether fishers are assumed to be self-interested or whether they are assumed to be altruistic is unimportant. In many situations, their behaviour will be constrained by their membership in a group. If such is the case, the collective catch may be limited and the "tragedy of the commons" avoided.

The implications of these criticisms of the "tragedy of the commons" model of fisheries resource use is that, in at least some circumstances, it may not be necessary to invoke a central authority to prevent ruin. In the light of widespread problems with both limited entry and individual quota programmes, the writings of these resource analysts may represent the first
indications of a new fashion in dealing with the tragedy of the commons—that community-level regulation may be a viable management option, for at least some, small-scale fisheries.

2.2.3 Socialism: The Least Examined Option

In the English language literature dealing with the "tragedy of the commons" there is little consideration of resource use in countries with centrally-planned or command economies. In such countries, the state not only acts as the central authority regulating the use of the commons, but is also the owner of the means of production:

The concentration of the basic means of production as state property makes it possible to efficiently regulate social production on the basis of a single national economic plan...all members of society are related to one another as co-owners of the crucial means of production. The socialist state regulates the society's economic life, the activity of ... enterprises, the expansion of production, and the rational use of the instruments of labour in the interests of the entire society" (Suvurova and Romanov 1986: 114).

The socialist state, endowed with such powers, should be able to regulate the exploitation of the commons and should, therefore, be able to avoid the occurrence of the "tragedy". In the fisheries, it has the authority and the means to limit effort and to optimize fleet, rather than individual vessel, operations. Theoretically, then, damaging competition between individual vessel operators can be replaced by co-operation and information-sharing, the size and disposition of the fleet can be adjusted for optimal exploitation, and economic misexploitation and biological overexploitation can be avoided. In this dissertation, the case study of the Cuban shelf fisheries
is employed as a vehicle for an evaluation of the "socialist option" in the management of fisheries.

2.3 WIDENING THE ANALYSIS

The "tragedy of the commons" model has been emphasized in this chapter because in the form of the bioeconomic model it has been paradigmatic in the study of fisheries for the last 40 years or so. It remains persuasive but it has been subject to an increasing amount of criticism from commons theorists, marine anthropologists, resource analysts and from economists themselves. As an anthropologist has pointed out, "However useful the Tragedy of the Commons model may have been in helping fisheries managers to conceptualize fisheries problems, it seems also to have reified some erroneous assumptions about fishers that have led to inappropriate fisheries policies" (McGoodwin 1990: 96). Some of the additional factors that may have to be taken into account in the analysis of fisheries development are enumerated below.

2.3.1 Environmental Change

It is clear that fish stocks are subject to fluctuations in populations size as a result of natural and human-derived environmental changes out of which the bioeconomic model, which assumes a static environment, has nothing to say. While intense fishing pressure undoubtedly contributed to the collapse of the Peruvian anchoveta fishery, it is also certain that the ultimately fatal blow was given in 1971-72 by an "El Niño" event which cut off upwelling and the nutrient supply upon which the fish were dependent. Similarly, the collapse of the reduction herring fishery on the Pacific coast of Canada was attributed to both very high exploitation rates and a succession of
very poor year-classes in the mid-1960s caused by unidentified environmental changes. The existence of such environmental fluctuations which critically affect some marine species, calls into question the possibility of achieving any kind of sustained equilibrium catch in all fisheries (Caddy 1984). To take account of them, it would be necessary to make constant adjustments of the optimum level of effort in limited entry management plans or in the Total Allowable Catches in individual quota systems.

Human activity outside of the fishery may also have an impact on fish stocks through habitat destruction. The list of potential impacts is a long one. Dam construction may block the spawning routes of migrating species or may increase salinity in estuarine areas by reducing the inflow of fresh water (Kutkuhn, 1966). Estuarine wetland habitats may also be physically affected by drainage and removal of vegetation consequent upon port and recreational development (Walker, 1984). Urbanization and industrialization subject rivers and coastal areas to toxic pollution (Pearse, 1982; Walker, 1984). In the tropics, tourist and other developments have resulted in extensive clearance of coastal mangroves which are nursery areas for many marine species as well as damage to coral reefs from increased sedimentation and pollution from sewage (Rodríguez, 1981; Snedaker, 1978; Thayer, Wolfe and Williams, 1975).

2.3.2 Fisheries Economic Theory

Fisheries economists have also been criticized from within the discipline for focusing on the common property/open-access character of the fishery to the exclusion of other important constraints within which it operates.

2.3.2.1 Externalities. The common property/open-access fishery, as an economic activity, is subject to a number of externalities, costs that the
activities of one fishing enterprise impose on others (Cunningham, Dunn and Whitmarsh, 1985: 17). Copes (1991) has outlined the most important externalities as follows:

Stock externalities

**Biomass reduction.** This simply refers to the fact that, as each fisher takes fish, there are fewer left for other fishers. As the stock is thinned, a greater amount of effort and cost is required to harvest a given amount of fish.

**Growth effects.** Over time, the aggregate weight of a cohort (all fish of a unique breeding stock that are born in the same season, a year-class) of fish will describe a normal curve. At the peak of the curve, the cohort will have achieved its maximum weight or critical size. From the point of view of biomass maximization, fishing the cohort before it reaches this critical size is growth overfishing, while fishing it after the peak, is growth underfishing. To the extent that it is impossible to harvest an entire cohort instantly, a trade-off will have to be made between growth overfishing and growth underfishing. If, because of consumer preference or lower handling costs, the value per unit weight of fish is greater for larger than for smaller sizes, some degree of growth underfishing may be desirable to obtain the optimal harvest value from the cohort. If, on the other hand, smaller sizes are valued more, fishing the cohort slightly before critical size is reached, may be desirable.

**Recruitment effects.** If too many spawning fish are removed from a stock, and if the stock is self-regulating, there may be a decline in recruitment and, possibly, failure to obtain the optimal sustainable harvest.

Crowding externalities

**Mutual interception.** Crowding of gear on the fishing grounds is such that fish are prevented from being caught by other fishers' gear.

**Interference.** Costs are imposed on fishers by tangling of gear.

Gear externalities

**Damage.** Some types of fishing gear may not be appropriate for use in the same locality. For example, trawl nets may damage fixed or set nets.
Selectivity. Fishers, trying to maximize the weight of their catch, use gear with low selectivity and thereby catch fish that are too small as well as large ones—the classic common property problem described at the beginning of this chapter.

Interspecies externalities

Predator-prey relationships. Some fishers concentrate on fishing predators, some on prey. If more of the prey species is taken, it may, in removing food, have an adverse effect on the stock abundance of the predator species.

Fishing strategy externalities

Space interception. Fishers move progressively farther out in the fishing grounds in order to be the first to take, for example, migrating fish. Other fishers are forced to follow suit in a type of leap-frogging operation as fishers try to outdo each other to get to the front of the line along the migration route. They thereby increase costs for the fleet as a whole.

Time interception. Fishers, attempting to gain a competitive advantage over their fellows, fish earlier and earlier in the fishing season and, therefore, take smaller and smaller fish.

Information management. Withholding information from, or giving false information to, other fishers.

Rent-seeking activities

Absorbing rents. If resource rents are generated in a fishery, participants may invest money in lobbying to attempt to obtain a larger share and, in doing so, will waste resources.

The existence of such externalities in fisheries result in "market failure" in this economic activity and is the justification for fisheries management.

2.3.2 Low incomes. Among economists, Copes (1987) has questioned whether the "tragedy of the commons" can provide an adequate explanation for the generally low incomes amongst fishers in many small-scale fisheries. While acknowledging the inevitability of overexploitation of resources by overcapitalized fleets in open-access fisheries, he argues that widespread poverty among small-scale fishers in both developed and
developing countries is attributable to additional factors such as: the isolation of fishing communities resulting in low opportunity costs for fishers; the failure of surplus labour to leave the fishery in spite of productivity improvements; the difficulty of removing capital investment from the fishery in poor fishing years which occur with varying frequency as a result of the cyclical nature of markets and stocks; lifestyle preference; optimism among fishers about potential rewards (highliner illusion); and, often, "perverse" assistance from governments (See also Copes 1986b). A convincing case is made by Copes and others (Parsons, 1993: 612) for the necessity, in the investigation of economic problems in fisheries, to widen the scope of the analysis beyond that provided by the "tragedy of the commons" model.

2.3.3 Politics

The importance of politics in the management of common property resources has also been noted. Neilsen (1976: 21) points out that this is not a recent phenomenon. "When a "British commission finally saw the need for management in 1893, Parliament ignored its recommendations." More recently, the Minister of Fisheries of Canada overrode the recommendations of fisheries managers and thereby crippled a plan to severely limit entry to the British Columbia roe herring fisheries in 1974. His actions resulted in a seine fleet that was more than 300% larger and a gillnet fleet that was more than 700% larger than what had been considered to be optimal (Brown and Joyce, 1994: 82).

2.3.4 International Law of Fisheries

On a more formal level, fisheries are subject to the impact of both
international law and national fisheries policy. The fundamental reorganization of world fisheries since proclamation of 200 mile exclusive economic zones in 1977, resulted in the decline in importance of some distant-water fleets consequent upon their exclusion from such zones. In some cases this has necessitated re-appraisal of national fisheries policies.

2.3.5 National Fisheries Development Policy

Governments have embarked upon fishery development programmes for many, often conflicting, reasons. Among the objectives may be: to increase the supply of affordable protein to the population; to improve the welfare of fishers who work in small-scale fisheries and who may also live in isolated communities with few alternative sources of employment; to substitute locally-caught for imported fish; to develop export fisheries for high value species, like lobster and shrimp, which can generate hard currency earnings for the country and; to support integrated national economic development plans (Royce, 1987: 4).

Given such a heavy burden of tasks, it is not surprising that the record of fisheries development has been mixed. Among many possible examples, the following may be cited. Copes (1990: 5-6) has shown the limitations of import-substitution in the case of Papua New Guinea where a strong cultural preference for cheap imported canned mackerel makes it unlikely that local fish will enter the diet in large quantities in the near future. McGoodwin (1989) has documented conflicts in the shrimp fishery on the Pacific coast of Mexico where an artisanal fishery catches juvenile shrimp for local consumption as they exit coastal lagoons for the sea. At the same time, and as a result of national government policy, an industrial fishery catches shrimp from the same stocks in the offshore areas after they have attained greater size
and, therefore, higher value. Modernization, in this case, has proven to be of little benefit to the artisanal fishers. Similar small-scale/large-scale conflicts have occurred, again as a result of government modernization programmes, in the Philippines (Cruz, 1985) and in Sri Lanka (Alexander, 1976).

2.3.6 National Economic Policy

National economic policy may also be instrumental in determining the characteristics of a fishery through subsidy and development programmes and in sustaining populations of fishers, often at great cost, in isolated communities such as those on the east coast of Canada (Copes, 1983; 1986b). Ideological changes in general economic policy may also have impacts on the fishery. It is surely no accident, for example, that the implementation of large scale ITQ programmes in the 1980s, as noted earlier, coincided with the accession to power of many governments espousing free enterprise, "smaller" government and de-regulation of economic activities.

The significance of the foregoing review is that the "tragedy of the commons" model, in considering fisheries solely as a common property/open-access phenomenon, may yield only partial explanations. It is clear that fisheries are part of complex cultural-environmental systems. The reduction of all of the problems in fisheries to "tragedies of the commons" will not do justice to the complexity of relationships between human groups and marine resources. It is apparent that an attempt should be made to conceptualize and to analyze fisheries, including those with common property/open access characteristics, as human activities embedded within much larger cultural-environmental systems.
PART II

THE PHYSICAL AND BIOLOGICAL BASES OF THE FISHERY
CHAPTER 3
THE PHYSICAL BASIS OF THE FISHERY

The Cuban archipelago lies just south of the Tropic of Cancer in the entrance to the Gulf of Mexico (Fig. 3.1). It is bordered on the northeast by the tropical western Atlantic Ocean, on the south by the Caribbean Sea and on the northwest by the Gulf of Mexico. The southern tip of the Florida peninsula lies about 230 km to the north while the Yucatan peninsula is located some 200 km to the southwest across the Yucatán Channel, the major passage between the Caribbean Sea and the Gulf of Mexico. In addition, the archipelago commands two important entrances, the Straits of Florida and the Windward Passage, into what has been called the "American Mediterranean." This situation has been of major strategic importance in Cuban history. Of more importance to Cuban fishing has been the relative proximity of the shallow shelf areas of Florida, the Great Bahama Bank, Cay Sal Bank and Campeche Bank (Fig. 6.1).

The archipelago has a land area of 110 922 km² and is made up of the large island of Cuba, the much smaller Isle of Youth (formerly the Isle of Pines) and about 1 600 islands, islets ("keys") and reefs arising out of a submerged insular shelf. Four groups of islands and keys may be distinguished along the outer edge of the shelf. The Colorados Archipelago is the least extensive and parallels the northwest coast in the province of Pinar del Río. It consists of a number of low, swampy keys situated between the coast and a barrier reef which rises along the edge of the shelf. The Sabana-Camagüey Archipelago, also known as the "King's Garden" (Jardines del Rey), with more than 400 keys and islands, is the most extensive in the country. On
FIG. 3.1. Republic of Cuba: Situation
its seaward border is a barrier reef 400km in length. Towards the east, the keys increase in size to true islands and enclose a long sheltered inland sea made up of the bays of Buenavista and Jigüey. The Queen's Garden Archipelago (Jardines de la Reina), on the south coast was named by Columbus after Queen Isabela and is composed of a number of keys and reefs bordering the Gulfs of Guacanayabo and Ana María. Finally, to the west, is the series of keys and reefs and the Isle of Youth which together make up the Canarreos Archipelago bordering the Gulf of Batabanó. Each of these island groups provides extensive nurseries for fish and crustaceans and also provides protection from storms for fishing vessels.

3.1 RELIEF

The geology and geomorphology of the archipelago have been described by numerous foreign and local geologists and geographers beginning with von Humboldt at the beginning of the nineteenth century (von Humboldt, 1895) and extending into the present century with such works as that of Pardo (Pardo, 1975) and the sustained work of geographer and speleologist Núñez Jiménez (e.g.1968). The current state of knowledge on these subjects is exhaustively summarized in the most recent atlas published in 1989 by the Academy of Sciences of Cuba.¹

The archipelago is located in the Antillean island arc in the zone of interaction between the North American and Caribbean tectonic plates. The

¹ The "Nuevo Atlas de Cuba" published in 1989 is a large format (60 cm x 50 cm) atlas published by the Academia de Ciencias de Cuba. It is organised in broad topic sections such as Geology, Relief, and Natural Resources which are numbered using roman numerals. Subdivisions within each section, pages and maps are numbered with Arabic numerals. Therefore, the reference VI. 3.3, Map 31 refers to the topic section on climate, the subdivision on precipitation, page 3, on which is located map 31 "Average Annual Precipitation. 1964-83. Each section is provided with a written introduction of approximately 5 000 words summarizing the current state of knowledge on the topic. The atlas will be cited as A. C. C. 1989.
Cuban microplate is bounded by the steep scarps of eastern Yucatán basin, northern Cuba and the Bartlett Deep. The island of Cuba, 1250 km long with a width which varies from 31 km to 191 km, has been described as resembling a crocodile with its tail at the entrance of the Gulf of Mexico and its snout close to the west coast of Haiti (Nuñez Jiménez, 1968: 2). In spite of the fact that it contains three mountain systems and several upland areas, Cuba has a larger percentage of gentle slopes and plains than any of the other Greater Antilles (Fig. 3.2). The eastern mountain system, including the Sierra Maestra, is the most heavily dissected and includes the highest point in Cuba, Pico Turquino, with an elevation of 1,973 m. The central system or Escambray with elevations reaching 1,143 m includes the Sierra de Trinidad in the west and the Sierra de Sancti Spíritus in the east. The western system or Cordillera de Guaniguanico with a maximum elevation of 728 m is composed of the two parallel ranges of the Sierra del Rosario and the Sierra de los Organos (Fig. 3.2) and contains the most extensive karst landforms (caves, sinkholes, cone-karst) in Cuba.

The island of Cuba also contains a number of highly eroded areas, lower in elevation than the mountains, which may be called uplands (alturas). Three groupings can be distinguished: the Havanna-Matanzas Uplands (Alturas de La Habana-Matanzas) and the Bejucal-Madruga-Coliseo Uplands (Alturas de Bejucal-Madruga-Coliseo) comprise an area of some relief in the northern parts of the provinces of Havana and Matanzas; the Santa Clara Uplands and the Uplands of Northeastern Las Villas (Alturas del Nordeste de Las Villas) together make up an area lying to the northeast of the Escambray lying within the eastern edge of Cienfuegos, southern Santa Clara and northern Sancti Spíritus provinces. Lastly, the narrow elevated area made up of the Sierra Cubitas and the Peneplain of Florida-Camagüey-Tunas,
together called the Maniabón Uplands, forms a spine which extends southeastwards through the provinces of Camagüey, Las Tunas, and Holguín towards the eastern mountain system.

More than half of the area of the main island is made up of plains of various origins. In the west, the plains of Guanahacabibes, southern Isle of Youth and Zapata are the result of the dissolution of large areas of limestone. The plain of Cauto-Guacanayabo in the east was formed by fluvial deposition while those of Camagüey and Las Tunas are the result of denudation (Núñez Jiménez, 1968). As a gross generalization, it can be said that the plains are wider on the southern side of the island although in several places they extend completely across it from the north to the south coast.

3.2 HYDROLOGY

The major watershed runs like a spine along the length of the main island and, as a consequence, most of the 900 Cuban rivers are of limited length and reduced or even intermittent flow. In addition, many parts of the island are underlain by limestone so that rivers may flow underground for at least parts of their lengths. Almost two-thirds of the rivers discharge along the south coast including the largest, the Cauto, which flows from the Sierra Maestra into the Gulf of Guacanayabo and the second largest, the Zaza, which enters the sea in the Gulf of Ana María (Instituto Cubano de Geodesia y Cartografía [I.C.G.C.], 1978: 147). River discharge, in affecting the salinity of inshore waters and in acting as a transport system for sediments and nutrients, plays a seasonally important role in coastal ecosystems. In Cuba, the impact is greatest in the estuarine areas of the Gulfs of Guacanayabo and Ana María and La Broa Bay. Natural lakes on the island are generally small and not numerous but there are more than 200 reservoirs the great majority
of which have been built since 1959.

A number of coastal lagoons up to 1 000 hectares (ha) in area are located on the coast of the southeast shelf (González-Sanson and Aguilar Betancourt, 1984: 130). They are concentrated in three zones: a 79 km strip in Tunas de Zaza from the River Higuanojo to the Las Canarias Bay with 3 500 ha of lagoons; a stretch of 119 km in the Southern Littoral Swamp from the Ana María keys to Santa Cruz del Sur encompassing 6 700 ha of lagoons; and a stretch of 32 km in the Cauto delta from the Birama estuary to Manzanillo with 3 500 ha of lagoons (Gonzalez-Sanson and Aguilar Betancourt, 1984: 131). The natural evolution of lagoons to swamp and, eventually, to drier land has been accelerated in the Tunas de Zaza zone as a possible result of the damming of rivers in the region and the consequent substantial decrease in the fresh water supply.

3.3 THE COAST

Tectonically, the coastline of the island of Cuba can be classified as a convergent margin type (Summerfield, 1991: 314) but such a classification conceals more than it reveals about the considerable place-to-place variation which exists along this coastline. Cuban geographer Núñez Jiménez (1968) has described its geomorphology according to a three-fold classification which may be expressed, in simplified form, as follows: structural coasts, resulting from tectonic processes; rocky coasts resulting from marine erosion; and lowland coasts caused by deposition. Most stretches of the Cuban coast present mixed characteristics but an attempt at generalization has been made and is shown in Fig. 3.3.

Structural and rocky coasts are found along stretches of the coastline where the insular shelf is narrow or non-existent (I.C.G.C, 1978: 30-31; A.C.C.,
The two major stretches of structural coast are the fault-bounded ones located along the edge of the Sierra Maestra on the south coast of Oriente province from Maisí Point to Cape Cruz and between Casilda and the Bay of Pigs where the Escambray abuts the south coast. The major stretches of rocky coasts occur along the north coast from Gobernadora Point to Hicacos Point and from Sabanal Key to Maisí Point. Shorter stretches of this type occur on the north coast of the Oriente region from Cape Cruz almost to Manzanillo, and along the south coast of the Guanahacabibes Peninsula. In total, structural and rocky coasts, along which sandy beaches are common, make up over 40% of the coastline of the main island.

These coasts are generally inimical to fishing activity. However, they are interrupted in many places by wide, deep bays with narrow entrances called pocket bays (*bahías de bolsa*). In origin, the bays are either tectonic or erosional or a combination of both type of processes (Pavlidis and Avello, 1975: 11). Such bays have been extremely important both as harbours (e.g. Mariel, Havana, Guantánamo, and Santiago de Cuba) and as habitats for marine fauna. Their narrow, shallow entrances, however, restrict interchange of waters with the open ocean so that pollution has become a critical problem in some of the more developed ones, Havana Bay being probably the most severely affected.

The extensive lowland coast is more important for fisheries. The southern coast of the main island is generally backed by plains of different widths and is variously bordered by estuaries, deltas, swamps and lagoons with extensive development of mangrove forest. The approximately 700 km of coast between Cape Cruz and the vicinity of Trinidad, bordering the gulfs of Guacanayabo and Ana María is of low elevation and contains the longest stretch of coastal swamp in Cuba. Along it are found the delta of the Cauto,
Cuba's largest river, as well as the coastal lagoons described above. All of it is bordered by mangrove forest. Farther west, the coast from the Bay of Pigs to Cape Francés, bordering the Gulf of Batabanó, is similar in character with extensive coastal swamps, including the Zapata swamp, and coastal mangroves.

Two areas with similar physical characteristics occur on the north coast. The northwest coast from Cape San Antonio to La Gobernadora Point, about 500 km in length, is low and swampy with deltas of numerous small rivers and stretches of mangroves. It is sheltered in places by numerous low keys. To the east, from Hicacos Peninsula to Nuevitas Bay, about 900 km, the coast again is generally low with many swamps and deltas, the most important of which are those of the Sagua la Grande and Sagua la Chica. Parallel to the coast, at a distance that varies from 10 to 20 km is a series of large, narrow keys of the Archipelago of Sabana-Camagüey which are bordered on the north by a barrier of coral reefs. Between the keys and the coast is a sheltered, shallow inland sea.

3.4 THE INSULAR SHELF

The waters of the Cuban insular shelf contain most of the marine resources of the country. The shelf is a submerged plain with an area of 54 000 km² (Baisre and Páez, 1981: 2) the surface morphology of which, at least in its gross features, was formed by surficial processes during the period of lower sea levels of the late Pleistocene. The sea covering the shelf is shallow everywhere. Over numerous banks and shoals, like the Gran Bajo de Buena Esperanza in the Gulf of Guacanayabo the depth may only be a few centimetres. Cuban atlases follow the conventional practice of employing the 200 m isobath to delimit the outer edge of the shelf. However, an inspection
of larger scale charts reveals that the waters are so uniformly shallow that the edge of the shelf could probably be delimited fairly accurately by the 20 m isobath (Admiralty, 1991). Pavlidis & Avello (1975: 9) report that the depth of water reaches 50-70 m only in scarce, isolated places. Large areas of shallows and reefs present obvious dangers to navigation by fishing vessels on the shelf, and channels may have to be marked, often by a curvilinear line of slender poles fixed to the bottom.\(^1\) In addition to being shallow, the water is also clear so that the bottom and fishing gear are often visible from vessel decks.

The width of the shelf varies from only a few hundred metres along the south coast of the Oriente region to 140 km between the south coast of the province of Havana and the Isle of Youth (Fig. 3.1). In many places, its outer edge is elevated and delineated by a line of keys and reefs (e.g. the Archipelago of the Jardines de la Reina on the southeast shelf) which offer protection from the open sea. The edge of the shelf is abrupt in profile and is bordered by steep, often terraced, slopes which descend to ocean abysses, as deep as 7 000 m off the south coast of Oriente province. (See typical cross-sections in Instituto Cubano de Geodesia y Cartografía, 1978: 22-23; A.C.C., 1989: IV. 2.2)

Tropical continental shelves generally exhibit a surficial geology made up of some combination of: inorganic terrestrial deposits such as sands, silts and clays; organic material including plant debris; and biogenic deposits such as oolitic sand, shell sand and reef corals (Longhurst and Pauly, 1987: 8). While the Cuban shelf is not truly continental, a study by Soviet and Cuban scientists of the Gulf of Guanahacabibes found similar sediments (Pavlidis and Avello, 1975). In a sequence, beginning closest to the shore, there was: mud; terrigenous sediments made up of alluvium and organic matter with

\(^{1}\) An example of such markers was observed on the northeast shelf in the vicinity of Caibarién.
very little carbonate content derived from shoreline vegetation, especially mangrove; an extensive zone of biogenic sands; and an accumulation of carbonate detrital products derived from barrier reefs. The precise nature and extent of each type of sediment depends upon local conditions. For example, fine mud predominates in the Gulfs of Guanahacabibes, Batabanó and Ana María while sandy sediments are typical of the Gulf of Guacanayabo (A.C.C., 1989: VII. 2. 2, Map 19).

The environmental conditions required for the growth of hermatypic corals (Longhurst and Pauly, 1987: 19) are present on the Cuban shelf: mean sea-surface temperatures higher than 18°C, a small tidal range, salinities greater than 27%, clear waters and absence of large salinity and temperature fluctuations. Many species occur in the form of barrier, fringing and patch reefs (A.C.C., 1989: VIII. 2.3).

Barrier reefs normally occur at some distance from the coast and are separated from it by a channel or lagoon. In the Cuban archipelago, they are found on all shelves but especially on extensive stretches of the exterior edges of the Gulf of Ana María, the Gulf of Batabanó, the Gulf of Guanahacabibies and along the windward side of the Archipelago of Camagüey (Fig. 3.1). Barrier reefs, being home to large numbers of animal and plant species, possess great biological and ecological significance. In addition, where they elevate the edge of the shelf they provide protection from the open sea and act to restrict exchange of waters between the shelf and adjacent oceans.

The structure of barrier reefs is quite complex and varies in detail from place to place, especially between windward and leeward reefs (Barnes and Hughes, 1988: 170). Fig. 3.4, which shows 2 simplified cross-sections of the outer edge of the shelf in the Gulf of Batabanó, demonstrates the essential
FIG. 3.4 Typical Reef Cross-Sections in the Gulf of Batabanó
gross characteristics of barrier reef structure\textsuperscript{1}. The crest is subject to the greatest wave action and may be exposed briefly during the lowest spring tides. It tends to be dominated by branching corals which form ramparts (Barnes and Hughes, 1988: 171). It may also have a system of alternating sandy channels and coral spurs. Seaward of the crest is the fore reef which slopes toward the shelf edge. Landward of the crest, in locations where keys or islands parallel the shelf edge, a shallow, narrow reef lagoon exists. In locations where keys and islands do not exist, the reef lagoon extends into a wide macrolagoon which reaches a maximum width of 140 km in the Gulf of Batabanó (Claro et al., 1990: 6).

Fringing or coastal reefs form inshore on rocky coastlines. They are less important from a fisheries point of view than the other two types. In the archipelago, they can be found along the coasts of Havana province, along the northeast coast and on the south coast of the Isle of Youth.

Patch reefs (cabezos) occur as isolated clusters of coral on sandy or seagrass bottoms in areas where the influence of the open sea is felt. Size is variable and may reach up to one hectare in area although the majority are no larger than 2 000 m\textsuperscript{2}. They are especially common in the Gulfs of Ana María, Guacanayabo and Guanahacabibes. Although they present dangers for navigation and restrict the use of trawl nets in the areas where they occur, they also act as natural concentrators of valuable marine species.

Coral reefs, by providing substrate, food and shelter, are homes to highly diverse communities of organisms, many of which are of commercial importance.

\textsuperscript{1} Fig. 3.4 is adapted from: Claro et al. (1990: 7).
3.5 SHELF REGIONS

The insular shelf may be divided into four well-defined regions, the southeastern, southwestern, northwestern and northeastern shelves, which are separated from each other by stretches of coast where the shelf is narrow or nonexistent. Each region possesses distinctive physical and ecological characteristics, a fact which is of great significance for fisheries.

3.5.1 Southwest Shelf

The southwestern region is the most extensive of the shelf regions. It is made up of the Gulf of Batabanó and La Broa Bay and has an area of 20 850 km² (Baisre and Páez, 1981: 2). Its outer edge extends from the Bay of Pigs west to the Isle of Youth and thence to Cape Francés. East of the Isle of Youth, the exterior edge of the shelf is marked by a narrow strip of barrier reefs and keys which serve to separate the waters of the shelf from those of the Caribbean. To the west of the Isle of Youth, such reefs and keys are mainly absent so that here the waters of the gulf are much more open to exchange with those of the adjacent Caribbean Sea. A sinuous line of keys running north from the Isle of Youth to the coast of the main island just west of Surgidero de Batabanó divides the shelf into three major sub-regions (an eastern region, a western region and La Broa Bay) between which there is little circulation of waters. A schematic cross-section of the Gulf (Fig. 3.4) shows the characteristic landforms of this shelf (Claro et al., 1990: 7). The barrier reef, with distinctive crest and outer reef slope, is separated from a line of keys (e.g. Canarreos Archipelago) by a narrow, discontinuous reef lagoon. Inland of the keys is what, in Cuba, is called the "macrolagoon" within which patch reefs are found. The average depth of waters above the shelf is only 6 m. Excluding the muddy bottom of La Broa Bay, the sediments covering the bottom of the
gulf comprise: a mixture of mud and sand (46%); sand (34%); and mud (20%).
The pattern of their distribution is quite complex (Páez, Revilla and Baisre, 1990: 275) but it can be said that almost all of the bottom of the Gulf west of a line joining the northeast corner of the Isle of Youth to Gorda Point, the western extremity of the Zapata Peninsula, is composed of mud with the exception of a narrow strip of sandy bottom along the shelf edge (A.C.C., 1989: VIII. 2.2, Map 19). Samples in this part of the gulf show a high organic content. The muddy bottom of La Broa Bay, on the other hand, shows a high carbonate content while in the eastern part of the Gulf the bottom is overwhelmingly composed of sand with high carbonate concentrations. Hard limestone (caliza) bottoms occur along the edges of the Gulf of Cazones in the eastern extremity of the shelf and along the outer edge to the west of the Isle of Youth (Páez, Revilla and Baisre, 1990: 275).

3.5.2 Southeast Shelf

The southeast shelf is the second most extensive region. It extends from Cape Cruz to María Aguilar Point and has an area of approximately 18 800 km² (Baisre and Páez, 1981: 2). It is divided into two basins, the Gulf of Guacanayabo to the southeast and the Gulf of Ana María to the northwest, by a zone of reefs and keys extending from the coast of Camagüey to the edge of the shelf. The outer edge of the Gulf of Ana María is marked by the chain of keys of the Queen's Garden and the reefs of the Médanos de la Vela which together serve to reduce interchange of waters with the Caribbean. There are numerous areas of patch reefs in the macrolagoon and the average depth is 15 m with maxima of 20 to 25 m. The Gulf of Guacanayabo lies in the depression of the River Cauto and is divided into two basins, a northeast one and a southwest one, by the reefs of the Gran Banco de Buena Esperanza
which runs parallel to the southern shore at some distance from it. The outer edge of the gulf is bordered by shallows, coral reefs, and small keys but its separation from the Caribbean Sea is less pronounced than that of the Gulf of Ana María. The average depth is about 15 m. A coastal strip in both gulfs, widening adjacent to the mouths of the rivers Cauto and Zaza, is covered by alluvial mud with a high organic and low carbonate content. Extending from its outer edge to the limit of the shelf, the bottom is covered mostly by sand. (A.C.C., 1989: VIII. 2. 2, Map 19).

3. 5. 3 Northwest Shelf

The northwest shelf is the least extensive of the shelf regions. It extends from Cape San Antonio to Honda Bay and has an area of 3 945 km². It can be divided into two parts: a wider western one, the Gulf of Guanahacabibes and a narrow eastern one from Cayo Buenavista to Honda Bay. Its greatest width is 40-50 km and it is separated to some extent from the waters of the adjacent Gulf of Mexico by the barrier reefs of Los Colorados and the Sancho Pardo Bank at its outer edge. Its average depth is 3-4 m. The surficial geology of the Gulf of Guanahacabibes, as previously mentioned, shows a sequence of terrigenous sediments, biogenic sands and carbonate detrital material. Deposits on the narrower eastern part of the shelf, being overwhelmingly composed of reef-derived carbonate products, show a very reduced terrestrial influence.

3. 5. 4 Northeast Shelf

The northeast shelf extends from the Peninsula of Hicacos to the Bay of Nuevitas and has an area of 10 118 km². The numerous small keys of the Sabana Archipelago mark the outer edge of the western part of the shelf while
the eastern part is bordered by much larger keys which are large enough to constitute true islands (Coco, Romano, Guajaba and Sabinal keys). The seaward edge of the archipelago is bordered by a barrier reef 400 km in length which, according to Núñez Jiménez (1968), is the second largest in the world after the Great Barrier Reef in Australia. The larger islands severely restrict interchange of waters with the adjacent Atlantic Ocean and enclose a long sheltered "sound" or inland sea made up of the bays of Buenavista and Jigüey. The waters of this inland sea are divided into a series of shallow (2 or 3 m average) basins (acuatorios) separated from one another by shoals and keys. Their shallowness and the restricted circulation give them hydrological characteristics similar to coastal lagoons. (A.C.C., 1989: VIII. 2. 2, Map 19).

Numerous, mostly small, rivers discharge onto this shelf, the largest being the Sagua la Chica which has developed a wide delta. Surficial deposits on the northeast shelf have not been well-studied (A.C.C., 1989: VIII. 2. 2, Map 19). Given the fairly large number of rivers which discharge onto the shelf, it would be expected that terrigenous deposits would predominate close to the coast. Similarly, the existence of an extensive barrier reef along the shelf edge would lead, as on the other shelves, to the presence of carbonate detrital sands at a greater distance from the coast.

3.6 CLIMATE

Climate and weather are important in fisheries in constraining both fishing activity and fish behaviour, especially reproductive behaviour (Saila, 1979: 67). The Cuban climate has been the subject of scientific study since the early 19th century beginning with the work of von Humboldt during his trip to the region from 1799 to 1804 and continuing with the observations of Poey

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1 This status has also been claimed for the barrier reef off the coast of Belize (Craig, 1966: 9).
and other Cuban naturalists in the early 19th century (A.C.C., 1989: VI. 1. 1). Modern climatology, however, dates from the establishment in 1965 of a network of meteorological stations throughout the Republic.

With a latitudinal extension from 19° 49' 36" N to 23° 17' 09" N, Cuba lies at the northern extreme of the intertropical zone. The climate of the archipelago may be classified, according to the Köppen system as Aw or tropical wet and dry. In such climates, temperatures are high and do not vary greatly throughout the year. Seasons, consequently, are defined by the precipitation regime rather than by the temperature regime.

Mean temperatures in Cuba range from 22.1°C in the coldest month of February to 28.1°C in July-August resulting in an annual mean of 25.2°C. Extreme temperatures of 1.0°C and 38.6°C have been recorded but are exceptional. The lack of variation in mean annual temperatures is underlined by the fact that it is less than the mean daily variation. The highest mean annual temperatures tend to occur in the eastern regions of the country but the most significant variation in temperature is altitudinal. There may, for example, be more than a 6°C difference in mean annual temperatures between the coast and the highest elevations in the Sierra Maestra.

Mean annual precipitation for the country amounts to 1375 mm with higher amounts being recorded in upland and mountainous regions. The wettest part of the country is the region of Sagua-Baracoa in the provinces of Holguín and Guantánamo where the annual mean is greater than 3000 mm. Precipitation patterns display a markedly seasonal pattern with a mean of 1059 mm (or about 80% of the total) for the "rainy" season of 140 to 180 days in the summer months of May to October in contrast to only 316 mm in the winter dry season from November to April (I.C.G.C., 1978: 149). Summer rain
is usually associated with afternoon thunderstorms while the source of
winter rain is usually cold fronts issuing from the adjacent North American
continent. In spite of the seasonal contrast in precipitation, humidity is high
throughout the year, varying only between 79% and 81%. Precipitation is
variable from year to year. Droughts occur from time to time while, in
contrast, tropical storms and hurricanes may deposit large amounts of
precipitation in short time periods with profound effects on the waters of the
shelf and on marine life.

Cuba lies within the zone of the northeast Trade Winds. As a result,
the north coast is subject to fairly strong ENE winds which may be reinforced
by afternoon sea breezes. However, the impact of the wind along this coast is
often lessened by the sheltering effect of offshore islands and keys. The south
coast tends to be less subject to strong winds. Land breezes occur along almost
all coasts but are generally not as strong as sea breezes. In spite of the existence
of such large-scale and local circulation systems, calm days, called "calmas
chichas" by fishermen do occur (Núñez Jiménez, 1968, 132).

In addition to such climatic averages as have been described above, the
Cuban climate, as a result of the location of the island on the frontier of
tropical and extra-tropical atmospheric circulation systems, is also
characterized by meteorological features of less regular occurrence. Especially
notable are, on the one hand, cold fronts and, on the other, tropical storms
and hurricanes.

3.6.1 Cold Fronts

Cold fronts associated with eastward-moving mid-latitude depressions
frequently affect Cuba during the winter months. These are called 'nortes' by
Cubans because of the persistence of winds from that direction after the
passage of the frontal zone (Díaz Aríaz and Valdés Boada, 1979: 39). They bring with them modified Arctic or Polar Continental air masses which cause abrupt drops in temperature and changes in wind direction and strength. They are also usually accompanied by a band of squalls and thunderstorms and followed by stratiform clouds and more or less continuous rain. Cold fronts in Cuba are classified according to the velocity of the north winds that accompany them. Weak fronts have wind velocities of less than 35 km hr\(^{-1}\); moderate fronts 36 to 55 km hr\(^{-1}\); strong fronts greater than 55 km hr\(^{-1}\). In the period from winter 1916-1917 to winter 1977-1978, Cuba was affected by 6,379 cold fronts, an average of 103 each winter.\(^1\) The majority were in the weak and moderate classes (Días Aríaz and Valdés Boada, 1979: 41). The western and central regions of the country are most affected by cold fronts. However, in January of 1958, a severe front affected the north coast from Cape San Antonio to Nuevitas sinking the schooner "Enriqueta" with the loss of its five hands and causing considerable damage to other vessels and loss of gear. For example 6,000 traps were lost to the fishermen of Playa de La Panchita alone (Hopgood, 1958). More recently, in the spring of 1993, a massive cold front associated with a mid-latitude storm passing along the east coast of the United States, traversed the entire island from west to east and left such damage in its wake that it was named the "storm of the century".

The weather associated with the passage of such fronts often constitutes a danger to navigation. In addition, the decrease in water temperatures, as well as the increase in wind speed and change in wind direction associated with the first cold fronts in the autumn trigger massive migrations amongst

\(^1\) Oceanographer, Benigno Hernández de la Torre of C.I.P. (1994) indicated that this is an overestimate and that only 1,548 cold fronts affected the island during this period for an average of 19.7 per year (Pérez, 1994). This does seem a more reasonable figure but the difference may be one of classification.
the lobster populations of the insular shelf (Cruz et al., 1987: 29).

3. 6. 2 Hurricanes

Cuba lies in the tracks of tropical storms and hurricanes originating both in the Atlantic Ocean and in the Caribbean Sea. The peak hurricane season occurs in August, September and October. The eastern part of the island is the most vulnerable but all areas have experienced such storms. Between 1800 and 1975, 165 hurricanes struck the island for an average of almost one each year (I.C.G.C., 1978: 35).

While such storms are not regular occurrences, their intensity is such that they may result in considerable damage to marine habitats and populations, as well as to vessels, coastal settlements and peoples. For example, in November 1932, the fishing port of Santa Cruz del Sur on the southeastern shelf was destroyed by hurricane-driven waters and more than 3 000 people were killed (López and Rubiera, 1988: 11). The most recent severe hurricane to strike the archipelago was "Kate" in November 1985. With winds greater than 200 km per hour, it damaged 80 000 homes, industrial plants and agricultural facilities as well as flattening large areas of sugar cane. Seventy percent of the island was left without power and physical damage was estimated at a value greater than U.S. $1 billion.

There are few detailed accounts of the impact of hurricanes on fishing activity and marine environments in Cuba. However, research from the adjoining regions of British Honduras (Craig, 1966; Stoddart, 1971), Jamaica (Woodley, 1981) and Quintana Roo, Mexico (Miller, 1982) is probably relevant to Cuba. Miller (1982: 20) reported that, in the adjacent region of the Yucatán state of Quintana Roo, most fishing boats powered by sail were removed from the water at the beginning of the hurricane season. Also, Craig (1966: 10)
reported damage to, and dispersal of, fishing fleets and disruption of the industry in nearby British Honduras for more than two months. That similar impacts occurred in Cuba is indicated by the fact that the Cuban government helped to repair extensive hurricane damage to the fishing fleet in Surgidero de Batabanó in 1944 (Martínez, 1948a: 2). Since the technological sophistication of Cuban weather forecasting and of the shelf fleet is now quite advanced, it is likely that fair warning of approaching hurricanes avoids significant damage to fleets. The Ministry of the Fishing Industry has further improved the security of fleets by the recent publication of a cartographic directory of refuges for fishing vessels (Ministerio de la Industria Pesquera [M.I.P.], 1992).

With respect to the impact on marine environments, wind, waves and flooding caused by hurricanes in adjacent regions were found to cause both major changes to reefs and islands and damage to coastal and submarine vegetation with consequent impacts on marine habitats and populations. The extent of damage was found to depend on both the intensity of the storm and its path.

Stoddart (1971: 173-176) identified 9 major types of erosional effects, including the destruction of keys and unconsolidated spits, channel-cutting, stripping of sand surfaces, erosion of consolidated deposits, beach movement as well as five types of depositional effects such as the accumulation of coral rubble on eroded surfaces, and the accumulation of gravel and sand against vegetation barriers and extension of leeward shores of reefs. Coral colonies were uprooted and deposited usually in deeper water. Such mortality occurred at depths as great as 50 m in Jamaica during Hurricane Allen in 1980. Woodley notes the destruction of constructional reefs (Woodley, 1981, 753). In addition, mortality was found amongst urchins (Diadema antillarum) as
well as aberrant behaviour amongst some species of fish. "Overnight, Hurricane Allen created patterns of distribution and abundance of organisms that are strikingly different from pre-existing states" (Woodley, 1981: 754).

Damage to vegetation depends on its distance and direction from the storm centre, the nature of the substrate and whether it is affected only by wind alone or by some combination of wind, wave action and inundation (Stoddart 1971, 181). Stoddart found that mangrove trees close to the storm centre were completely defoliated and there was a zone of massive defoliation 25 miles wide especially on windward shores. However, mangrove roots provided stability so that shore outlines did not change greatly.

In addition, the large amounts of rainfall accompanying these storms may also cause changes in the salinity of tropical inshore waters close to river mouths (Stoddart, 1971: 165). In September 1979, a large increase in fresh water flow into La Broa Bay following hurricane "Frederick" caused a decrease in salinity which resulted in a mass extinction of pink shrimp in the area. This abrupt environmental change also had a direct impact on the more euryhaline white shrimp population because all fishing effort in the area then targeted them and rapidly overexploited the stock (Baisre et al. 1984: 371). The decrease in salinity lasted into the spring of 1980 and resulted in a decrease in catches of scale fish in the southeast of the Gulf of Batabano. However, the inflow of freshwater also caused an increase in plankton production which increased fish populations and catches in 1981 (Claro and Giménez, 1989: 157). The poor present state of the stone crab population on the northeast shelf is attributed partly to the disappearance of large areas of seagrass beds as a result of high precipitation and mud deposition during hurricane "Flora" in 1963 (Claro 1990, 11; Pérez Puentes 1986, 37). The same hurricane is reported to have terminated an artisanal shrimp fishery in Nipe Bay (García del Barco,
Hernández and Marrero, 1981: 5).

Hurricanes may also have beneficial effects on marine ecosystems. Lluis, in a study of the sediments in the Gulf of Batabanó, noted that, "violent agitation of shelf sediments can remove their cap and thereby release notable quantities of nutrients which will mix vertically through the water column" (1972: 45). It seems reasonable to assume that the violent disturbance of waters accompanying a hurricane is capable of having such an impact.

3.7 VEGETATION

3.7.1 Mangroves

Mangroves, or mangals, are the dominant plant community occupying mud flats wherever estuarine conditions occur throughout the tropics (Longhurst and Pauly, 23). In Cuba, this ecosystem occupies a narrow coastal strip tens to hundreds of metres deep comprising about 40 000 ha or about 3.5% of the national territory (Lalana, 1992: 76). This represents about 30% of the coastline of the main island, almost 50% of that of the Isle of Youth and probably more than 90% of the coasts of numerous smaller islands and keys (I.C.G.C., 1978: 38-39) (See Fig. 3.5).

Four major mangrove species occur in Cuba (Lalana, 1992: 77). Red mangrove (mangle rojo or mangle colorado, *Rhizophora mangle*), distinguished by its dense network of prop roots, occupies the water's edge and colonizes new territories. It is succeeded further inland by black mangrove (mangle prieto, *Avicennia germinans*) which, in turn, is succeeded by white mangrove (mangle blanco or mangle patabán, *Laguncularia racemosa*) and then by buttonwood (mangle yana, *Conocarpus erecta*).

Three types of mangal may be distinguished in the archipelago:
Riverine, coastal and basin. (Lalana, 1992: 77). Riverine mangals, dominated by the tall (up to 12 m) trees of red mangrove, develop on the margins of river channels and estuaries in soft, unstable soil. Coastal mangals are much more extensive, occupying protected sea coasts, keys, and coastal lagoons. The outer strip, washed daily by the tide passing through a dense network of channels and, therefore, subject to alternate flooding and drying, is occupied by the red mangrove with its dense mass of downward-curving prop roots to which clusters of oysters may be adhered. In this highly saline environment, individual trees are smaller than in the riverine mangal. Inside the outer fringe, where the land has been built up by sedimentation encouraged, in part, by the mangroves themselves, the red mangrove is replaced by taller black mangrove with specialized upright, slender aerial roots, called pneumatophores, sticking out of the mud instead of prop roots (Longhurst and Pauly, 1987: 24). Basin mangal is established in more inland areas where water renewal occurs slowly. Black mangrove dominates in areas of higher salinity, white mangrove in areas subject to higher fresh water flow.

Mangals play an important role in both the stability and productivity of the coastal zones in Cuba. Sediment is trapped in the root systems and thereby helps to stabilize newly colonized shoals (Snedaker, 1978: 9). As we have seen, they also control erosion and provide protection against wave action, especially during hurricanes (Mercer, Evans and Hamilton, 1984: 17). In addition, the roots provide habitats for a large number of marine plants and animals.

3.7.2 Marine Phanerograms

Six species of marine phanerograms grow in various shallow water environments of the archipelago, including channels between keys,
macrolagoons and coastal lagoons. The most important is turtle grass (*Thalassia testudinum*) which, with associated algal species, forms dense meadows (*seibadales*) on sandy substrates in clear waters with salinities around oceanic normal in depths of up to 22 m (Lalana 1992, 83). The species has fast-growing (up to 5 mm day⁻¹), spear-like leaves usually about 50 cm in length and develops dense sub-surface rhizome mats. Meadows may also be formed by manatee grass (*Syringodium filiforme*), especially on sandy-muddy bottoms in the mouths of rivers and in coastal lagoons, and by shoal grass (*Halodule wrightii*) in areas of strong turbulence (Lalana, 1992: 84).

Like the mangals, seagrasses perform important functions in marine ecosystems. The leaves increase stability by acting as a baffle which reduces current flow and increases sedimentation. The rhizomes bind the sediment and reduce erosion. The meadows also support and shelter, permanently or temporarily, a large and diverse number of marine organisms. These include clams, snails, conch, sponges, and crustaceans like crab, shrimp and lobster. The meadows, in addition, act as nurseries for many species including juveniles of many fish.

The distribution of seagrass meadows on the shelf has not been subject to detailed mapping. As a generalization, it can be stated that *Thalassia* meadows predominate in areas of biogenic marine sediments while they are replaced by other phanerograms or algae in areas closer to the coast and in those subject to fluvial influence (Baisre, 1985a: 257).

### 3.8 OCEANOGRAPHY

The Cuban archipelago lies in the midst of tropical seas. Knowledge of their characteristics is based largely upon Soviet and Cuban research carried out in the 1960s (Boldanov 1966; Tapanes, 1963) and 1970s (Emilsson and
Tapanes, 1971; Nelepo, 1977). The absorption of solar radiation at the surface of these seas results in a warm layer of lower density water overlying colder, denser layers. The average temperature of this surface layer in the open seas around the archipelago is about 27°C with variations between summer and winter (August monthly mean of 29°C, January-February monthly mean of 26°C) (A.C.C., 1989: VIII. 1.2, Maps 1 and 2). Salinity values in the surface layer vary seasonally from about 34/00 in the rainy season to over 36/00 in the dry season (A.C.C., 1989: VIII. 1.2, Maps 3 and 4).

Tropical seas are highly stratified vertically with respect to temperature and salinity (Barnes and Hughes, 1988: 5; Tait, 1981: 74) and the Caribbean is no exception. The vertical distribution of temperature for the central area in summer (A.C.C., 1989: VIII. 1.2, Map 2) shows a temperature on the surface of about 27°C followed by a slow decrease to about 50 m and then an abrupt decrease so that the temperature at a depth of 500 m is 10°C and at 1 000 m, 4°C. In these waters there is also a discontinuous vertical distribution of salinity values such that they are very high in the lower surface layer (Nelepo, 1977: 121). These abrupt changes in the temperature and salinity profiles indicate the presence of a boundary layer, the thermocline, which has serious consequences for vertical circulation and biological productivity in the seas around Cuba.

Since the waters over the shelf are much shallower than those in the open ocean, they are much more sensitive to changes in atmospheric temperatures. Shelf waters, therefore, experience greater seasonal variations in temperature than does the adjacent open sea. They tend to be colder than surrounding seas in the winter months with January, February and March

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1 See Nelepo (1977) and Treadwell (1972) for a review of Soviet and Cuban oceanographic research in the Caribbean.
average temperature of 23-25°C and warmer in summer (July, August, September average temperature - greater than 29°C on all shelves except the northeast where the average is 27-29°C (A.C.C., 1989: VIII. 1.2, Maps 1 and 2). Emilsson and Tapanes (1971: 9) report an extreme high temperature of 33°C in the Gulf of Batabanó and an extreme low of 22°C in the Gulf of Ana María.

The salinity of open ocean surface waters shows a value of 360/00 throughout the year but those over the shelf vary seasonally as a result of evaporation, contact with the sea, and discharge of fresh water from rivers. Shelf waters generally show the highest salinities (390/00 or higher) in the spring at the end of the dry season and lowest values in fall and winter when areas near major rivers have salinities lower than 350/00 (Emilsson and Tapanes, 1971: 16). In general, the greatest variations in both temperature and salinity occur in the most landlocked areas of the shelf: in the shallow basins (acuatorios) of the northeast shelf, extreme salinity values vary from 200/00 during the rainy season, to 43 0/00 in the dry season (A.C.C., 1989: VIII. 1. 2, Maps 3 and 4); and in coastal lagoons. González-Sanson and Aguilar (1984: 132) report variations in salinity from 10.00/00 to 42.20/00 and in mean temperature from 22.8°C to 31.6°C.

Variations in temperature and salinity combine to cause density differences in shelf waters which have some impact on the exchange of waters between the open sea and the shelf. In winter and spring, shelf water, being lower in temperature and higher in salinity, sinks on the shelf edge and is replaced by ocean water (Emilsson and Tapanes, 1971: 30).

The waters of the archipelago and adjacent seas are not stationary. They are in motion as part of complex large- and small-scale systems of ocean currents and tides which have significance for both fishing activity and biological activity such as the distribution of the larvae of various marine
species and the movements of migratory fish.

At the largest scale, the waters adjacent to the archipelago are affected by westward moving branches of the North and South Equatorial Currents which enter the Caribbean through the passages between the Antillean Islands (Fig. 3.6).\footnote{Fig. 3.6 is adapted from Ritzhaupt (1963: 1).} To the south of Cuba, the South Equatorial Current flows between the Lesser Antilles to become the Caribbean or Antillean Current which passes through the Caribbean Sea and into the Gulf of Mexico through the Yucatán Strait. In addition, an arm of the North Equatorial Current flows through the Windward Passage between Hispaniola and Cuba and joins the Caribbean Current to the south of the island (I.C.G.C., 1978: 42-43; A.C.C., 1989: VIII .1.4, Maps 9 and 10).

After its passage through the Yucatan Strait, the Caribbean current spreads out like a fan in the Gulf of Mexico (Cruz, 1991: 49). One branch rounds Cape San Antonio at the western end of Cuba, flows to the east along the northwest coast of the island and, joining with other streams from the Gulf, through the Straits of Florida to become the Gulf Stream. Along the eastern part of the north coast, from the Point Maisí to about the western extremity of the Archipelago of Camagüey the offshore surface flow is to the west through the Old Bahama Channel under the influence of the North Equatorial Current. This flow meets the eastward-moving current from the Gulf of Mexico off the coast of Matanzas from which point the combined current moves to the north. On a large scale, therefore, there are three fundamental movements of surface currents around the archipelago: to the west along the south coast and along the eastern part of the north coast; and to the east along the western part of the north coast.
However a closer examination of currents reveals a much more complicated pattern. The Caribbean Current remains fairly concentrated as it moves through the Caribbean Sea and, as a result, divides it into two basins each containing a subsidiary eddy: a southerly, cyclonic one in the western Columbia Basin; and a northerly anticyclonic one south of Cuba in the east Cayman Basin (García Díaz, 1991). On the eastern part of the south coast, therefore, there is an easterly counter-current which flows inshore of the general westerly movement. On the north coast, in addition, Ritzhaupt has noted the existence of a light easterly countercurrent at the entrance of the Old Bahama Channel (Ritzhaupt, 1965: 7).

Water movement on the shelf is a product of the large scale movements described above and the influence of the depth of water, the distribution of channels between islands and keys, and bottom topography. There are, therefore, many local gyres and currents. In general, movements on the southeast and southwest shelves are towards the west or northwest, on the northwest shelf towards the east, and on the northeast shelf towards the west (A.C.C., 1989: VIII. 1.4, Maps 9 and 10; Cruz, 1991: 49).

With respect to vertical movements of water masses, as a result of the general southeast to northwest surface movement in the Caribbean Sea, a significant area of upwelling occurs in offshore waters adjacent to the Colombia-Venezuelan border (Kjerfve 1986). Conversely, as water moves toward the northern side of the Caribbean Basin, it piles up so that, off the Cuban south coast, the predominant movement is one of sinking (Boidanov, 1966: 14). A small area of upwelling, on the other hand, seems to exist on the north coast in the area of the San Nicolás Channel and the Old Bahama Channel (Tapanes, 1963: 10-14) where the westward and eastward moving currents meet.
As a result of the particular combination of shoreline configuration, meteorological conditions, and the depth and bottom topography of the three different bodies of water surrounding the archipelago (the Atlantic Ocean, the Caribbean Sea and the Gulf of Mexico), different parts of the archipelago experience different kinds of tides. Semidiurnal tides, with two high and two low tides each day, occur on the north coasts of Villa Clara, Sancti Spiritus and Ciego de Avila as well as in the pocket bays of Puerto Padre and Nipe. On the south coast, such tides occur in the Manzanillo region, the Bay of Cienfuegos and in the western part of the Gulf of Ana María (A.C.C., 1989: VII. 2.2, Map 18). However, the predominant type of tide in the archipelago is mixed semi-diurnal, a tide which exhibits two cycles each day but which experiences periodic changes in the magnitudes of highs and lows. Mixed diurnal tides, on the other hand, occur on the northwest coast as a result of the influence of the waters of the Gulf of Mexico.

The amplitude of tides varies from place to place on the coast but is everywhere small, averaging less than 40 cm (southeast shelf: 30 cm; southwest shelf: 18 cm; northwest shelf: 28 cm; northeast shelf: 47 cm) with extremes varying from 11 cm to 136 cm (A.C.C., 1989: VII. 2.2, Map 18). Even such a low tidal range may have an impact on fishing activities. The narrowness and shallowness of the channels between keys on the outer shelf edge and the narrow entrances of pocket bays can cause fairly high tidal current velocities (Emilsson and Tapanes, 1971: 6). In July 1976, a current velocity of 125 cm s⁻¹ was recorded in the channel at the entrance of the Nuevitas Bay (A.C.C., 1989: VIII. 1.1). Velocities such as this represent hazards to navigation. Collecting of molluscs such as oysters and clams is more easily carried out at low tide and, in contrast, extensive areas of inshore waters may only be navigated during periods of high water. According to Sánchez Roig
and Gómez de la Maza (1952, 42), Cuban fishermen in the 1950s believed that the time of flood tide (momentos de entrada de marea) was the most favourable for fishing certain species.

As a result of the combination of physical circumstances which occurs in the Cuban archipelago, three distinctive marine habitats can be identified on the insular shelf (Longhurst and Pauly, 1987: 148; Baisre, 1985b: 11): muddy bottoms of inshore bays, estuaries and coastal lagoons bordered by mangrove forests; sand and sandy-mud bottoms with seagrass, especially turtle grass, meadows; and coral reefs. The next chapter will examine the productivity of each type of habitat and the nature of the marine organisms which inhabit them. It will also present a classification and description of the ecological complexes of Cuban waters.
CHAPTER 4
THE ECOLOGICAL BASIS OF THE FISHERY

4.1 PRODUCTIVITY IN TROPICAL OCEANS

The fundamental basis of fisheries in all of the world’s oceans is primary production, by means of which marine plants produce organic matter from inorganic substances, using energy supplied by solar radiation. Because of the narrow latitudinal extent of the Cuban archipelago, the receipt of solar radiation does not vary significantly from place to place. Variations in primary production within archipelagan and surrounding waters are, therefore, dependent upon the supply of a number of inorganic substances or nutrients amongst which nitrogen and phosphorous are especially important. The spatial distribution of such nutrients, the basis of fertility of the waters, is no more uniform in the ocean than it is in the soils of the continents. They occur only in relatively restricted areas in the open ocean and in the waters over the continental and insular shelves with the result that organic production is similarly limited (Caddy and Sharp, 1986: 6).

4.1.1 Open Ocean

Primary production may be divided into two types: regenerated production, driven by the recycling of nutrients already in the system; and new production which is dependent upon nutrients external to the system (Longhurst and Pauly, 1987: 117; Baisre, 1985: 253). Both types are found in tropical waters.

In the open ocean, organic material is produced by phytoplankton. The distance of the open waters of the central Caribbean and Gulf of Mexico from
land masses and the stratified nature of the water column, described in the last chapter, have an impact on both new and regenerated production (Corredor, 1974: 104). With respect to regenerated production, thermal stratification and the consequent stability of the water column results in loss of nutrients to the euphotic zone by sinking to depths below the thermocline. The absence of benthic organisms within the euphotic zone in these deep waters means that there is no pathway by which these nutrients might be recycled and their loss is permanent. Nutrient depletion is, therefore, characteristic of the pelagic ecosystems in the tropical ocean.

The principal sources of nutrients for new production are land masses and upwelling. It is clear from the last chapter that the terrestrial influence of the Cuban archipelago, via river discharge, does not extend very far from the coastline of the major islands. Nutrients from this source are not, therefore, available to the pelagic ecosystems of the Caribbean and Gulf of Mexico. Research has also made clear that large scale upwelling in the American Mediterranean occurs only in the southern Caribbean (Corredor, 1977: 103; Kjerfve, 1986: 39).

The lack of nutrients and consequent low levels of both new and regenerated production in the euphotic zone are typical of open tropical waters and have led them to being called "biological deserts" (Ryther, 1972: 74; Ogden, 1983: 1). Margalef (1971: 487) reports a mean value for primary production of between 25 and 50 gC m\(^{-2}\) y\(^{-1}\) in the central areas of the Gulf of Mexico and the Caribbean Sea. Situated within this "desert", the shelves of the Cuban archipelago are areas of higher productivity, and may be considered as analogous to oases. As such, they are crucial to archipelagan marine life and fisheries.
4.1.2 Insular Shelf

The productivity of tropical island shelves, like that of tropical pelagic ecosystems, is dependent upon both new and regenerated production (Longhurst and Pauly, 1987: 124; Baisre, 1985a: 253). With respect to regenerated production, Longhurst and Pauly (1987: 125) note that,

Where the water is sufficiently shallow for tidal mixing from the roughness of the sea floor to reach up into the photic zone, or completely to destroy the layered density structure of the water column, then benthic biota (from bacteria to starfish) play a role in the regeneration of nutrients.

To such tidal mixing may be added the impact of wind-induced mixing which may also affect the water column to depths of 200 m (Barnes and Hughes, 1988: 6). On tropical shelves, organic material containing nutrients, of which nitrogen is especially important, fall from the euphotic zone. However, instead of being lost to the abyssal deeps as they are in the open tropical ocean, they are taken up and decomposed by the benthic biota. In this way, they are regenerated and made available once again to phytoplankton in the euphotic zone. There is, therefore, continuous recycling of nutrients between the benthic and planktonic ecosystems. The waters over the Cuban shelf are sufficiently shallow for the stratified density structure of the open tropical ocean to be broken up by tide and wind induced mixing. Lluis (1972: 9) reports that the values of a variety of physical and chemical factors in the Gulf of Batabanó differed very little between the surface and the bottom, indicating that there is mixing in the water column on this part of the Cuban shelf. The shallowness of the other shelf regions, described in the last chapter, would indicate that similar mixing occurs in the water column over them.

New production on the shelves is fueled by nutrients imported from
outside of the ecosystem. There are three sources of such nutrients: coastal upwelling, dynamic events at the shelf edge, and river discharge (Longhurst and Pauly, 1985: 126). As previously mentioned, large scale upwelling does not occur in the waters adjacent to the archipelago. However, there is evidence for localized upwelling on the north coast of Cuba. Tapanes (1963: 10-14) reported the presence of a zone of upwelling between latitude 22° 30' N and 24° 00' N; longitude 79° 00' W and 80° 00' W adjacent to the San Nicolas and Old Bahama Channels. Its presence is indicated by the occurrence of abundant plankton, gulf weed (sargazo), flying fish, which are plankton eaters, and tuna (Ritzhaupt, 1965: 7) in this region. Such upwelling does not seem to be common in Cuban waters. However, smaller scale semi-permanent upwelling may occur in places where bottom irregularities give rise to an "island mass effect" which may bring nutrients into the surface layers (Carles, 1993; Lafond and Lafond, 1971: 250).

Dynamic processes along the edge of the Cuban shelf have been found to influence productivity. In a study of primary production on the northwest shelf, Kondratieva and Sosa (1967: 27) found that the highest productivity (500-700 mg C m⁻² day⁻¹ ie. 182.5 - 255.5 gC m⁻² y⁻¹) occurred at about 10 to 20 miles from the coast at the shelf edge. This may indicate the presence of wave trains. These are internal waves propagating along horizontal density surfaces between oceanic layers (Corredor, 1977: 104; Lafond and Lafond, 1971: 249; Longhurst and Pauly, 1987: 29). The process is explained as follows:

Cooper considers that internal waves can cause vertical mixing where they impinge upon the continental slope, their motion here becoming translated in a manner comparable with that of waves breaking on the shore, carrying deep water up the continental slope much as surf waves run up a sloping beach. In this way, oceanic deep layers
rich in nutrients may sometimes spill over the continental edge, mixing with and increasing the fertility of shelf water (Tait, 1981: 163).

It seems possible that such dynamic processes occur along the edges of the other Cuban shelves but their extent has not been established. There is an additional supply of nutrients from the ocean to the shelf during winter and spring when cooler, more highly saline and, therefore, denser shelf water sinks along the outer edge and is replaced by nutrient-rich water from the deeper ocean (Emilsson and Tapanes, 1971: 30). However, once again, the extent of such sinking is not known.

River discharge, delivering terrestrial materials in particulate and dissolved form to shelf waters, is the most important external source of nutrients for primary production in coastal waters. The existence of a positive relationship between this nutrient supply and marine organic production has been clearly established in coastal areas of several parts of the world such as the Mediterranean Sea and the Gulf of Mexico (Longhurst and Pauly, 1987: 127) as well as in Cuba (Kondratieva and Sosa, 1967: 36). This nutrient supply varies with the volume of river discharge, the intensity of the precipitation, and the configuration of the river basins. In Cuba, it becomes especially important in the rainy season (Baisre, 1985a: 255; López Baluja and Vinogradova, 1974: 15). In general, the nutrient contribution from this source is greatest on the southeast shelf. Waters here receive discharges from the largest rivers (the Cauto and the Zaza) and the most extensive lagoon systems in the archipelago. However, it is also significant in La Broa Bay, in the inland sea of the northeast shelf, and, locally, on the northwest shelf.

As a result of the processes described above, nutrient concentrations and primary productivity in shelf waters are generally higher than those in
the surrounding open oceans. However, the spatial distribution of production on the shelf itself is not uniform. Within it, phytoplankton production is combined with that of macrophytic plants in three restricted areas of intense production: mangroves, seagrass meadows and, coral reefs.

The bases of primary production in mangroves are particulate and dissolved nutrients as well as organic matter transported by river discharge. These nutrients support primary production by phytoplankton and by the mangrove plants. However, mangrove primary production is not directly consumed by herbivores. The year-round leaf fall of the mangroves, estimated at about 8 mt (dry weight) ha\(^{-1}\) y\(^{-1}\) (Snedaker, 1978: 11), enters the estuarine ecosystem where it forms the basis of detrital food webs. Fallen leaves are colonized by fungi, bacteria, and nematodes which begin the process of decomposition. Eventually the leaf will be reduced to small particles covered with micro-organisms that are consumed by invertebrates and fish in the estuary. Where decomposition occurs in situ, soluble organic compounds are produced, dissolved in the flushing tide water, and transported into the estuary. By means of such processes, the mangal contributes to the food webs of estuaries and nearby coastal waters.

Boaden (1985: 126) reports estimates of mangrove primary production of around 350-500 gC m\(^{-2}\) y\(^{-1}\) or 7 to 10 times that of the maximum estimated by Margalef for the adjacent open waters of the Gulf of Mexico and the Caribbean Sea (Margalef, 1971: 487). No measurements of mangrove primary productivity in Cuba are available. However, the fact that it is similarly elevated is indicated indirectly by González-Sansón and Aguilar Betancourt (1984: 135) who found phytoplankton production in lagoons in the mangrove zone of the southeast coast to be insignificant compared to primary production of algae, seagrasses and mangroves.
Meadows of *Thalassia* and other marine phanerograms which cover large areas on tropical shelves including those of the Cuban archipelago, support and provide a habitat for a large variety of marine organisms. Seagrasses also play important roles in the nutrition of many marine organisms. The leaves provide direct food for a few species, such as the green turtle and manatee but, more importantly, like mangrove leaves, form the basis of detrital food webs. In addition, the plants pick up nutrients from sediments and release them through the leaves to enrich the surrounding waters. Epiphytic algae on the leaves also contribute to the nutrient supply by fixing nitrogen. Like mangroves, then, seagrasses represent areas of elevated production on tropical shelves. In the Caribbean, net productivity may reach as high as 4 000 gC m\(^{-2}\) y\(^{-1}\) (Phillips, 1978: 34). Lewis (1977: 315), converting figures obtained by Buesa (1974), reports a value of 585 gC m\(^{-2}\) y\(^{-1}\) for Cuban seagrass beds. This value is still much higher than that in the surrounding open waters and compares to 412 gC m\(^{-2}\) y\(^{-1}\) for cultivated corn and 497 gC m\(^{-2}\) y\(^{-1}\) for cultivated rice (Thayer, 1975: 290).

Coral reefs are the archetypal tropical marine ecosystem which, in spite of their relatively restricted extent, contribute a significant proportion of the world's annual fish catch (Caddy and Sharp, 1986: 48). The apparent paradox of the existence of such areas of high primary production, located in oligotrophic tropical seas far from land masses, is explained by the delivery of nutrients from the open ocean as a result of the various shelf edge processes described previously and by re-cycling of nutrients within the reef ecosystem (Boaden, 1985: 104). Estimates of primary production of coral reefs vary: a mean value of 7 gC m\(^{-2}\) d\(^{-1}\) (2 555 gC m\(^{-2}\) y\(^{-1}\)) has been reported (Kinsey, 1979 cited in Longhurst and Pauly, 1987: 139); Longhurst and Pauly (1987: 139) state that most estimates lie within the range of 1.5-14.0 gC m\(^{-2}\) d\(^{-1}\) (547.5-
5.110 gC m\(^{-2}\) y\(^{-1}\); Lewis (1977: 310) gives values of between 300 and 5,000 gC m\(^{-2}\) y\(^{-1}\); while Barnes and Hughes (1988: 191) cite a value of 12,000 gC m\(^{-2}\) y\(^{-1}\). The variation in the range of such estimates is at least partly due to the unreliability of methods of measurement of carbon fixation (Tait, 1981: 153) but all of them agree that primary production on coral reefs is much higher than that in surrounding waters. Much of this production, unlike that in mangroves and seagrass meadows, is consumed within the reef community (Boaden, 1985: 104).

4.2 MARINE RESOURCES

The distribution of organisms in tropical seas reflects the major variations in fertility outlined above, in that the biota of the shelves is much larger and more varied than that of the pelagic zone of the open ocean. The marine resources of Cuban waters are no exception since the overwhelming majority of exploited species lives in shelf waters. They are also typically tropical in being composed of a very large number of fish, crustacean, mollusc, turtle and other species (Appendix II).\(^1\) However, great biological diversity, a commonly-accepted characteristic of tropical marine species, exists only within the fish. As Longhurst and Pauly (1987: 63) have noted, there are important examples where diversity is not the case, especially, as will be seen in this chapter, amongst the crustacea.

Any attempt to document the marine resources of the archipelago, in order to compare the manner of their exploitation by different culture groups, must acknowledge the difficulty, even the impossibility, of reconstructing with any degree of accuracy the physical environment and biota of several

\(^1\) The drawings in Appendix II were adapted from MIP, 1989. Some scales were not given in the original document and all scales are approximate. Spanish names are employed where no English equivalents could be found.
thousand years ago. Short- and long-term environmental change, especially in the atmosphere-ocean system, may have provided competitive advantage to some species over others. In addition, the impact of fishing activity by human beings in the course of several thousands of years must be considered. This is especially true of the recent past. The high exploitation rates experienced since the early 1960s, the introduction of industrial trawling in the shrimp fisheries, and habitat damage in various localities have all affected marine populations in tropical waters, including those of Cuba (Longhurst and Pauly, 1987: 145; Claro, 1988, 1990). It is clear, then, that the present condition of many of these populations must differ to some unknown extent from their unexploited state. It is likely, however, that the gross characteristics are similar enough for careful comparisons to be made. There follows a general description of the most important groups of marine resources of the shelf and adjacent waters based on modern sources (Baisre, 1985a, b; Baisre and Páez, 1981; Depestre Catony and Blanco Cabrera, 1985, 1987; Guitart, 1979; Howell Rivero, 1955; MIP, 1989: MIP, Dirección de Regulaciones, 1990; Páez, 1989; Rodríguez et al., 1984).

4. 2. 1 Fish

Diversity is the rule among the fish in shelf waters. Five hundred and fifty species live all or part of their lives on the shelf, about 40 species live in the deep waters of the slope and 160 live in or pass through Cuban oceanic waters (A.C.C., 1989: VII. 2. 2). The number of exploited species is much smaller and of those that are specifically targetted (i.e. not part of a by-catch in other fisheries) even smaller. However, the official price list of the Ministry of Fisheries still lists about 120 species (MIP, Dirección de Precios, 1992).

The fish of the shelf can be divided into three broad groups: demersal,
neritic pelagic, and oceanic pelagic. The demersal fish are essentially sedentary in nature, so that different populations reside on each of the four shelves (Baisre and Páez, 1981: 10). The most important families are the snappers (Lutjanidae), groupers (Serranidae), mullets (Mugilidae), mojarras (Gerreidae) and grunts (Pomadasidae). Neritic fish are those species which live in surface waters above the shelf. In Cuba, the most common families of this group are the sardines (Clupeidae), the mackerels (Scombridae), and the jacks (Carangidae). The most notable of the oceanic pelagic fish around Cuba are the tunas (Scombridae), sharks (Squalidae), marlins (Istiophoridae), and swordfish (Xiphiidae). All of them are migratory.

4.2.2 Crustaceans

Crustaceans, including lobster, shrimp and crabs, are the most economically important marine resources in modern Cuba. Several species of lobster, belonging to the families Palinuridae and Scyllaridae, are found in the Cuban archipelago. The species of major commercial interest is the common, spiny or Caribbean lobster (langosta común, langosta espinosa, langosta comercial, [*Panulirus argus*]). There are several species of Peneid shrimp in the waters of the Cuban shelf (Baisre and Zamora, 1983; MIP, Comité de Administración Pesquera, 1984; Pérez et al., 1989; Pérez, Puga and Rodríguez, 1983; Simpson and Ruís de Quevedo, 1975). Only two species, pink shrimp (camarón rosado, [*Penaeus notialis*]) which make up 85% of the catch, and white shrimp (camarón blanco, [*Penaeus schmitti*]) are exploited commercially. Three types of crab are caught commercially in Cuba: stone crab (cangrejo moro, [*Menippe mercenaria*]) land crab (cangrejo de tierra, [*Cardisoma guanhumi*]); and blue crab (jaiba azul, [*Callinectes sapidus*]). (Centro de Investigaciones Pesqueras and Dirección de Industrias Pesqueras de
4.2.3 Molluscs

The most important Cuban molluscs are slow-moving or sedentary marine animals which generally live in coastal areas. Both characteristics have made them objects of exploitation for many thousands of years (MIP, 1989). They include conch (cobo, [*Strombus gigas*] ), oyster (osti{on}, [*Crassostrea rhizophorae*] ), and clam (almeja, [*Arca zebra*] ).

4.2.4 Turtles

The turtles are migratory reptiles which spend most of their lives at sea but which lay their eggs on sandy beaches. Their numbers have been drastically reduced as a result of the desirability of their eggs and meat for food and their shells for decoration but they are still exploited commercially in Cuba. Three species are caught (MIP, 1989; Baisre and P{ae}z, 1981): the loggerhead turtle (caguama, [*Caretta caretta*] ), the hawksbill turtle (carey, [*Eretmochelys imbricata*] ), and the green turtle (tortuga verde, [*Chelonia mydas*] ). The leathery turtle (tinglado, [*Dermochelys coriacea*] ) also exists in Cuban waters but is rare (Baisre and P{ae}z, 1981).

4.2.5 Sponges

At present, six species of sponge are exploited commercially on the shelf: esponja hembra (*Hippospongia lachne*), hembra aforada (*H. gossypina*), macho fino or macho (*Spongia obliqua*), macho cueva (*S. graminea*), macho amarillo (*S. barbara*), and macho guante (*S. cheiris*). They live attached to sandy or rocky bottoms in clear, oxygenated water on all four shelves but the densest banks are on the southwest and northeast shelves.
4. 2. 6 Marine Mammals

Marine mammals are not common in the waters of the archipelago. The manatee (manatí, *Trichechus manatus*), reaching 3 m in length, is a herbivore which lives in the brackish waters of river mouths and estuaries (MIP, Dirección de Regulaciones, 1990). It has been subject to intense exploitation for its meat, fat and hide and populations have suffered drastic declines. There is now a complete prohibition on catching the animal (MIP, Dirección de Regulaciones, 1990: 59).

The marine organisms of the Cuban archipelago and adjacent oceanic waters, described above, live in communities which are constituent parts of ecosystems. In the next section, the relationships between organisms and the physical environment will be examined and the characteristics of the major marine ecosystems of the archipelago will be described.

4.3 ECOSYSTEM INTERRELATIONSHIPS

It is clear that in the tropics, a fundamental distinction can be made between primary production in the open ocean, on the one hand, and on the insular shelves, on the other. Within a tropical ocean of generally low fertility, insular shelves in general represent areas of elevated primary production. However, the areas of highest production within them are not universally or uniformly distributed but are restricted to mangroves, seagrasses, and coral reefs which form the basis of ecosystems of great significance. Their role and importance in fisheries production have been documented for tropical waters of both the Atlantic and Pacific Oceans (Baisre, 1985a, 1985b; Barnes and Hughes, 1988; Caddy and Sharp, 1986; Goreau, Goreau and Goreau, 1979; Kaplan, 1982; Longhurst and Pauly, 1987; Ogden, 1983; Ogden and Zieman, 1986; Páez, 1989; Phillips, 1978; Snedaker, 1978; Tait,
Mangrove, seagrass and coral reef ecosystems do not exist in isolation but interact with each other and with the pelagic ecosystem of the open ocean. Caddy and Sharp (1986: 6), considering the nature of food webs, identified centres of higher production such as mangroves and seagrass meadows as "dissipation structures" within which biological material is synthesized and from which it is dispersed passively by means of water movements and actively by means of migrations of marine organisms. Such ecosystems should therefore be considered to be "open", having some degree of linkage to other ecosystems.

More specifically, Ogden (1983) has examined the nature of the interactions between mangroves, coral reefs and seagrass beds in the Caribbean. Of the three ecosystems, coral reefs are the most "closed" but even here, biological material is imported from the oceanic pelagic ecosystem and exported via daily movements and migrations of many fish and invertebrates. Ogden identifies a number of potential physical and biological interactions between the three ecosystems. The following account is based on his work.

Barrier reefs, located on the shelf edge, provide protection from waves and currents for the lagoons and coastal areas thereby creating low energy environments in which seagrasses and mangroves thrive. In addition, calcareous sediments created by reef erosion are deposited in the lee of the reef where they may accumulate in sufficient quantities to form sediment aprons, shoals, and keys which form a substrate for seagrass and mangrove growth. Seagrasses also play an important role, by means of their root and rhizome systems, in sediment stabilization and, through the activity of associated calcareous algae, epiphytes and infauna, in sediment production. Mangroves
offer protection for coasts from erosion and regulate the physical environment of shelf waters by trapping and thereby regulating the supply of river-transported sediments. Fresh water is also trapped by the mangrove forest and may be lost by evapo-transpiration so that the amount of non-saline waters reaching the coast is both reduced and discharged over a longer period of time.

All three ecosystems produce and export nutrients in the form of both dissolved and particulate organic material. Dissolved organic material is produced in much greater quantity in, and exported by, mangroves so that on Caribbean shelves there is a net transport in the direction from mangrove to seagrass beds to coral reefs. Particulate organic material, as we have seen, is produced in great quantities by mangroves and seagrass beds and is then dispersed spatially and vertically providing, in the process, the basis for detrital food webs. Coral reefs also produce considerable quantities of mucus, algae particles from fish nibbling, and faecal matter, all of which also enter detrital food webs. However, as with dissolved organic matter, much more of this material is exported from mangroves than from seagrass beds and, in keeping with the more tight re-cycling which exists in reefs, the least amount escapes from them.

An important series of interactions between mangroves, seagrass beds and coral reefs result from animal migrations which may involve short-term feeding migrations, seasonal spawning migrations, and life-history migrations. Feeding migrations occur when species utilize one ecosystem for shelter but feed in another. Short distance movements from coral reefs are made by "edge feeders" such as urchins and parrot fish (Ogden, 1983: 10) while longer-range, nocturnal feeding excursions from reef shelters to seagrass meadows are undertaken by grunts, snappers, barracudas, lobsters, and other
species. Interaction between the reef and pelagic ecosystems is also demonstrated by schools of *Harengula* species which feed on oceanic plankton on the seaward side of the reef at night.

Many species of fish and crustaceans migrate to the outside edge of the shelf to spawn in oceanic waters and their larvae become part of the pelagic plankton system. As a result of the effect of ocean currents, a proportion of these may be recruited as juveniles to coastal ecosystems far from those in which they were spawned. As indicated previously, mangroves and seagrass meadows play an important role by providing shelter and protection from predation for the juveniles of many species, including grunts, snappers, lobsters and shrimp. As fish grow, they move from the shelter of seagrasses or mangroves to form schools of adults over patch reefs or other shelter from which they make daily feeding migrations mentioned above. Juvenile shrimp live in the waters of reduced salinity in mangroves but move progressively into seagrass meadows and then into deeper offshore waters as they grow larger.

### 4.4 ECOLOGICAL COMPLEXES

A great deal of research has been done in Cuba on various aspects of shelf and oceanic ecosystems, especially with respect to questions related to fisheries. Drawing upon it, and acknowledging that such ecosystems, as we have seen, are not closed but constitute an "integrated web" (Ogden, 1983: 1), Baisre (1985a; 1985b), has identified several "ecological complexes" in Cuban waters. These are groupings of ecosystems identified on the basis of: the distribution of commercial species; the geography of the archipelago; the

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1 The present Director of the Department of Science and Technology of the Ministry of Fisheries,
distribution of bottom sediments; the hydrology of the shelf and oceanic waters; rates of primary production; and the distribution and composition of phytoplankton and zooplankton. Using this information, he has identified three major ecological complexes in Cuban waters: an estuarine littoral complex; a coral reef-seagrass complex; and an oceanic waters complex. The following account of ecological complexes in Cuban waters relies heavily on Baisre's work verified by reference to studies conducted in adjacent and distant tropical waters by other researchers.

4.4.1 Estuarine-Littoral Complex

The estimated area of the estuarine-littoral complex in the archipelago fluctuates with seasonal changes in river discharge but it is estimated to encompass about 8,500 km² or approximately 16% of the total shelf area (Baisre, 1985a: 251). It reaches its greatest extent on the southeast shelf in the Gulfs of Ana María and Guacanayabo into which the largest river systems of the country, the Cauto and the Zaza, drain. The only other extensive area occurs in La Broa Bay but it is also found in a narrow strip along the coast of the northeast shelf and within many pocket bays.

This is a complex of low coasts, river mouths and lagoons dominated by terrigenous sediments and mangroves. Ecologically, the estuaries and lagoons represent highly fluctuating habitats subject to great environmental stress, often accentuated in the latter by narrow mouths which restrict interchange with outside waters (M.I.P., 1992). As was seen above, this is a complex with elevated levels of primary production and organic detritus which is the basis of relatively simple food webs (Baisre, 1985a: 255).

The estuarine-littoral complex presents a very rich environment within which populations of marine organisms must be adapted to variable
conditions of tides, currents, temperatures and salinity (Rodríguez, 1975: 313; Guitart, 1978: 32; Kutxun 1966: 16). Species diversity tends to be low (Caddy and Sharp, 1986: 9) and, with the exception of the large predators, almost all of the species of this zone combine high rates of reproduction and growth with small size. Table 4. 1 shows the most important commercial species which inhabit this complex1.

Mangrove prop roots, the only hard substrate in this environment of anaerobic mud, provide a habitat for epiphytic algae, clusters of filter-feeding bi-valves (oyster, *Crassostrea rhizophorae*; clams, *Arca zebra*) and barnacles (*Polycipes cornucopiae*). Other molluscs, small crabs, sponges, and small fish live on and in the mud and in the brackish water amongst the roots. The roots also provide a refuge for the juvenile stages of numerous commercially important fish such as species of *Eugerres* and *Mugilidae*, and invertebrates such as Peneid shrimp and lobster. Snedaker (1978, 12) reports that in estuarine areas with mangroves, more than 90% of the marine species are found in the mangroves during one or more period of their lives.

There are several species of Peneid shrimp in the waters of the Cuban shelf (Baisre and Zamora, 1983; MIP, Comité de Administración Pesquera, 1984; Pérez et al., 1989; Pérez, Puga and Rodríguez, 1983; Simpson and Ruíz de Quevedo, 1975). Only two, pink shrimp (camarón rosado, *[Penaeus notialis]*) which make up 85% of the catch, and white shrimp (camarón blanco, *[Penaeus schmitti]*)*, are exploited commercially. They are consumers of microinvertebrates which are generally found associated with areas adjacent to river mouths or estuaries where bottoms are composed of sand and mud and where there is a supply of fresh water. The largest populations are found on the southeastern shelf in the Gulfs of Ana María and Guacanayabo. A

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1 The table is based on Baisre (1981a: 256, Table 1) with up-dated catch data.
Table 4.1

Estuarine-Littoral Complex. Mean Annual Catch of Commercial Species and Groups: 1981-85

<table>
<thead>
<tr>
<th>Species/Group</th>
<th>Catch (t)</th>
<th>% of national total catch</th>
<th>% of total catch in complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shrimp ((P. \text{schmitti} ; P. \text{notialis}))</td>
<td>5574.92</td>
<td>8.10</td>
<td>44.77</td>
</tr>
<tr>
<td>Oyster ((Crassostrea \text{rhizophora}))</td>
<td>2521.02</td>
<td>3.65</td>
<td>20.24</td>
</tr>
<tr>
<td>Atlantic thread herring ((Opisthonema \text{oglinum}))</td>
<td>2071.06</td>
<td>3.0</td>
<td>16.6</td>
</tr>
<tr>
<td>Clam ((Arca \text{zebra}))</td>
<td>1347.60</td>
<td>1.95</td>
<td>10.82</td>
</tr>
<tr>
<td>Mojarras and Pataos ((Gerridae))</td>
<td>1166.50</td>
<td>1.70</td>
<td>9.37</td>
</tr>
<tr>
<td>Mullets ((Mugilidae))</td>
<td>552.24</td>
<td>0.80</td>
<td>4.43</td>
</tr>
<tr>
<td>Mackerels ((Scomberomus \text{spp.}))</td>
<td>.409.20</td>
<td>0.67</td>
<td>3.29</td>
</tr>
<tr>
<td>Stone crab ((Menipe \text{mercenaria}))</td>
<td>158.80</td>
<td>0.23</td>
<td>1.28</td>
</tr>
<tr>
<td>Total</td>
<td>12453.74</td>
<td>20.10</td>
<td>100.00</td>
</tr>
</tbody>
</table>
second important population is located in La Broa Bay and other much smaller ones occur in the Sagua Bay, the bays of Cienfuegos and Nipe, and in some shallow coastal areas such as Isabela de Sagua. White shrimp may grow to 20cm, are diurnal in habit, and have a distribution which is restricted to coastal areas and lagoons close to river mouths. Pink shrimp are smaller, nocturnal in habit, and much more widely distributed. They may be found up to 30km from the coast. The population levels of both species may be quite sensitive to changes in environmental conditions.

Both pink and white shrimp have short life cycles. Spawning takes place at the shelf edge and from there larvae move toward estuarine and lagoonal waters where they arrive as post-larvae (Kutkhun, 1966: 20). A juvenile stage lasting from two to four months is passed in inshore areas and the shrimp then migrate back to offshore areas to complete their life-cycle. Spatial distribution is consequently stratified to some extent by size. Pink shrimp exhibit a single major recruitment period while white shrimp show two distinct periods. As a result of the nature of the resource, then, there are large seasonal, annual, and spatial variations in the economic productivity of the fishery.

Mullets (lisas and lisetas) are the commonest species of the Mugilidae, medium-sized fish which are adapted to great variations in salinity and so are able to live in estuarine areas. They live in schools and feed on organic detritus found on the muddy bottoms (Longhurst and Pauly, 1987: 303). Spawning migrations, in which the fish form large schools and move to deeper water away from the coast, occur from October to December. They are especially common in areas where fluvial influence is significant, in the estuaries and lagoons of the Gulfs of Guacanayabo and Ana María, and in the bays of Nipe and Nuevitas on the northeast shelf.
The Gerreidae, amongst which the pataos (patao, *Eugereis plumieri*) and mojarras, (*Gerres cinereus*) are the most common, are small to medium in size. They share the estuarine and lagoon environments of the Mugilidae, living very close to the coast in muddy mangrove areas with relatively low salinity on the southeast and northeast shelves. Their food is small crustaceans and other infauna of muddy bottoms.

King mackerel (sierra, *Scomberomorus cavalla*), Spanish mackerel (serrucho, *Scomberomorus maculatus*), and painted mackerel (pintada, *Scomberomorus regalis*) the major species of the Scombridae, are fast swimmers like the tunas but live in inshore waters. They are schooling predators which eat small fish, especially sardines and anchovies, and average about 70 cm in length. The greatest concentrations are found on the southeast shelf. Spawning takes place in oceanic waters, so that is probable that the populations on the different shelves can mingle.

The Clupeidae includes, among other species, the Spanish sardine (sardina española, *Sardinella aurita*), the red-ear sardine (sardina de ley, *Harengula humeralis*), and the Atlantic thread herring (machuelo, *Opisthonema oglinum*). They are small in size and are the only commercial species in Cuba which feed on plankton. They are schooling fish but, because of the relative paucity of plankton in tropical surface waters, the size of the schools on the Cuban shelf does not approach the scale of those which exist in temperate seas. Their preferred habitat is close to the coast where fluvial influence is high. The greatest abundance of Atlantic thread herring is found on the southeast shelf while that of the sardines is in the Gulf of Batabanó.

The Engraulidae are represented in Cuban waters by the anchovy (boquerón, *Engraulis japonicus*) which is used mainly as bait in small tuna fisheries.
Three types of crab are exploited in Cuba: stone crab (cangrejo moro, \textit{Menippe mercenaria}), land crab (cangrejo de tierra, \textit{Cardisoma guanhumi}), and blue crab (jaiba azul, \textit{Callinectes sapidus}) (Centro de Investigaciones Pesqueras and Dirección de Industrias Pesqueras de la Plataforma, 1981; MIP, 1989; Moncada Gavrilán, 1986). The stone crab may achieve a carapace width of 13cm. It inhabits all coastal estuarine areas with sandy-mud bottoms with seagrasses, but especially those on the northeast shelf and in La Broa Bay. The population of each shelf is probably independent of the others. The reproductive period is from July to September. There are several species of swimming crabs in the archipelago but the blue crab is of the most economic importance. It lives in bays with fresh water inflow and in estuarine areas, especially that of the Cauto on the southeast shelf. The population suffers seasonal variations but its reproductive movements are not well-known. Land crabs live in underground holes or caves in areas close to the shore. At the beginning of the rainy season, they make spawning migrations to the sea, where the females deposit their eggs. Adults may reach 12cm carapace width. The most abundant population is in the Zapata Swamp.

A generalized food web for this zone is shown in Fig. 4.1. The pelagic web is a relatively simple one in which plankton are consumed by species such as the Atlantic thread herring (\textit{Opisthonema oglinum}) which, in turn, are consumed by predators such as the mackerels (\textit{Scomberomus spp.}). It should be noted that the pelagic food web is not perfectly isolated from the benthic-demersal one. Organic material in the form of dead organisms and excreta, both colonized by decomposing bacteria contribute to the detritus of the latter. In this web, the shortest food chain is from detritus to the filter-

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1 The source for Figs. 4.1, 4.2 and 4.3 was Caddy and Sharp (1986: 80-81), who adapted diagrams in Baisre (1985).
feeding clams and the herbivore mullets (*Mugil* spp.). A longer, more complex chain links detritus-consuming microinvertebrates which pass through small carnivores such as the mojarras and pataos (*Gerridae* spp.), shrimp (*Penaeus* spp.), and blue crab (*Callinectes sapidus*) all of which may be consumed by the snooks (*róbalo*, *Centropomus* spp.). Such a diagram is, of course, an extreme simplification of the feeding relations in estuarine and lagoonal waters. As Caddy and Sharp (1987, 45) have noted, the estuarine littoral system receives dissolved nutrients, organic material, bacteria, and pollutants from the terrestrial system and, in turn, exports similar material to shelf waters. It is, therefore a much more open system than is depicted in Fig. 4.1.

4.4.2 Coral Reef-Seagrass Complex

The coral reef-seagrass ecological complex encompasses a total area of 45,000 km² on all four Cuban shelves but is most extensive on the southwest one. As noted in Chapter 3, large areas of highly productive seagrass meadows occupy extensive areas of the shelf on stable biogenic sediments in shallow, clear waters protected by the barrier reefs, shoals and keys of the shelf edge. The barrier reefs themselves, along with patch reefs within the macrolagoon, are, as we have seen, highly productive ecosystems. Both seagrass meadows and coral reefs, being further removed from terrestrial influence, occupy environments characterized by much greater stability in their physical parameters than is the case in the estuarine-littoral complex.

The marine resources exploited in this complex are shown in Table 4.2. Lobsters are by far the most valuable commercial group. The major species, the common, spiny or Caribbean lobster (*langosta común*, *langosta espinosa*, *langosta comercial*, *Panulirus argus*) is most abundant in the southwest
Table 4.2

Coral Reef-Seagrass Complex. Mean Annual Catch of Commercial Species and Groups: 1981-85

<table>
<thead>
<tr>
<th>Species/Group</th>
<th>Catch (t)</th>
<th>% of national total catch</th>
<th>% of total catch in complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lobster (Panulirus argus)</td>
<td>11 897.50</td>
<td>17.20</td>
<td>51.88</td>
</tr>
<tr>
<td>Lane snapper (Lutjanus synagris)</td>
<td>1 771.90</td>
<td>2.57</td>
<td>7.73</td>
</tr>
<tr>
<td>Mutton snapper (Lutjanus analis)</td>
<td>946.10</td>
<td>1.37</td>
<td>4.13</td>
</tr>
<tr>
<td>Grey snapper (Lutjanus griseus)</td>
<td>780.00</td>
<td>1.13</td>
<td>3.40</td>
</tr>
<tr>
<td>Yellowtail snapper (Ocyrus chrysurus)</td>
<td>863.70</td>
<td>1.25</td>
<td>3.77</td>
</tr>
<tr>
<td>Grunts (Pomadasydae)</td>
<td>1 903.50</td>
<td>3.02</td>
<td>8.30</td>
</tr>
<tr>
<td>Nassau grouper (Epinephelus striatus)</td>
<td>946.10</td>
<td>1.50</td>
<td>4.13</td>
</tr>
<tr>
<td>Sharks*</td>
<td>2 490.00</td>
<td>3.60</td>
<td>3.61</td>
</tr>
<tr>
<td>Sardines (Harengula spp.)</td>
<td>436.60</td>
<td>0.69</td>
<td>1.90</td>
</tr>
<tr>
<td>Jacks (Caranx sp.)</td>
<td>389.70</td>
<td>0.62</td>
<td>1.70</td>
</tr>
<tr>
<td>Total</td>
<td>22 425.10</td>
<td>32.95</td>
<td>100.00</td>
</tr>
</tbody>
</table>

*Available data does not distinguish between sharks caught in this complex and those caught in oceanic waters. They have been separated in the proportions given by Baisre in the belief that these have not varied greatly between 1976-80 and 1981-85.
region (Buesa, 1972; Baisre et al., 1984; Cruz, Blanco and Baisre, 1981; Cruz et al., 1991; MIP, 1989). Like all of the crustaceans, it grows by means of shedding its hard carapace in several moulting episodes and may grow to a length of 45cm. It is of nocturnal habit, spending the days hiding in coral or rocky refuges, emerging at night to make feeding forays in search of bivalves, worms, or sea urchins living in adjacent seagrass meadows.

Larger scale movements also occur and are of two types. During the reproductive period from March to June, females migrate to colder, deeper waters at the edge of the shelf where each one releases 60-80 000 eggs. In 3 or 4 weeks, a minute, spider-shaped phyllosoma larva is produced from each egg and hundreds of millions of them are distributed by currents throughout the pelagic layers of the ocean. In the following 6 to 8 months, the surviving larvae grow and undergo a metamorphosis into a transitional post-larval stage (Phillips and Brown, 1989: 163). During the winter months of November to February the tiny transparent lobsters swim toward the coast where they attach themselves, in a process called puerulus settlement, to fixed or floating objects like submerged mangrove roots and seaweed of the estuarine-littoral complex. After further growth and several more metamorphoses, sexual maturity is reached in two to two and a half years and the surviving lobsters achieve a size sufficient for recruitment to the fishery.

In addition to movements associated with spawning, Cuban spiny lobsters make major migrations (recalos) during the fall or beginning of winter. These seem to be initiated by the abrupt decrease in water temperature accompanying the first winter storms. When this occurs, large numbers of lobsters concentrate in columns and cover great distances (e.g. on the southwest platform, from Isla de la Juventud to Cape San Antonio). During this period, the lobsters are particularly vulnerable to fishing activity.
Coral reefs, with their diversity of substrates, are characterised by having a great number of species, especially fish, in a very small area (Longhurst and Pauly, 1987: 176). The majority of fish species in this complex are demersal. Some both reside and feed on reefs. Herbivorous Acanthuridae, Scaridae, Holocentridae, Chaetodontidae, Balistidae occupy shallow reefs, feeding on algal mats while snappers such as L. vivanus and L. bucanella and groupers (Epinephelus spp.) inhabit the deeper zones of the shelf slope in depths to 400 m. However, the most important commercial species use the reef only as a refuge but feed in seagrass meadows.

The Lutjanidae family is composed of the snappers (pargos in Cuba) and related species: mutton snapper (pargo criollo, [Lutjanus analis]), blackfin snapper (pargo del alto, [L. bucanella]), Cuban snapper (cubera, [L. Cyanopterus]); grey snapper (caballerote, [L. griseus]), lane snapper (biajaiba, [... synagrís]), and yellowtail snapper (rabirrubia, [Ocyurus chrysurus]). All are colourful fish of medium to large size which tend to inhabit coral or rocky reefs.

Grey and lane snappers are the most abundant species of this family. They exist on all four shelves although the Gulf of Batabanó is the most important fishing area. Since the fish are relatively sedentary (Baisre and Páez, 1981: 10), the populations of each shelf are considered to be independent of each other. Species of this family make short-distance, nocturnal feeding forays from the reef habitat into nearby seagrass meadows where they feed on a large variety of marine worms, crustaceans, and small fish. Larger scale movements (arribazones) occur during the reproductive period when aggregations form and move toward the shelf edge where spawning takes place. For example, in the Gulf of Batabanó schools of lane snapper move from shallower inshore waters towards the Los Indios and San Felipe keys in
the west and the Diego Pérez keys in the east during the months of April to June. This reproductive strategy is shared with other tropical fish and, according to Johannes (1978, cited in Saila, 1979: 67), is a response to heavy predation in shelf environments. It is designed to ensure the widest pelagic dispersion and survival of larvae. However, such schooling behaviour, in concentrating the fish in space, renders them particularly vulnerable to fishing. The snappers are amongst the most popular fish for human consumption in Cuba.

The commonest members of the Pomadasydae family in Cuba are of the genus *Haemulon*, known as grunts (*roncos* in Cuba). They are small to medium in size and live in shallow waters where they form large schools over sandy or rocky bottoms. Like the Lutjanidae, they feed in seagrass meadows. They form separate populations on each shelf and are especially abundant on the southwest and northeast shelves. The grunts are not of high value for human consumption and are usually caught as part of the by-catch of other fisheries.

The family Serranidae is represented in Cuban waters by the groupers (genus *Epinephilae*) of which the Nassau grouper (*cherna criolla* [*Epinephelus striatus*]) is the most common. They live in rocky and coraline areas but feed in seagrass meadows and may grow to a large size (up to 20 kg). Individuals live solitary lives except during winter months when spawning groupings are formed.

The Carangidae or jacks, including the jack mackerel (*jurel*, [*Caranx sexfasclatus*]), Crevelle jack (*jiguagua*, [*C. hippos*]), and other species are schooling pelagic predators which eat plankton, worms, and small crustaceans. They are most abundant on the southeast shelf and, while they are not the object of a directed fishery, they appear as by-catch in other
fisheries.

The conch (cobo, *Strombus gigas*) is the most important of the gastropods in Cuban waters. It lives in isolated colonies on sandy bottoms with seagrasses, especially on the northeast shelf. Although there may be larval dispersion between shelves, the population on each one is considered to be independent (Baisre and Páez, 1981). Sponges are also found in this complex, especially on the southwest and northeast shelves.

The pelagic food web in the coral reef-seagrass system (Fig. 4.2) is a quite straightforward one in which plankton are consumed by zooplankton which are then consumed by fish such as the red-ear sardine (*Harengula humeralis*). The benthic-demersal web, on the other hand, is quite complex so that, this ecosystem, like that of the tropical rain forest on the continents, possesses many pathways through which energy may cycle giving it the attribute of great stability. It can be seen that this system includes a substantial number of predators, including very large ones such as the sharks.

### 4.4.3 Oceanic Waters Complex

In area, the oceanic waters complex includes all of the remaining waters within the Cuban Exclusive Economic Zone.\(^1\) It is not a shelf ecosystem. However, its more proximate areas are exploited by the inshore fishing fleets so it is included here. Baisre (1985a: 262) delimits this complex as extending 2nm from the edge of the shelf with a resultant area of 13 800 km\(^2\). It abuts the coast of the main island in several places: along the north coast between the northwest and northeast shelves, along the northeast

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\(^1\) According to the 1982 LOS Convention, the coastal state has sovereign rights in an Exclusive Economic Zone to explore and exploit, conserve and manage the living and non-living resources of the waters above the seabed and the seabed and its subsoil (Parsons, 1993: 243). The establishment of the Cuban Exclusive Economic Zone is described in Chapter 13.
FIG. 4.2. Food Web: Coral Reef - Seagrass Complex
coast between Sabinal Key and Point Maisí, from Point Maisí along the far south coast to Cape Cruz, and along the south coast between the Gulfs of Ana María and Batabano.

As noted earlier, this pelagic complex is characterized by a scarcity of nutrients and a resultant lack of resident populations of fish (Table 4.3). The majority of species occupying it are migratory and individuals are often of relatively large size (Longhurst and Pauly, 1987: 211). The largest biomass is attained by the Scombroids, represented by the small tunas, especially skipjack tuna (bonito, *Katsuwonus pelamis*) and the blackfin tuna (albacore, *Thunnus atlanticus*). These are highly migratory species which form surface schools with which birds and sharks are often associated. They eat decapod larvae, small fish, and squid, may reach a weight of 10 kg., and are exploited on the outer edge of the southwest, northwest, and northeast shelves in a highly specialized fishery. On the southwest shelf, so-called "resident" schools occur. These are not truly resident but are schools which pause in their migrations to exploit localized semi-permanent upwellings caused by the island-mass effect acting on irregularities in the topography of the shelf. (Carles Martín, 1993).

The Squalidae are represented by at least 20 species of shark which are caught in the oceanic waters on the edge of the shelf. They are migratory but not much is known about the directions and extent of their movements.

Members of the Istiophoridae and Xiphiidae are collectively known as billfish. The former includes the sailfish (aguja de abanico, *Istiophorus platypterus*) the blue marlin (castero, *Makaira nigricans*), and the white marlin (aguja blanca, *Tetrapterus albidus*). Amongst the latter, the most important species is the swordfish (emperador, *Xiphias gladius*). All of these are migratory oceanic species which appear seasonally in the waters of
Table 4. 3
Oceanic Waters Complex. Mean Annual Catch of Commercial Species and Groups: 1981-85

<table>
<thead>
<tr>
<th>Species/Group</th>
<th>Catch (t)</th>
<th>% of national total catch</th>
<th>% of total catch in complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skipjack tuna (Katsuwonus pelamis)</td>
<td>1874.90</td>
<td>2.72</td>
<td>69.56</td>
</tr>
<tr>
<td>Blackfin tuna (Thunnus atlanticus)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oceanic sharks</td>
<td>510.00</td>
<td>0.74</td>
<td>18.92</td>
</tr>
<tr>
<td>Billfish (Istiophoridae; Xiphidae)</td>
<td>310.30</td>
<td>0.45</td>
<td>11.51</td>
</tr>
<tr>
<td>Total</td>
<td>2695.20</td>
<td>3.91</td>
<td>100.00</td>
</tr>
</tbody>
</table>
the shelf edge, especially during their spawning period. They eat fish and squid and may reach up to 3 m in length.

A generalized food web is shown in Fig. 4.3. This is a system in which the original source of energy is phytoplankton photosynthesis. The phytoplankton are consumed by zooplankton and by the larvae of those species (e.g. lobster) which spend part of their life cycle in oceanic waters. Since such production is not evenly distributed in oceanic waters, the large predators in this complex, such as the billfish and tuna, are necessarily migratory.

On the basis of the description of the physical and biological characteristics of the Cuban shelf and adjacent waters, presented above, Part III will examine the exploitation of the three major ecological complexes in the period from initial human occupation of the archipelago to the revolution of 1959.
FIG. 4.3. Food Web: Oceanic Waters Complex
PART III

FISHERIES DURING THE PRE-REVOLUTIONARY PERIOD
CHAPTER 5
THE ABORIGINAL AND EARLY COLONIAL PERIODS

The tropical idyll of the accounts of Columbus and Peter Martyr was largely true. The people suffered no want. They took care of their plantings, were dexterous at fishing and bold canoeists and swimmers. They designed attractive houses and kept them clean. They found aesthetic expression in woodworking. They had leisure to enjoy diversions in ballgames, dances, and music. They lived in peace and amity" (Sauer, 1966: 69).

"(The Spaniards) did not like fish" (Thomas, 1971:40).

5.1 THE ABORIGINAL PERIOD
5.1.1 Culture History

The initial occupation of the Cuban archipelago and the beginning of exploitation of the marine ecological complexes described in the last chapter has not been precisely dated but appears to have taken place at some time in the last 10,000 years during a time of rising post-Pleistocene sea-levels (Dacal Moure and Rivero de la Calle, 1986: 59). Given that the prevailing ocean currents and winds in the Caribbean region move from east to west, the most probable migration route of the early inhabitants was from island to island through first the Lesser, and then the Greater Antilles from an area of origin around the mouth of the Orinoco River on the South American mainland. However, it has been hypothesized that in earlier times, when post-glacial sea levels were much lower than at present, exposing extensive shelf areas around Nicaragua, the Bahamas, Florida and Cuba itself, movements may
also have taken place from central America and from the North American mainland (A.C.C., 1989: XXIV. 1. 2. Map 2). It is possible, therefore, that different peoples made their way to Cuba using different routes.

At least three groups of people occupied the archipelago in succession. Previous archaeological literature identified them as Ciboney, Mayari and Taino (Tabio and Rey, 1985: 15-16) but more recent usage (e.g. Dacal Moure and Rivero de la Calle, 1986) employs the terms "Preagroalfarera" (literally Pre-agro-ceramic), here referred to as Pre-agricultural; Proto-agricultural and Agro-ceramic, here referred to simply as Agricultural. Each of these may be further sub-divided but only the larger groupings will be employed here. The Proto-agricultural group is a transitional one identified by the presence of pottery fragments in sites with no evidence of agriculture. Since its economy seems to have been essentially similar to that of earlier groups and since its geographical distribution was relatively restricted, it may be ignored for the purposes of this discussion of the fishery.

5.1.2 Pre-Agricultural Peoples

Pre-agricultural peoples, hunters and gatherers whose settlement in Cuba extends from at least 6 000 years ago to 500 years ago, lived all over the archipelago (Dacal Moure, and Rivero de la Calle, 1986: 75). However, sites which have been identified show a discontinuous coastal distribution throughout the island of Cuba and the Isle of Youth (Fig. 5.1). It is difficult to make meaningful generalizations about this distribution but it does seem that proximity to a shelf was not a universally crucial locational factor for settlement. About half of the discrete areas shown on the map lie adjacent,

1 Figs. 5.1 and 5.2 are adapted from A. C. C. (1980: XXIV, 1.2. Map 3).
not to one of the insular shelves, but either to pocket bays (Nipe Bay, Jagua [Cienfuegos] Bay) or on structural coasts such as the south coast of Oriente region, the coasts adjacent to the Escambray and the Havana-Matanzas Uplands, the south coasts of the Isle of Youth and the Guanahacabibes Peninsula. More important, it seems, was location in proximity to coastal mangrove forests with their abundant resources (Dacal Moure and Rivero de la Calle, 1986: 81). However, it should be pointed out that the distribution of sites also reflects the degree of completeness of archaeological surveying and, in addition, it is possible that an unknown proportion of early sites were submerged by the post-Pleistocene rise in sea level.

Agricultural peoples began to occupy Cuba about 1000 years ago. They were concentrated in the eastern half of the island, a distribution that has been interpreted as evidence of their later arrival, probably from Hispaniola to the east, and subsequent displacement of the older Pre-agricultural inhabitants towards the west. The later arrivals show a less restrictively coastal distribution (Fig. 5.2). Only two areas of settlement, one on the south coast of the Gulf of Guacanayabo, the other along the northeast coast lie close to the insular shelf.

5. 1. 2. 1 Population. Estimates of the size of the aboriginal population of Cuba at the time of the arrival of Europeans, like those for the New World as a whole (Denevan, 1992: 370-371), show some variability but there seems to be agreement that it was not large. Thomas (1971: 1511) considers that Las Casas' estimate of 300 000 is too high and that the figure of 60 000, generally accepted by Cuban historians is more reasonable. Geographer Núñez Jiménez (1968: 311) also proposes a relatively modest population of 80 000 to 100 000 as does Marrero (1956: 57) who suggests a population size in the same range.
The explanation for a population of this small size, according to Sauer (1966: 183) may lie in the relatively recent arrival of agriculturalists in the archipelago.

5. 1. 2. 2 Economy. The economies of both Pre-agricultural and Agricultural peoples included exploitation of marine resources. Subsistence among the former was based upon an annual round made up of the collection of vegetable food, the capture of small mammals, birds, reptiles and insects and, most importantly, the collecting of marine life. As noted above, the settlements of these peoples was generally adjacent to, or within, the coastal mangrove forest, a location which facilitated the exploitation of both land and marine resources. From this location, land plants could be collected and a variety of small mammals, especially the jutía (Capromys spp.), were hunted.

Exploitation of marine resources by these peoples focused strongly on shellfish of various kinds. In the estuarine-littoral zone, the most important were the bi-valves: the mangrove oyster (ostión, [Crassostrea rhizophorae]) and the flat tree oyster (baya, [Isognomon alata]) both of which lived on mangrove roots in the inter-tidal zone; and the gastropod, brown crown conch (melongena, [Melongena melongena]), found on muddy bottoms in shallow waters. These existed in great quantities and, being easily collected, provided a stable food resource (Dacal Moure and Rivero de la Calle, 1986:48). However, of central importance both for food and for the manufacture of tools and ornaments were the large uni-valve species of the turtle grass beds of the coral reef-seagrass complex: queen conch (cobo, [Strombus gigas]), king helmet (quinconte, [Cassis tuberosa]), and the West Indian top shell (sigua, formerly Livona pica, renamed Cittarium pica [Morris, 1973: 120]) living in inter-tidal rocky areas (Dacal Moure, and Rivero de la Calle, 1986: 82).
could have been easily taken in shallow waters and, with the clarity of shelf waters, would have also been accessible, at greater depths, by diving, (see Brandt, 1984: 17 on diving).

The flesh of all of the above shellfish was used for food and, in addition, the shells of the large gastropods were used to make a large variety of tools. Using techniques of percussion, fracture and abrasion, more than 30 tool types were manufactured, including containers, plates, spoons, gouges, knives, hammers, scrapers and lance or javelin points. Although wooden artifacts are not common in the archaeological record, because of rapid deterioration in the Cuban climate, a sufficient number have survived to indicate that they were manufactured using some of these shell tools.

In addition to shellfish, some sites showed "extraordinary consumption" of land crabs (cangrejo de tierra, [Cardisoma guanhumi]) and marine crabs such as blue crabs (jaiba azul, [Callinectes sapidus]) (Dacal Moure and Rivero de la Calle, 1986: 82). Manatee and turtles, which were easily caught, the former in estuarine areas, the latter on beaches or in shallow water, were also consumed. Archaeologists (Tabio and Rey, 1985: 36; Dacal Moure and Rivero de la Calle, 1986: 82) mention the presence of fish bones in sites but do not provide a systematic species list. However, it is likely that mullet and other species of inshore waters could easily have been taken by these fishers, especially at the time of schooling in preparation for their spawning migrations. The presence of barracuda and shark bones indicate that tools such as, perhaps, hook and line and spear or harpoon, were used in fishing.

There is no archaeological evidence for the use of boats by pre-agricultural peoples in Cuba. Tabio and Rey (1985: 31) consider it likely that these groups possessed vessels of some kind. The very fact of the existence of
human beings on the island of Cuba argues for such possession. Even if sea-
level had fallen drastically during the later-Pleistocene, Cuba would still have
remained isolated from other land masses by deep, if narrower, channels
which could only have been crossed by vessels. In addition, the existence of
human beings of this period on keys, islets and islands throughout the
archipelago provides further evidence that they were familiar with the use of
sea-going vessels.

The pre-agricultural peoples of the archipelago, therefore, seem to have
been accomplished fishers who exploited the resources of both the estuarine-
littoral and the coral reef-seagrass complexes. The extent of their impact on
these resources is difficult to assess. A great deal would depend on their
numbers. However, as McMillan (1988: 182) has noted with respect to
aboriginal cultures of the northwest coast of North America, even small
communities could exhaust stationary or slow-moving shellfish quite
quickly. However, if population numbers were as small as seems to be the
case, the food and tool supply of the community as well as replenishment of
resources could be accomplished simply by moving to a new location. Such
temporary exhaustion of local marine and other resources probably provided
the mechanism for the peopling of the archipelago.

5.1.3 Agricultural Peoples

More is known about the agricultural peoples of the Cuban archipelago
because, in addition to the archaeological record, we have the accounts of
various early Spanish chroniclers such as Las Casas and Oviedo. However,
the picture is by no means complete because, as some authors (Sauer, 1966:
183; Tabio and Rey, 1985: 117) have noted, the Spanish, on their arrival in
Cuba, were already accustomed to aboriginal ways from their stay in
Hispaniola and found those in Cuba so similar as to be unremarkable and, therefore, did not record them. Written accounts of the fishery in Cuba are even less complete. They are restricted to a few entries in Columbus' diary (Jane, 1960) and in the chronicles of Las Casas and Oviedo. More modern accounts of aboriginal fisheries tend to repeat these accounts.

5.1.3.1 Migrations. The Agricultural peoples of the archipelago were of relatively recent arrival in Cuba (Dacal Moure and Rivero de la Calle, 1986: 123). They were members of an Arawak group who came to the archipelago from South America by way of the Antillean islands. Archaeologists divide them into an early group which probably began to settle in the archipelago about 1000 years ago and a later one which had only been there for about 200 years before the arrival of the Spaniards, and who occupied only very restricted areas on the eastern extremity of the island around Point Maisí in the extreme southeast corner of the island. Most Spanish contact with aboriginal peoples in Cuba was, therefore, with members of the earlier group although they were well acquainted with the later one from their time in Hispaniola. Both groups were farmers and pottery makers, and for the purposes of this account they will be treated as one.

Moving from the east and displacing or absorbing earlier inhabitants, Agricultural peoples occupied almost the entire archipelago with the probable exception of the far west. Settlement sites were more varied than was the case with previous groups. Some were in elevated, and even mountainous, inland sites but others were at river mouths and on the shores of lagoons and large bays (Dacal Moure and Rivero de la Calle, 1986: 123). Areas of higher density were located around Point Maisí and along the central part of the south coast of Oriente region; along the south coast of the Gulf of Guanacayabo; around and northwest of Nipe Bay and in the hilly area inland
and west of it in the Maniabón Upland; along the north coast from Sabinal Key to Key Coco; and on the south coast around, and extending inland from, Jagua Bay. The western part of the island, in Pinar del Río and the Isle of Youth, is devoid of agricultural settlement sites but this may indicate incomplete archaeological investigation rather than absence of such peoples in this extensive area (Dacal Moure and Rivero de la Calle, 1986: 154).

5. 1. 3. 2 Economy. Subsistence centred on cultivation and was combined with hunting and fishing. Tillable land was, therefore, the primary factor in the location of settlements but large plains were avoided because their heavy soils were not suited to the digging stick. Starch and sugar were supplied to the diet by a number of root crops such as yuca (manioc) which was made into bread, and the sweet potato, grown in more or less permanent plots of cleared land called conucos (Sauer 1966, 52-57). The carbohydrates supplied by these and other crops were supplemented by protein and fat supplied by terrestrial and marine animals. At inland sites, the hunt for small mammals, birds and reptiles became the complement of agriculture while on coastal, river mouth and lagoon sites, fishing, in the broadest sense, supplied not only essential proteins, but also material for the manufacture of tools.

The agricultural peoples of the archipelago exploited all of the marine resources used by their predecessors. The Spaniards have left written evidence that they possessed a more than adequate assemblage of fishing gear to exploit the varied marine resources of the archipelago. The earliest account comes from Columbus' diary (Jane, 1960: 44) of October 28, 1492 in which he reported visiting two houses where, "he found nets of palm fibres and lines.

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1 Sauer also mentions the existence in the islands, but in a subsidiary position, of the maize-beans-squash plant complex as a later introduction, he thinks, from South America (Sauer, 1966: 55).
and horn fish-hooks, and bone harpoons, and other fishing tackle." Columbus later visited other settlements where he saw fishing tackle and established that the aboriginal peoples grew cotton and employed it in the manufacture of nets. Stone sinkers found in archaeological sites (Baisre, 1987, 262: 41; Dacal Moure and Rivero de la Calle, 1986: 130), provide further evidence of the use of nets. Corrals were used in bays and estuaries both to trap fish (Sauer, 1966: 58) and to keep turtles for later use. Fish poisons were also used in inland waters (Sauer, 1966: 58).

The Spaniards were impressed by the boat technology of the people and Columbus described several elaborately decorated dugout canoes one of which he considered to be large enough to carry 150 people. Such vessels were probably built for ceremonial purposes and employed on special occasions (Sauer, 1966: 60). Their presence, however, argues for the existence of a sophisticated boat-building technology, archaeological evidence of which is lacking. Sauer (1966: 60) considers Cuban aboriginal boat builders to have been equal in competence to those of Polynesia and of the northwest coast of North America.

Employing this array of fishing gear, the Agricultural peoples exploited the marine life of the estuarine and coral-reef seagrass complexes. In the former, oysters, other bi-valve molluscs as well as land and marine crabs were collected and the manatee was pursued by canoe in estuarine waters (Rivero Muñiz, 1958a: 41). Although Columbus mentioned shrimp as being present in these waters, they are not mentioned in the archaeological texts. It seems possible, however, especially in the light of the subsequent exploitation of juvenile shrimp in shallow inshore waters and lagoons of the Gulf of Guacanayabo, that these may also have been fished by the aboriginal peoples.

Fish species exploited in the estuarine-littoral complex included the
mullet, *Mugil spp.*), mojarra (*Gerres spp., Eugerres spp.*) and săbalo (*Megalops atlanticus*) (Baisse, 1987, 262: 42), all species which come into inshore and estuarine waters and which were captured and, perhaps kept, in fixed traps. Dacal Moure and Rivero de la Calle (1986: 128), among others, consider the use of such traps to be the first evidence of fish farming in Cuba but it seems more likely that they were employed simply for catching and storage. Turtle eggs were also collected and the animals themselves were captured, on beaches, by hitting them on the head and overturning them (Baisre, 1987, 262: 41), or in the sea with nets (Sauer, 1966: 58). A method of catching turtles using a remora (pez pega, *Echeneis spp.*) was described first by Oviedo and then repeated by many other writers:

The inhabitants of Cuba then employed a small fish to take the great sea-turtles; they fastened a long cord to the tail of the revès (the name given by the Spaniards to that species of *Echeneis*). The 'fisher-fish,' formerly employed by the Cubans, by means of the flattened disc on his head, furnished with suckers, fixed himself on the shell of the sea-turtle, which is so common in the narrow and winding channels of the Jardinillos. "The revès," says Christopher Columbus, "will sooner suffer himself to be cut in pieces than let go the body to which he adheres." the Indians drew to the shore by the same cord, the fisher-fish and the turtle" (Humboldt, 1895: 192).

Interestingly, this technique was also known in China, Australia and East Africa (Brandt, 1984: 32).

Resources of the coral reef-seagrass complex were also exploited. Conch could have been easily caught by diving from canoes in the clear, shallow water of the shelf and were used for food and for the manufacture of tools and for personal adornment. Demersal fish such as mutton snapper (*Lutjanus*
analis), yellowtail snapper (*Ocyurus chrysurus*) and Nassau grouper (*Epinephelus striatus*) as well as neritic fish like the jack mackerel (*Caranx sexfasciatus*) and many species of shark were caught with hooks and lines which were cast by hand or using poles (Sauer, 1966: 58). As with the Pre-agricultural peoples, the shells of large uni-valves were still very important in the manufacture of tools like gouges and hand axes. Decorative, finely worked beads and pendants were also manufactured from shells (e.g. the Caribbean olive and related species (*Oliva* spp.) and necklaces were made from shark teeth and fish vertebrae. Baisre (1987, 262: 42) has argued against the utilization of lobster by aboriginal peoples on the basis of their behaviour (hiding in refuges during the day), difficulty in handling (spiny carapaces) and necessity for boiling for palatability. Archaeology texts are silent on the matter.

The impact of Agricultural peoples on the marine resources of the archipelago must have been considerably greater than that of their predecessors. Living in more permanent settlements and in larger numbers, their mobility in case of exhaustion of stationary and slow moving species like oyster or conch must have lain in expanding the sphere of their operations outwards from the shore rather than moving their settlement to a different location. Possession of canoes of various sizes would have allowed them to do this easily. It is likely, therefore, that their impact would have extended much further from shore, and with greater intensity, into the coral reef-seagrass complex than did that of the pre-agricultural peoples. However, it is difficult to imagine that, with their relatively small total numbers, they could have had any serious impacts except, perhaps at the local scale.
5.2 THE EARLY COLONIAL PERIOD: CULTURAL DISCONTINUITY

The historical record of the early colonial period in Cuba is distinguished by the absence of any mention of fishing as an important economic activity. On the face of it, this represents a rather surprising cultural discontinuity given the comprehensive exploitation of the resources of the insular shelf by the aboriginal population of the archipelago. In this section, an attempt will be made to explain the discontinuity and to assess its completeness.

5.2.1 The Conquest

The Spanish conquest of Cuba began in 1511 with the arrival of 300 men under Diego Velázquez. It proceeded with rapidity and brutality and was completed more or less within the year. By 1514 the six villas (new towns) of Asunción de Baracoa, San Salvador de Bayamo, Trinidad, Sancti Spiritus, Puerto Príncipe, and San Cristóbal de la Habana (located on the south coast near the present location of Batabanó) had been established. A seventh, Santiago de Cuba, which later became the capital, was added in 1515 (Fig. 5.3).¹ The principal locational determinant of most of the villas was the distribution of abundant native populations, but the sites of San Cristóbal and Santiago were chosen for their positions on the coasts of the Caribbean Sea to which, in this early period, Spanish activity was still restricted (Le Riverend, 1967: 36).

The Spaniards had come seeking gold which they found in both the Escambray and, to a lesser extent, in the Sierra Maestra. The ensuing gold rush from Hispaniola increased the number of Spaniards in the island by several thousand and sealed the fate of the indigenous population. The

¹ The source for Fig. 5.3 was Sauer (1966: 186-187).
nature of relations between Spaniards and Indians had already been
determined in Hispaniola. The latter were shared among the former by
means of the *repartimiento*¹ and put to forced labour in the mines.
Conditions of labour were brutal, food production was neglected and the
Indians died in great numbers.

5. 2. 1. 1 Disappearance of the aboriginal population. About the
disappearance of the aboriginal population of Cuba there is no doubt. The
question of the occurrence and extent of cultural discontinuity, however, rests
to a great degree upon the rapidity of the extinction about which there is some
disagreement. Sauer (1971: 26) believed that most of the native population
was "used up in ten years." However, others envisage a rather slower decline.
Historian Hugh Thomas (1971: 1513) gives a figure of 5 000 Indians for 1535
while Marrero (1956: 57) reports a total population of 2 000, only 200 of whom
were not native, in 1550. Thomas (1971: 1511-1529) has argued that the decline
in aboriginal population numbers was a result of their absorption by the
Spaniards, rather than their extinction. He presents some persuasive
evidence in support of his argument. Intermarriage with Indian women, he
maintains, would not have presented a problem for the Andalusian colonists
many of whom were of mixed Jewish and Moorish blood. More
convincingly, he points to the large number of Indian words (*guajiro*), place-
names (Guanahacabibes, Guanabacoa), and other culture traits (e.g. the *bohío*,
the typical Cuban rural house) which have survived into modern Cuban
language and culture. Such survivals argue against an extinction as rapid as
that proposed by Sauer.

However, in arguing for the primacy of absorption in Cuba, Thomas

¹ *Repartimiento*, in this sense, refers to "The allotment of groups or gangs of Indian labourers to
works such as tillage, building, mining, transport" (Simpson, 1966: 183).
neglects the impact of European diseases on the aboriginal population. Recent research suggests that, even without Spanish brutality, the aboriginal population of the Americas was doomed by the impact of Old World diseases upon it (Lovell, 1992: 426-443). It is hard to imagine that the natives of Cuba were exempt from this "human tragedy ... unprecedented in scale" (Butzer, 1992: 351). It seems likely, then, that the aboriginal population of Cuba disappeared for multiple reasons: by disease, by Spanish brutality, and by intermarriage, probably in that order of importance. This disappearance must be at least partially responsible for the decrease in the importance of fishing as an economic activity in the archipelago.

5.2.1.2 Decline of fishing. Several additional causes may be proposed for the precipitate decline in the importance of fishing. Firstly, Spanish colonists, intent on obtaining as much gold as possible and being totally dependent on the Indian population to do so, must have been extremely reluctant to allow their native labourers the opportunity to go fishing and perhaps to escape. (The resultant lack of protein in the diet, no doubt, had a significant impact on health and increased the susceptibility to disease among the aboriginal population).

Secondly, with the exhaustion of available gold, and the possibility of unimagined wealth on Tierra Firme, Cuba quickly became unattractive to Spanish immigration and was reduced to acting as a supplier of expeditions to the mainland. According to Thomas (1971: 1513) the population grew slowly from 6300 (300 Spaniards, 1000 Africans, 5000 aboriginal people) in 1535, to 20,000 in 1602 (13,000 in Havana). "From about 1540 until the late-18th century, Cuba was a neglected underpopulated backwater subsidized from the Viceregal treasury in Mexico" (MacGaffey and Barnett, 1962: 4). Not only was the population small, it was mostly urban (Butzer 1992: 218). Most people
during this period were concentrated in and around Havana which, having been re-located to the north coast in 1519 to protect the passage through the Strait of Florida, had become the assembly point for Spanish fleets carrying the treasure of Mexico and Peru across the Atlantic to the home country.

Thirdly, the typical Spaniard who came to Cuba near the end of the sixteenth century was "a poverty-stricken Andalusian male aged 27½, unmarried, unskilled and probably only semi-literate, driven by hunger to make his way to Peru in the employ of any man who would pay his passage" (Boyd-Bowman 1976: 732). Such Spaniards, as Thomas (1971: 40) notes, could not or would not change their eating habits. They preferred wine, rice and bread made from wheat and, as noted in the quotation from Thomas at the beginning of this chapter, they "did not like fish." Bethell (1993: 2) agrees:

The native Indians of the sixteenth century also passed on to the Spaniards the art of cultivating sweet potato, yam, yucca, pumpkin, maize and various beans, though the colonists avoided vegetables and preferred to import almost everything which they had to eat: bread, for instance, was as a rule made from imported wheat. Wine, too, was imported, not made. Fish was not much enjoyed.

Fourthly, the Spaniards very quickly developed a terrestrial source of protein. They were culturally predisposed to ranching (Bishko, 1952: 495). Cortés is quoted by Marrero (1957: 97) as saying "I have come to America to become rich, not to work the earth like a farm-hand." The livestock which they had brought to the islands from Andalusia and Extremadura proved to be extremely adaptable to conditions there. There being no predators or endemic diseases, hogs were extremely successful in the forests and cattle adapted easily to the extensive grasslands. Both increased rapidly in number.
(Sauer, 1966: 189; Marrero, 1957: 97) and thus, the first period in the economic
development of the Spanish colony - livestock ranching - was initiated: first,
with hogs, which supplied food for the local population and for expeditions to
*Tierra Firme*, followed by a short period, ending in 1538, in which horses were
produced for export (Marrero, 1957: 102); and lastly cattle ranching which
produced salted and dried meat but especially dried hides for export.

Fifthly, Baisre (1987, 263: 39) has made a case for the impact of the
poisoning called *ciguatera* on Spanish attitudes toward fish and shellfish in
Cuba. *Ciguatera* is poisoning caused by a toxin produced by a free-swimming
protozoa which attaches itself to marine algae and is eaten by small fish and
then passed upward through food webs and concentrated in top predators
such as barracuda and jacks (Longhurst and Pauly, 1987: 249). Symptoms of
the poisoning in humans include nausea, vomiting, diarrhea and abdominal
cramps as well as neurological symptoms such as numbness and tingling of
the lips, tongue, throat, fingers and toes. Hot and cold sensations may be
reversed and weakness, dizziness and muscle and joint aches may be
experienced. Poisoning is rarely fatal but, obviously, extremely uncomfortable
(Brody, 1993: A15). According to Baisre, 70 Cuban shelf species, including
groupers (*Serranidae*), snappers (*Lutjanidae*) and barracuda (*Sphyraenidae*),
are capable of being *ciguatas* at various times. The danger of being subject to
such poisoning may well have reinforced already existing Spanish prejudice
against the consumption of fish.

Given the destruction of much of aboriginal culture and the
conquistadors' attitudes toward fish and proclivities toward ranching and
meat eating, the disappearance of fishing from the historical record for the
early colonial period in Cuba is not surprising. However, it is unlikely that
cultural discontinuity was complete. As noted above, some traits persisted.
With respect to knowledge of marine resources and fishing techniques, support for disappearance by absorption rather than by destruction comes from the continuing use, into modern Cuban Spanish, of aboriginal names for many marine species, including: caguama and carey for the turtles Caretta caretta and Eretmochelys imbricata respectively; biajaiba for the lane snapper (L. synagris) and jiguagua for the Crevelle jack (Caranx hippos) (Baisre, 1987, 263: 39). Such linguistic evidence suggests that some information with respect to the marine resources of the shelf was passed to the colonists. According to Gómez de la Maza, native dugout canoes (cayucos) remained in use in some regions "until quite recently" (1957: 26).

In addition to such transfers, there are indications that, in spite of their attitudes towards fish and fishing, the Spaniards did not completely ignore the marine resources of the archipelago. Sánchez Roig and Gómez de La Maza (1952: 14) refer to a primitive industry of salting and smoking fish in the first years of the colony. The identification of some species by both Spanish and aboriginal names (e.g. ronco blanco=jallao; pez pluma=bajonao) may date from this early period (Baisre 1987, 263: 39) but there is no completely convincing evidence that this is the case. Evidence for the exploitation of turtles and manatee is more convincing. The meat of both easily caught species was dried and salted and supplied both to expeditions to Tierra Firme and to fleets bound for the mother country. Green turtle (Chelonia mydas) along with beef and pork was the principal meat eaten in the mid-17th century (Suárez Caabro, 1988:26).

In conclusion, the Spanish impact on the aboriginal peoples coupled with their own cultural predispositions, seems to have resulted in the decline of fishing as an economic activity in the Cuban archipelago during the early
colonial period. With the exception of some local names for fish and vessels, it appears that the aboriginal Cubans' rich knowledge of marine resources and highly developed repertoire of fishing gear and techniques was almost completely lost and did not form a basis, as will be seen, for the development of fisheries in subsequent centuries.
Economic and population growth in Cuba remained slow throughout the 16th, 17th and most of the 18th centuries. The first census in 1774 reported 171,620 inhabitants (96,440 whites, 31,847 free blacks, 44,333 black slaves), a figure considered by some authors to be rather low (Atlas demográfico nacional, 1985: 10; Rudolph, 1987: 12). However, the latter part of the eighteenth century, marked by the English occupation of Havana in 1762 and the slave revolt in St. Domingue (Haiti) in 1791, saw a substantial expansion in the Cuban sugar industry and, with it, the intensification of the slave trade. In 1792, there were 85,000 African slaves and 54,000 free blacks; in 1810 this had increased to 217,000 slaves and 109,000 free people of colour; and in 1840 there were 437,000 slaves and 153,000 people of colour (Pérez, L. A. ed. 1992: xv). The number of slaves in the colony, therefore, had increased almost ten-fold in 66 years.

The white population also increased during this period, both by natural increase and by immigration from the Canaries, the Balearic Islands and the Iberian peninsula. The immigrants also included 132,435 Chinese imported as indentured labourers (classified as white) (Augelli and West, 1989: 137). Growth occurred in spite of demographic reversals such as the expulsion from Cuba of many of the Haitian French refugees in the early nineteenth century, and the deaths of 50,000 Cubans during the Ten Years War of 1868-1878.

Total population reached more than one million by the mid-nineteenth century, 1,631,687 in 1887, partly as a result of several hundred
thousand Spanish immigrants, mainly from Asturias and Galicia, who came after the end of the Ten Years War in 1878. As a result of losses in the renewed War of Independence, the total population decreased somewhat to 1,572,797 in 1899 (Atlas demográfico nacional, 1985: 10).

During this period of rapid population growth for the country, the capital increased in demographic and economic importance. Havana's population increased from 51,000 in 1792 to 388,000 in 1841 and, in doing so, increased its share of the total population from 20% to 40% (Pérez, L. A. ed., 1992: xvi) making it a decidedly primate city. Given that the major development of sugar production was concentrated in the area around it, the capital became the focus of a densely populated functional region. In 1850, the three western provinces of Pinar del Río (the eastern part), Havana and Matanzas contained 734,000 persons or 65% of the total population of Cuba. Subsidiary population concentrations existed in Oriente and in and around some small coastal towns (James and Minkel, 1986: 164).

6.1 FISHING

The reappearance of fishing as an economic activity dates from this period of intense economic growth in the 19th century but it does not appear to have been a straightforward reflection of population growth nor of a general increase in wealth. Two major sources of development can be recognized: the food market for fish and shellfish, especially in Havana, but to a lesser extent in the provincial capitals too; and a demand for sponges, first from Europe, later from the United States.

6.1.1 The Food Fishery

6.1.1.1 Rural and urban diets. From historical and traveller's
accounts, it appears that rural Cubans had failed to develop a taste for fish in the previous two hundred and fifty years. Hazard (1992: 212) writing in 1871 described country fare as follows:

The daily meals of the more humble farmers consist of fried pork and boiled rice in the morning, and, in lieu of bread, the roasted plantain. At dinner, they make use of cow-beef, je-ked beef, birds and roasted pig; but usually this meal consists of roasted plantains, and the national dish of ajiaco, or what we should call an Irish stew. This dish is to the island what olla podrida is to Spain. It is composed of fresh meat, either beef or pork,—dried meat of either—all sorts of vegetables, young corn, and green plantains. It is made with plenty of broth, thickened with a farinaceous root known as malanga, and has also some lemon-juice squeezed into it... Boiled rice is never dispensed with at any meal, and the cooking of it is understood to perfection. It is used mixed in all their stews, or with a simple sauce of tomatoes. El aforreado is made of half raw meat, dressed with water, vinegar, salt, etc., which operation is known as perdigar (or stewing in an earthen pan); then mashed and stirred together, it is fried slightly in a sauce (mojo) of lard, tomatoes, garlic, onions, and peppers. Picadillos, or hashes, are always good upon the island... The tasajo brujo, or jerked beef bewitched, so called from the fact that it grows so much larger in cooking, is the dish found almost everywhere, and cooked in many ways.

This preference for root crops, rice, pork and beef and the absence of greens and fruit has persisted and, depending on supply, is characteristic of the modern Cuban diet. Also characteristic is the absence of any mention of local marine species. This is not to say that shelf species were not eaten in the countryside but their absence from this description of the rural diet indicates that demand for them from this sector of the population could not have been great.
The other, larger, sector of the rural population was made up of slaves whose diet was described by Humboldt (1895, III: 249) at the beginning of the century: "The slaves are fed with *tasajo* (meat dried in the sun) of Buenos Ayres and Caracas; salt-fish (bacalao), when the *tasajo* is too dear; and vegetables (viandas), such as pumpkins, muñatos, batatas, and maize." The salt-fish of which Humboldt spoke was not local fish but cod, caught in large quantities by Spanish fishermen on the Grand Banks of Newfoundland. Cuba was not exceptional amongst Caribbean countries with respect to the importation of large quantities of food. Kenny (1985: 105) has noted a similar pattern in the former British colonies in the West Indies. With the necessity to feed large numbers of slaves, food had to be obtained not only cheaply but in great quantities. Imports to Cuba were aided by the introduction of regular steamship service to Spain in 1827. García de Arboleya (1859: 175) estimated that 645 622 arrobas\(^1\) or 7 424 653 kg (7 424.7mt) of cod was imported annually. Canned and salted sardines were later added to these imports. Thomas (1971: 273) describes the situation in the 1880s:

Further, the old economic anomalies, typical of slave societies, remained (despite erosion of the slave system): even the rural population did not grow minor crops for subsistence. Nor did villages and towns. The tradition of Cuba, like the rest of the West Indies, was still to buy food in bulk from the north or from Europe, to feed the slaves who drove the plantations which made the money to buy, *inter alia*, the food. This was slavery's most lasting contribution to Cuban society (Thomas, 1971: 273).

The huge increase in the rural population which occurred in the 19th century, then, did not result in a corresponding increase in demand for marine species

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\(^{1}\) 1 arroba = 11.5 kg approximately.
from the insular shelf.

In Cuban towns and cities however, the situation was different. Proprietors of sugar plantations, continued the Spanish tradition of urban living and did not live on their plantations. So too, did many foreigners - French, English, German, and American. Since Havana was both functional node of the major sugar producing area and the most important port in the country as well as its largest city and capital, the majority of wealthy proprietors and the greatest proportion of foreigners lived there. It was there, therefore, that Cuban culture was most open to outside influences.

The cosmopolitanism of the capital was reflected in the diet of the proprietor class: "As the service of the table, in most of the cities, at all the hotels, and many of the best private houses partakes of the nature of French cooking, it is only in the rural parts one can see the bona fide Cuban dishes" (Hazard, 1871: 211). French cooking did not share the Cuban-Spanish aversion to fish. Dana (1966: 14), describes a breakfast in Havana in 1859:

We call for the usual breakfast, leaving the selection to the waiter; and he brings us fruits, claret, omelette, fish fresh from the sea, rice excellently cooked, fried plantains, a mixed dish of meat and vegetables (olla) and coffee. The fish, I do not remember its name, is boiled, and has the colors of the rainbow, as it lies on the plate. Havana is a good fish market; for it is as open to the ocean as Nahant, or the beach at Newport; its streets running to the blue sea, outside the harbour, so that a man may almost throw his line from the curb-stone into the Gulf Stream (Dana, 1966: 14).

Growth in demand in the capital resulted in the construction of a fish market which became a place of admiration for many travellers. Wurdemann (1971:35) described its appearance in 1835:
Whoever goes to Havana, should not fail to visit the fish-market, where his eyes will be regaled with a sight of the most beautiful of the finny tribe known to the naturalist; rivalling, in the splendor of their painted scales, and the varied combinations of colors, the brilliant hues of the feathered tribes of Guiana. If you could imagine the rays of the prism in all their harmony and softness, now drawn in stripes, now divided in spots, or checkered in various angles; now a single color in all its purity abruptly ending in one far removed from it in harmony, as if nature had purposed, by their contrast, to exhibit more strongly the peculiar beauty of each, while a single narrow ray of gold or silver would traverse both, a faint idea would be formed of the beauty of the Havana fish. The best time to visit the place is early in the morning, when the marble table is covered with the products of the fisherman's labor, many of them still alive; nor will the epicure return disappointed some of them being of acknowledged flavor...The building is composed of an upper story supported by pillars and arches, and sheltering from the weather one marble table 150 feet long, on which the fish are exposed for sale. It is open its whole length on one side to the street, and on the other to the sea, and being thus ventilated, is in a great measure free from the usual unpleasant odours of such marts. A man named Marti, half fisherman and perhaps half smuggler, built it under Tacon from his private purse, on condition of being permitted to monopolize the sale of fish in Havana for twenty years, after which time the building reverts to the city (Wurdemann, 1971: 35).

This "new" market replaced an older one (Rivero Muñiz, 1957b: 42) and remained in service until 1895 (Sánchez Roig and Gómez de la Maza, 1952: 16). Other smaller markets and stores, which sold fresh fish as well as fried snapper and grouper steaks, were distributed throughout the city (Rivero Muñiz, 1957b: 42).

About 100 species of fish were sold in the large market (Thomas, 1971:
Fish came from all three ecological complexes but the most popular species of all were yellowtail snapper and mutton snapper (García de Arboleya, 1859: 175). That fish was food mainly for the wealthier classes in the 1850s, as indicated by its cost: "El pescado no ha logrado entre nosotros la baratuna de la carne, y su ordinaria carestía le hace casi un objeto de lujo" (Among us, fish has not achieved the cheapness of meat and its scarcity has made it almost a luxury object. García de Arboleya, 1859: 175).

While fish from the estuarine-littoral zone, such as mullets and their roe, were consumed, this ecological complex was exploited more for shellfish (mariscos) which made up 50% of the consumption of marine products in the capital. This included crustaceans such as shrimp, sold dried and salted (Gómez de la Maza, 1957: 26), and crabs (blue crabs, stone crabs) as well as molluscs such as oysters and clams which were sold from street stalls. García de Arboleya (1859: 173) mentions lobster as being present in Cuban waters but does not make it clear to what extent they were consumed. Manatee (manatí, [Trichechus manatus]), which may already have been subject to over-exploitation (García Ramón, 1970: 27), were also caught. Their oil was extracted, the meat made into jerky, and skins used in the manufacture of canes and whips.

It seems, then, that during the late colonial period in Cuba, two distinct local consumption patterns of food fish co-existed. One was rural, mainly, but not exclusively slave-oriented, and based on imports of large quantities of cheap salted and dried cod as well as canned sardines. The other was urban, upper-class, cosmopolitan and based on fresh fish and shellfish. This is not to suggest that fish was not also caught and consumed for subsistence throughout the archipelago but in the absence of records, it is impossible to estimate the extent to which this occurred.
6.1.2 Supplying the Capital

6.1.2.1 Extra-shelf fisheries. The major sources of supply of fish for the Havana market throughout the nineteenth century were located outside of the Cuban insular shelf on Bahamian, Floridian and Mexican banks (Fig. 6.1). Extremely poor communications on the island ("There were no good roads in Cuba" [Thomas, 1971: 18]) meant that seafood could not be transported in a sanitary fashion for any great distance from the point of landing. Transportation by sea was a much more successful method of delivering fish over fairly large distances.

Southern Florida was one of the major sources of fish for the Havana market. As early as the 17th century, Indians travelled by canoe from the Florida Keys, a journey of some 24 hours, to sell fish, ambergris and other items in the capital (Covington, 1959: 116). Spanish fishing vessels from Cuba travelled in the opposite direction. During the eight month fishing season (August to March) operations were carried out from bases (ranchos) on coastal islands. Fish, which were dried and salted, may have been destined to feed slaves on Cuban sugar plantations, while smoked roe appears to have been a luxury product (Covington, 1959: 118-119). Some thirty Cuban vessels were reported to be engaged in this trade in 1770 (Covington, 1959: 117). Americans became involved in the 1830s when a New Englander called William Bunce set up ranchos in Tampa Bay on the west coast of Florida (Rivero Muñiz, 1957a, 1957c, 1957d).

In the late eighteenth and early nineteenth century, fresh fish began to be delivered to Havana by American fishing "smacks." The centre of fishing operations for this fleet was Key West, only 170 km north-north-east from Havana. The fleet was made up of sloops and schooners which originally had
FIG. 6.1. Fisheries for the Havana Market in the Nineteenth Century
come from Long Island Sound to winter in Florida (Collins, 1885: 260) but which, in time, came to be built in the region using local materials. Collins describes the Emma L. Lowe, built in 1875 as "one of the largest and finest of the Key West fleet" (1885: 260-261). Having been built perhaps three-quarters of a century after the start of the fishery, this vessel may differ in degree from its predecessors but does demonstrate some of their essential characteristics. It was a carvel-built, two-masted, five-sail schooner of 46.6 registered tons with an overall length of 66 ft, a beam of 20 ft. In the middle, separated fore and aft by bulkheads, was situated a live-well (Andersen, 1984: 781), the outside walls of which (i.e. the hull) were perforated by holes which allowed the circulation of sea water to keep the catch alive.

The major fishing ground for the smack fleet was in shelf waters on the west coast of Florida between Charlotte Harbour and Anclote Keys. Fishing took place by single, baited handline from the weather side of the drifting vessel, in shallow waters (2-15 ft) in order to reduce the pressure differential on the swim bladders of the demersal snappers and groupers to better ensure their survival in the live-well.

The local Key West fleet of smaller vessels, called "smackees" also sent its surplus catch to Havana. These were live-well vessels which fished mainly off the south or ocean side of Sombrero Key, about 70 km east of Key West. They used baited troll or "drail" lines to fish for kingfish (i.e. mackerel).

Cubans took over the Florida fishery ("el Bey") from the Americans after 1868 when Spanish authorities imposed a prohibitory duty on the import to Cuba of fresh fish from the United States. This resulted in the decline of American involvement in these fisheries and most of the vessels

1 Illustrations of schooners and smackees can be found in Collins (1885).
in the smack fleet were sold to Cuban residents (Collins, 1885: 258) who subsequently delivered fish to Havana in live wells or packed in ice. By 1891, the Cuban live-well fleet consisted of 48 schooners (Gómez de la Maza, 1952: 27). It remained in operation into the early 1960s.

Cuban fishers also ventured out of local waters to fish on nearby keys such as Cay Sal Bank and the Dry Tortugas, and more distant banks such as the Campeche Bank ("la Sonda") where they set up fishing stations at which fish were dried and salted before being shipped to Havana by schooner (García de Arboleya, 1859: 175; Rivero Muñiz, 1957a, 1957c, 1957d; Sánchez Roig and Gómez de la Maza, 1952: 16).

6. 1. 2.2 Shelf fisheries. The relative importance of the Havana market at mid-century was reflected in the fact that, in 1856-57, 62% of all Cuban fishing vessels were registered in the capital (García de Arboleya, 1859: 333). Fishing villages existed at Casablanca on the northeastern side of Havana Bay and outside of the bay to the west at the mouth of the River Almendares (Chorrera de Vedado) and farther west on the Marianao shore (Sánchez Roig and Gómez de la Maza, 1952: 15). Although there is no record of it, fishing must have occurred in the bay itself in the past but by the mid-nineteenth century it was "a vast cesspool ... constantly accumulating filth" (Ballou, 1992: 30). Fishing, as a result, expanded to exploit demersal species, such as snapper and grouper, on the very narrow shelf outside of the bay.

During a visit of a few days in 1885, Capt. J.W. Collins observed local fishing (Collins, 1885: 221-222). He described two fleets. The first was composed of small wooden boats which left each morning about sunrise and moved along the coast, generally to the east where they fished using

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1 Havana was probably the port of registration for all vessels in Havana province but not all of these vessels actually fished from the capital. An undetermined number fished from other ports such as Surgidero de Batabanó.
handlines, returning between three- and five-o'clock in the afternoon.\(^1\) It is likely that this fleet supplied a small proportion of the demersal coral reef-seagrass species such as snappers and groupers, to the market. This fleet probably also fished for shark, a fishery mentioned by García Arboleya (1859: 175), in which large fish were caught for their oil and small ones (cazones) for food.

Collins also described another fleet made up of larger vessels which were used, according to his informant, for net and seine fisheries. No more detail about their operations or the type of fish they caught is given. It can be conjectured that they were employed in fishing for estuarine-littoral species like mullets and sardines at the mouths of the Almendares and other rivers, and in pocket bays along the coast, and for demersal species during their spawning migrations.

6. 1. 2. 3 Expansion on the shelf. As noted previously, subsistence fisheries probably existed in many parts of the archipelago during the colonial period and some sugar ports which later became fishing centres date from the 18th century and earlier (e.g. Matanzas, 1693; Manzanillo, 1784; Niquero, 1751; Nuevitas, 1775, Mariel, 1768) but major growth in the shelf fisheries, under the stimulus of the Havana market, dated from the 19th century (Fig. 6.2). From the local fisheries described above, activity expanded along the north coast. Fish and shellfish were transported in live-well vessels from Matanzas, Cárdenas (1828)\(^2\), Isabela de Sagua (1844) and Caibarién (1832) to the east and from Mariel and Puerto Esperanza (1860) to the west. Expansion to the south coast had to await improved land transportation across the island. In 1801,

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1 Given the prevailing northeasterly winds which are often reinforced by afternoon sea breezes, it would be quite difficult for a small sailboat to beat back into the bay from the west at the end of the day.
2 The dates are those of foundation of the ports.
FIG. 6.2. Major Nineteenth Century Fishing Centres
Humboldt reported that "the roadstead of Batabanó is scarcely visited except by smugglers, or, as they are here politely called, 'the traders,' (los tratantes)" (Humboldt, 1895 (III): 181). Later in the century, however, when transportation was improved by the building of a railway from Havana and an ice supply was assured, first from Florida and, after 1880 from the capital itself, came the growth of Surgidero de Batabanó as a supply point for fish to the capital (Baisre, 1987, 263: 40). The foundation of Nueva Gerona (1828), Cienfuegos (1819) and Santa Cruz del Sur (1826) also date from the early part of the century (República de Cuba, 1985: 13-14). During the same period, before the construction of railroads, fish from the ports more distant from Havana supplied, not the national capital, but its provincial counterparts none of which was far from a coast.

6. 1. 2. 4 The sponge fishery. The second stimulus for exploitation of the marine resources of the shelf during the 19th century was the rising demand for sponges in Europe and North America. Before about mid-century this had been satisfied from the Mediterranean Sea. Production started in the Bahamas in 1849 (Firth, 1969: 667) and Bahamian fishermen subsequently began to fish on the Cuban northeast shelf between Caibarién and Nuevitas, initially clandestinely and then under licence from the colonial authorities (Johnson, 1920: 283).

Sponge fishing by Cubans, for export to Spain, Britain and France, began sometime thereafter and Caibarién had become a major centre by 1867 (Baisre, 1987, 263: 40). In 1867, 1 400 dozen sponges were landed in Nuevitas and 156 236 dozen in San Juan de los Remedios (Caibarién), both on the northeast shelf (Baisre, 1985b: 89). Sponge fishing subsequently expanded to the southwest shelf where, according to García Ramón (1970: 133), it was begun by Greek fishermen in 1850. Growth in this area was initially slow
(only 4 000 dozen were landed at Batabanó in 1867), but increased rapidly after
the end of the Ten Years War (Baisre 1985b: 89).

By the end of the century, Batabanó had become the principal sponge-
fishing centre in Cuba and one of the most important in the world. According to Clark (1899: 310), about 800 fishers were employed in a fleet of 5-20 ton sailboats each of which had 4 or 5 auxiliary row-boats from which sponges were taken by diving.

6. 1. 2. 5 Vessels and fishers. Sixty-two per cent of Cuban fishing vessels, as we have seen, were registered in Havana at mid-century. The remaining 38% or about 300 fishing vessels were registered as follows: 18% in Santiago; 7% in Trinidad; 7% in Remedios; and 5% in Nuevitas (García Arboleya, 1859: 333). The rather large percentage of vessels in Santiago, located on an almost shelfless coast is explained by the fact that the city was probably the port of registration for all of Oriente province which was much larger at that time and included all of the far south coast, part of the northeast coast and the south coast of the Gulf of Guacanayabo.

Numbers of fishermen grew slowly during the later colonial period. A mariners' registry, the Matricula de Mar was established in Spain at the beginning of the 16th century and extended to the Americas in 1776. The first compilation of the registry in Cuba, in 1777, recorded 1 252 "gente de mar", an unknown number of whom were fishermen, as well as 1 550 carpenters and shipwrights (Gómez de la Maza, 1957).

At mid-century, the relative significance of the fishery in the Cuban economy was reflected by the very small numbers of fishers in a total national population of more than one million. According to García de Arboleya (1859:

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1 The Census of 1899 records only 529 fishers in all of Havana province so Clark's figure is either wrong or must include a large number of unregistered fishers.
there was a total of 1,603 in the country in 1856-57, 803 of whom registered and 800 unregistered. The registered fishermen were distributed as follows: 41% were registered in Havana; 24.5% in Santiago de Cuba; 15.2% in Trinidad (situated between the southeast and southwest shelves); 13.6% in Remedios (western part of the northeast shelf); and 5.7% in Nuevitas (eastern part of the northeast shelf). The discrepancy between numbers of vessels (529) and numbers of registered fishermen (329) in Havana may indicate that a large number of the unregistered fishermen worked out of that port. Havana, then, had by far the largest concentration of fishermen at mid-century.

The Census of 1899 recorded only 2,325 fishermen in the country, of whom 1,546 (66.5%) were classified as "white natives", 461 (19.8%) as "white foreigners" and 318 (13.7%) as "coloured". Unfortunately, there is no way to tell whether these census figures refer to both registered and unregistered fishers or only to the former. It is, therefore, impossible to draw conclusions about the rate of growth in the labour force in the second half of the century. However, some comments about their geographical distribution may be made (Fig. 6.3). Clearly Havana province is still important in terms of numbers of fishers but, reflecting the growth in the sponge fishery, the most important centre of registration was Santa Clara, the capital of the province of the same name, where Caibarién is located.

6.2 THE CULTURAL BACKGROUND OF FISHERIES DEVELOPMENT

6.2.1 Fishers

As we saw in the last chapter, little of the aboriginal fishing tradition

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1 Only a national total is given for unregistered fishermen.
2 The Census gives a figure of 2,265 for total fishermen but summing individual classes (provincial, racial, etc.) gives a figure of 2,325. The latter figure was employed in the following calculations.
Fig. 6. 3. Fishers by Province: 1899
persisted into the colonial period in Cuba. Fisheries development in the 19th century, moreover, was driven by Spaniards rather than Creoles. Before discussing this, it is interesting to note that in the Census of 1899, only a small proportion of fishers (about 15%) were classified as "coloured," an indication that Cuba did not possess a slave fishing tradition. Such slaves were reported for the French and English Caribbean islands where their purpose was to supply fish for the master's table and only rarely to produce cheap food for the labour force (Price, 1966: 1370).

Clark (1899: 188), writing late in the 19th century states that the fishery "has been practically in hands of Spanish sailors who, earlier in life, served out their time in the navy." Baisre (1987, 263: 40) also indicates that this was the case: "It is supposed that, in this period, exploitation of the fisheries intensified as the population of fishermen from Mallorca (mallorquinos), the islands and other maritime regions of the Peninsula grew" (See also García Ramón, 1970: 133). Further support for the immigrant basis of the fishery is the existence in Cuba of gremios in the early part of the nineteenth century (Baisre, 1987, 263: 40; Gómez de la Maza, 1957). These were guilds or brotherhoods of fishermen which originated in Spain in the thirteenth century as "social-religious-economic organizations for the purpose of special religious devotion to a saint, as a form of mutual security for members and their families, and for the purpose of regulating the conditions under which fishing was to be carried on" (Foster, 1960: 83). Additional evidence of the immigrant background of Cuban fishermen in this period may be obtained from an examination of their vessels and fishing gear.

6. 2. 2 Vessels

Variants of the aboriginal dugout canoe (cayucos) were in use in the
nineteenth century but were replaced by small, flat-bottomed wooden rowboats (*chalanitas, cachuchas*) of Spanish design (Gómez de la Maza, 1952: 26) and later by sail-powered vessels (*bucetas, guairos, balandros* and *faluchos*) used for shelf fishing. Some of them contained live-wells (*viveros*).

According to Collins (1885: 221-222), the Havana small boat fleet was composed of small wooden boats which he described as being poor copies of the American dory from which, he thought, they were derived. The close connections which had existed between Key West fishers and Havana, discussed previously, would have provided the means for the diffusion of this boat design. Boats were flat-bottomed, single-masted, about 15 ft long, and powered by either oars or sails.

Collins also described another fleet made up of larger (24 ft in length with an 8 ft beam) vessels built in the Balearic Islands and brought to Cuba by merchant vessels. These vessels were two-masted and rigged with two lateen sails, the typical sails of the Mediterranean (Kemp, 1976: 467). They were used, according to Collins' informant, for net and seine fisheries. No more detail about their operations or the type of fish they caught is given. It can be conjectured that they were employed in fishing for estuarine-littoral species like mullets and sardines at the mouths of the Almendares and other rivers and in pocket bays along the coast and for demersal species during their spawning migrations.

6.2.3 Fishing Gear and Methods

There are few descriptions of fishing gear in the literature of 19th century Cuba. However, there is general agreement among observers of the fishery in the 1950s, that, as Salmon (1963: 22) has stated "The fishing tradition

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1 An illustration of the vessel can be found in Collins (1885).
is that of Spain in the seventeenth century."\(^1\) However, the great variety which had developed over long periods of time on the many and varied coasts of the Iberian peninsula were reduced in number and simplified in construction in the archipelago, as they were in the rest of the New World (Foster, 1960: 77-86).\(^2\) While it is unlikely that absolutely no changes in gear took place during the first half of the twentieth century, it does appear that Cuban fishers were sufficiently conservative that a comparison of 1950s fishing gear with that of the Spain of one hundred and fifty years earlier, based on the exhaustive survey undertaken by Sañez Reguarte (1791), will provide a fairly accurate description of the types of fishing gear employed on the insular shelf in the 19th century.\(^3\) Gear may be conveniently divided into several groups which will be examined in the following order: hook and line; net, trap and auxiliary.

6. 2. 3. 1 Hook and line fishing gear. Many types of hook and line gear (avíos de pesca) were used. The simplest, hand-held forms, consisting of one or several hooks attached by leaders to a cotton or hemp line, were used by poor fishers with small boats for day or night fishing. The tackle was either lowered to the bottom from a stationary boat to fish demersal species such as snappers and groupers (pesca a fondo) or trailed on, or close to, the surface behind a moving boat to catch pelagic species like the Scombroids. The Cuban term for the latter trolling operation (al curricán) is of Andalusian derivation (Sañás Reguarte, 1791, II: 168).

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1 The only exceptions to this conclusion were the shrimp-trawl fishery and the small tuna pole-and-line fishery.
2 This reduction and simplification in fishing gear and practices may also be demonstrated for other culture traits in the New World. See Foster (1960); Harris (1977); Butzer (1992).
3 Ideally, these descriptions and comparisons of fishing gear would have been accompanied by visual evidence. However, the only available copy of Sañez Reguarte was on microfilm so that the drawings contained therein were not reproducable in a satisfactory manner. A similar problem was encountered with drawings and photographs of Cuban fishing gear of the 1950s.
A more complicated line for bottom fishing was the balance line (von Brandt, 1984: 80) called el chambel in Cuba (for an illustration, see Suárez Caabro, 1955: 50). Essentially it was composed of a vertical, weighted line from which were suspended, in various configurations, metal or wooden spreaders (penoles) to which were attached leaders and hooks. The tackle was named according to the number and arrangement of spreaders: la ballestilla (the general name given to this type of tackle in Spain [Sañas Reguart, 1791, I: 240]) had only one spreader; la ballesta had a long, thick one; el chambel doble had two spreaders; and a cruceta had two crossed spreaders. All lines were pulled by hand.

Longlines (palangres, espineles) were in common use in Spain in the 18th century (Sañas Reguart, 1791, IV: 297). According to Suárez Caabro (1955: 64), they were known in Cuba but "had only limited use." They may, consequently, be a later introduction. Drifting longlines were employed for pelagic fishing of large fish such as the billfishes and shark in the oceanic waters complex. Bottom longlines were used for demersal species, such as yellowtail snapper and groupers along the shelf edge. Both types consisted of a main or mother line (madre) either suspended at various depths from buoys or fixed to the bottom by anchors. Numerous hooks were attached to it by means of leaders (brazolados), the number and length of which varied depending on the fishery. The mother line with attached leaders was laid out in circular baskets on board the fishing vessel.

6. 2. 3. 2 Nets. The great diversity of mesh gear employed in Spain (Sañas Reguart, 1791) was reduced in Cuba to three principal types: the castnet (atarraya); the pocket, haul or beach seine (chinchorro); and the gillnet (trasmallo). The castnet, widely used all over the world, was introduced into the Mediterranean by the Greeks but may have originated in India (Brandt,
The Spanish variant was the *esparavel*, or *atarraya* (Sañas Reguart, 1791, II: 143). It is a circular net with a radius of up to 10 m. In Cuba, a simple version, (*atarraya de seno*) was used in shallow waters. In the more complex *atarraya de brioles*, several lines are connected to the weighted outside edge of the net and pass through a metal or cane ring at the centre (for an illustration, see Suárez Caabro, 1955: 76). The net, still in occasional use, is cast from the shore or a boat to fall flat on the surface of the water from where it sinks to cover the prey. Pulling on the central cord produces pockets from which fish cannot escape. According to Sánchez Roig and Gómez de la Maza (1952: 96), mesh sizes varied depending on the size of the fish being caught. These nets were used to fish in the estuarine-littoral zone for anchovies, sardines and other bait fish. However, they were also employed for fishing juvenile shrimp. By its nature, the castnet is not a very efficient gear but it was relatively inexpensive and could be operated by a single fisherman and, as a result, was widely distributed.

The second major type of net introduced to Cuba during the Colonial period was the *chinchorro* (for an illustration, see Suárez Caabro, 1955: 79). Finding a precise translation for this term is rather difficult because the net existed in great variety some of which were operated like a seine (not a purse seine: Brandt, 1984: 284) while the operations of others had the attributes of trawl nets.¹ The name is Spanish (Sañas Reg uart, 1791, II: 287) but nets of this type were also known in various regions of the Iberian peninsula by names such as as *jabega, bouet, boliche, labada pequeña*, and others. The best English translation is probably beach-, drag- or haul-seine.

The net consisted essentially of a cylindrical bag (*copo*) to which two

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¹ One Cuban informant confidently called it a seine net, another, equally confidently, called it a trawl net.
wings (bandas) with cork and lead lines to keep them vertical in the water, were attached (Sánchez Roig and Gómez de la Maza, 1952: 93; Suárez Caabro 1955: 79). Different parts of the net were constructed using different-sized mesh with the smallest mesh being in the bag. Suárez Caabro (1955: 81) described three types: chinchorro de copo, chinchorro de seno and chinchorro de volapié (bolapié). In Cuba they varied in length from 80-350 fathoms in length with a depth of 2-3 fathoms.

Nets could be set in various ways. The variant known as a beach seine is one of the oldest types of net gear in the world (Brandt, 1984: 289). In setting it, one end was fixed to the shore or held there by one or more fishermen, the other was taken out by a small boat (cachucha or chalana) which rowed in an arc and returned to the beach encircling, in the process, a school of fish. Both ends of the net were then brought together, the fishermen agitated the water with feet or hands to frighten the fish into the bag and the net was hauled towards the shore, and the fish were landed on the beach. In Spain, nine or ten men were required for each set.

Such nets could also be set in deeper water from boats. In the 1950s, in Puerto Esperanza on the northwest shelf, nets were from 100-150 fathoms long and were generally set close, or even attached, to the shore (Suárez Caabro, 1955: 79-80). The typical vessel used was a live-well sloop and one or two flat-bottomed rowboats. The crew of 12 men included a master who directed the operations of the boat and the net, a retriever (recorredor) who was responsible for keeping the net free from bottom obstructions, 8 haulers (beteros) who haul the net and 2 divers to free the net if it became caught. When the net was almost closed around a school of fish, the two divers swam inside and agitated the water to frighten the fish into the bag. The net was emptied into one of the rowboats which immediately took the catch to the
mother boat into the live-well of which the catch was transferred using a dip net. If the net was set far from shore, it was closed and "dried-up" directly to the mother boat. Certainly, there is no technology in this description which could not have existed in the 19th century. Small haul seines were employed in fishing for bait in the estuarine-littoral complex. Larger ones were employed during the spawning migrations of fish like mullets.

The third major type of net, the *trasmallo* or trammel net (Brandt, 1984: 374), was an entangling net. In other parts of the world, including Spain, it consisted of three panels of mesh. However, in Cuba the term was employed for entangling nets with one (properly called a gillnet), two and three panels (Sánchez Roig and Gómez de la Maza, 1952: 94). Nets of this type possess a floating cork line and a relatively heavy lead line and are hung vertically in the water usually across the paths of migrating fish (For an illustration, see Suárez Caabro, 1955: 84). The size of the mesh varies with the size of the desired prey. Small fish may pass through the net but larger ones, in trying to pass through, become entangled in the gills or fins. The addition of one or two panels with different sized mesh to the single-pannelled gillnet increased it entangling power.

The nets were better used at night when fish could not see the mesh. They could be set: across channels between keys to intercept migrating fish such as mullet and yellowtail snapper during spawning migrations (*red fija* or *red de través*); on the seabed (*trasmallo de fondo*); at the surface to catch flying fish (*trasmallo del aire*) or could be used to surround schools of fish before entangling them as in the mullet fishery (*red de corso*) (Suárez Caabro, 1955: 82) or as drift nets between two boats (*red volante*). In deeper waters, they were used to catch sharks and turtles. Trammel nets were not as commonly used in Cuba as were haul seines.
6.2.3.3 Traps. Fish traps are in widespread use throughout the world (Brandt, 1984: 174). There is some question about the origin of the various types (*nasas* or *trampas*) in use in Cuba in the 1950s. In his discussion of the Spanish origins of American fishing gear, Foster (1960) makes no mention of traps, implying, by omission, that they originated elsewhere. Some authors (Baisre 1987, 263: 41) consider that their origin lies in Africa from whence they were brought to Cuba by slaves. An alternative hypothesis, that they were brought to the Americas by the Portuguese from India and Sri Lanka via Madeira and Brazil, and thence to the Caribbean, is mentioned by Price (1966: 1374) and Brandt (1984: 179). Some support for this position lies in the rather strikingly similar shapes of the Madeira and Antillean traps (Brandt, 1984: 179, Fig. 319; Suárez Caabro, 1959: 91).

However, Sañas Reguart's dictionary (1791) contains many pages of descriptions of various types of traps in use in Peninsular waters in the eighteenth century. It seems reasonable to assume, therefore, that some, at least, of the types of traps in use in Cuba came to the archipelago as part of the repertoire of Spanish fishing techniques. The Spanish origin of some Cuban traps is indicated by the similarity in the shape of those described in the dictionary and those in use in Cuba. Suárez Caabro (1955: 91) described them as being almost always cylindrical with a conical entrance (*matadero*) at one end, through which the fish or crustacean entered. Traps were pulled by means of a line attached to a buoy. This description and an accompanying photograph (Suárez Caabro, 1955: 93) of a lane snapper trap are almost identical to a drawing in Sañas Reguart (1791, III, Lam XXIX, facing 198).

In addition to the types of gear described above, Cuban fishers had access to a large variety of less important fishing equipment including various types of harpoons, tridents, squid jigs, octopus lures, machetes, fish pikes, dip
6.3 SCIENTIFIC RESEARCH AND REGULATION OF THE FISHERY

Expansion of the fishery in the late eighteenth and early nineteenth centuries led to the first scientific attempts in Cuba to catalogue marine resources beginning with the work of Parra (1787) who was followed by Poey and Vilaró in the nineteenth century (Baisre, 1987, 263: 41). Scientific cruises also occurred in the 1880s (García Cañizares, 1919: 5).

The colonial government made the first steps toward regulation of the fishery and protection of resources during the second half of the nineteenth century. According to Sánchez Roig and Gómez de la Maza (1942: 15), however, the first colonial regulations were fairly direct transfers of Peninsular ones which often had little relevance to the Cuban situation. The oldest fishery regulations found by this author, dealing with molluscs and crustaceans, appear to support this contention. They were put into effect in Cuba in August, 1886 by the Central Fisheries Commission of the Apostadero of Havana (Apostadero de La Habana, 1907). These regulations established marine resources as being open to public use under the authority of the government. They also declared closed areas (nursery zones and areas subject to pollution), closed seasons and gear restrictions. In addition, they attempted to promote cultivation of oysters by private individuals. Closed periods were also specified for crustaceans such as lobster and shrimp (Vilaró, 1890). The introduction of such regulations may, indeed, simply be the result of bureaucratic transfer from the Peninsula but the creation, in 1886, of the Provisional Fisheries Commission (Comisión Temporal de Pesca) whose members included some Cuban naturalists, (Sánchez Roig and Gómez de la Maza, 1942: 15), may indicate an attempt to deal with the effects of the
intensification of fishing, especially around Havana.

### 6.4 HUMAN IMPACT ON MARINE LIFE

The impact of human activity on the resources of the various ecological complexes is rather difficult to evaluate for this time period given the scarcity of historical documentation. However, it seems likely that resources of the estuarine-littoral zone, being the most accessible, would have suffered the major impact. We have already seen that the manatee was already scarce in the mid-nineteenth century. Also the fact that the earliest fisheries regulations deal with shellfish of this complex may be an indication of concern for their numbers, especially in the areas supplying the Havana market. Havana Bay was thoroughly polluted and other pocket bays, subject to urban waste and discharges from sugar refineries, were probably also affected.

The fishery at the end of the colonial period could in no way be said to be an important economic activity. It employed only about 2,000 fishermen and an unknown number of shoreworkers. However, the roots of its development for the next half-century had been established. Baisre (1987, 263: 41) has described the fishery at this time as "artisanal and subsistent." Of the first, there is little doubt: vessels were of wood construction and powered by oar or sail, handlines, pole lines, longlines and nets were all set and hauled without the aid of auxiliary power of any kind. The subsistence nature of the fishery is more doubtful. It has been shown here that the rural population had little interest in eating the food from local seas, although a complete absence of subsistence fishermen during this period, while impossible to establish, is difficult to believe. Certainly, in the latter part of the century,
social and economic disruption consequent upon the Wars of Independence provided sufficient incentives for people living on or near the coast to supplement their diet with marine species.¹

However, it is clear that fishery development in Cuba during the late colonial period was stimulated on the one hand by international (and domestic) demand for sponges and on the other by the demand, from the urban-based upper classes, for luxury food. Thus, I must disagree with Baisre (1987, 264: 36) who considered that it was only in the 1930s that Cuban fisheries began to become market-oriented.

It is also clear that the resurgence of fishing in the archipelago had drawn little, if anything, from its aboriginal predecessor. The fishery was Spanish: fishermen were from the Canaries, Mallorca and other coastal areas of the Iberian peninsula and may also have been retirees from the Spanish navy; some vessel designs were of Spanish origin and so was fishing gear, albeit simplified and in less variety than in its peninsular hearth. As far as published records are concerned, the major fishery areas within the archipelago were the northeast and southwest shelves while Cuban fishermen had also extended their operations to the Dry Tortugas, Florida and the Campeche Bank.

The following chapter will examine the growth of fisheries during the period after the War of Independence until the "Triumph of the Revolution" in 1959, the period of the Republic or "Pseudo-Republic" as it is called by post-revolutionary writers.

¹ Thomas (1971: 285) reports that the number of cattle only increased by 100% (from one to two million) between 1827 and 1894 and that the number of pigs decreased by 50% in the same period while population rose four times.
CHAPTER 7

THE REPUBLIC 1902-1945: MODERN FOUNDATIONS

After a devastating war lasting from 1895 to 1898, in which 300,000 Spaniards and Cubans died, Cuba obtained its independence from Spain and, after three years of occupation by American forces, became a republic (or "pseudo-republic" as post-revolutionary writers have it) in 1902. American influence remained strong and large investments were made in the modernization of roads, railways, ports and other infrastructural elements. The United States became the major market for Cuban sugar. Production expanded, especially during World War I, bringing foreign investment, work and such prosperity (at least to some) that it came to be known as the "Dance of the Millions". It ended abruptly in 1920 with a crash in world sugar prices and "For the rest of the 1920s, sugar history is an unedifying tale of decline and squabble for cash" (Thomas 1971: 557). The decline of the 1920s was followed by world recession in the 1930s. It was not until World War II that the Cuban economy recovered.

7.1 POPULATION

After its long period of slow growth during the Colonial Period, population began to grow rapidly at the turn of the century (Fig. 7.1a), as a

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1 The country in the early part of the century was described in the following way: "This republic is not a creature of Cubans - it was neither fashioned by them nor by them influenced - but on the contrary it is of all-American manufacture. Americans built it. Americans set it up again when it fell flat. American influence is all that sustains it to this moment. If they discover anything to criticise in it, or its failure, let Americans remember in so criticising that they are dealing with the work of their own hands." (Wright, 1910: 152-3) quoted in Thomas, 1971: 501.

2 The source for Fig. 7.1 was Schroeder (1982: 42; 111)
Fig. 7.1. Population Characteristics
result of the eradication of yellow fever, general improvement in sanitary conditions, and immigration (Fig. 7.1b). Two hundred thousand Spaniards, mostly from Galicia and Asturias, emigrated to the country between 1902 and 1910 (Thomas, 1971: 497) and formed the backbone of the mercantile class in the cities and in the countryside. Immigration peaked in 1920, dropped to a lower level during the remainder of the decade and slowed to a trickle during the Depression and World War II.

In 1899, just over half of the population of the new republic lived in the west, especially in the provinces of Havana and Matanzas (40%; Fig. 7.1c). Havana retained its supremacy in the urban hierarchy with a population which exceeded 300,000 in the first decade of the century (Thomas, 1971: 497). However, expansion to the east, which had begun with the final disappearance of slavery in the 1880s, continued into the 20th century. As a result, the proportion of the population in the province of Oriente increased from 21% in 1899 to 28% in 1950. In the same period, the population in Havana province decreased slightly from 27% to 25% of the national total.

7.2 FISHERIES DEVELOPMENT: 1902-1927

Fishery catch statistics were not kept on a systematic basis until 1935, and reports are scarce so it is not easy to assess the trajectory of fisheries development in the Republic in the first two decades of its existence. It is clear, however, that the introduction of the protectionist Customs-Tariff Law in 1927 had a profound impact on fisheries development so that the pre-World War II development may be conveniently divided into two periods, one before and one after, that date.

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1 When Cuba became a Republic, the provinces of Puerto Príncipe and Santiago de Cuba were renamed Camagüey and Oriente, respectively, and in 1940, the province of Las Villas was renamed Santa Clara (Schroeder, 1982: 42).
Data on the numbers of fishers recorded in various censuses (República de Cuba, 1899, 1908, 1919) may act as a surrogate measure of development. They suggest an industry in decline in the first two decades of the century (Fig. 7.2).¹ From a high of 2,262 in 1899, the total dropped to 1,693 in 1908, to 1,587 in 1919 and, according to Canet (1955), 1,500 in 1931.² The sustained decrease in the fishing labour force may have been, at least until the 1920s, a result of better opportunities in other economic sectors, especially in the sugar industry (Canet, 1955).

The distribution of fishers showed some changes during this period. Between 1899 and 1908 the province of Las Villas, which includes Caibarién on the northeast shelf, showed a relative and absolute decrease in numbers of fishers (from 31% to 20% of the national total; 716 fishers to 339 fishers) while the provinces of Havana and Oriente showed relative increases (Figs. 7.2). The largest concentration of fishers (29% of the national total) were located in the province of Havana. However, in the following decade, the number of fishers in Las Villas, under the stimulus of growth in the sponge fishery, more than doubled (339 to 683, 43% of the national total).

In spite of the apparent decline in the fishery, national governments began to pay some sporadic attention to it in the early part of the century. In 1911, a National Fishing Council (Junta Nacional de Pesca) was established as a department of the Office of the Secretary of Agriculture, Commerce and Labour (Secretaría de Agricultura, Comercio y Trabajo).³ It was moved several years later to the jurisdiction of the Navy but returned to the Ministry of Agriculture in 1941 (Sánchez Roig and Gómez de la Maza,

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¹ The sources for Fig. 7.2 were: República de Cuba (1899, 1908, 1919, 1943); Canet (1955); and Fiedler (1946).
² It is not clear whether Cuban Censuses counted only registered fishers or whether they also included others, such as sugar- or dock-workers, who fished on a part-time or casual basis.
³ Decree 378 of 17 May, 1911.
Fig. 7.2. Fishers: 1899-1946
1952: 22). The membership of the Council, under the presidency of the Secretary of Agriculture, was a mixture of bureaucrats, scientists, industry representatives and fishers.¹

Among its tasks, the Council was to have responsibility for all aspects of the fishery in Cuban jurisdical waters and was also to dictate regulations for the exploitation of marine resources beginning with the compilation and publication of already-existing regulations. It would name delegates in each of the fishing ports of the country who would report infractions of fisheries regulations, submit a monthly statistical report, furnish data requested of them and propose any modifications that might benefit the fishery.² It would also appoint a number of fishermen as inspectors with the power to impose fines for infractions of regulations. A proposed fisheries museum and library were to be under the responsibility of the natural scientist members of the Board.

In the operations of the Council, some of the members, it seems, had more power than others. García Cañizares (1919: 13) described the contribution of the representatives of fishermen and processors from Batabanó to its operations: "They only whined for the indefinite maintenance of the unjustified privileges that they enjoy at the expense of all other Cuban fishermen and of the industry that they exploit." They had, he added, "captured the local authorities among their nets, just as in colonial times" (1919: 15). As a result of their "intransigence," (García Cañizares, 1919: 8) a general fisheries law, prepared by García Cañizares (1919: 12) in 1912, was

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¹ Membership: Secretary of Agriculture, Commerce and Work as President; the Captain of the port of Havana; two professors (catedráticos titulares) of Natural History or Zoology; a member of the Natural Science section of the Academy of Sciences; two representatives from the fishing industry; a fisherman; and the Chief of the Department of Agriculture of the Secretary of Agriculture, Commerce and Work, as Secretary.

² According to Salmon (1963: 33), this system formed the basis of the collection of fishery statistics from 1935 to 1955.
not put into effect.

That the balance of power did not change in the ensuing decades, is indicated by Planas (1933) who was appointed to the Board in 1927 and found that there were no scientists on it and that, "All of the members were rich sports fishermen." As a result, there is little evidence that the Council had any success in achieving its aim of promoting the "prudent and scientific protection of the fishing industry" (García Cañizares, 1919: 17) in the first two decades of its existence, but it did provide the legal and administrative framework within which fisheries regulations developed in the 1930s.

Further evidence of the power of Batabanó "fishermen" and of the impact of the Havana market, is demonstrated by what may be the first indication in the history of human occupation of the archipelago of the effects of pressure on fish (as opposed to marine mammal and reptilian) stocks. García Cañizares (1919: 55) was commissioned in 1908 to make a report on the problems of the lane snapper fishery in the Gulf of Batabanó. This demersal species of the coral reef-seagrass complex, in great demand in the capital, undertakes an annual spawning migration from April to June during which the fish move from the inner shelf to waters on the shelf edge in the vicinity of the Los Indios and San Felipe keys in the west and the Diego Pérez keys in the east. In the early part of the century, they were partially protected, during this period of spatial concentration, by a closed season from 20 April to 30 May and by a minimum legal size of 4 fish per pound.

In spite of what seems to be a rather small legal minimum size García Cañizares (1919: 59) found that even smaller lane snapper (less than 3 ounces in weight) were being sold in the market and that, in addition, the Batabanó "fishermen" were applying pressure for the minimum legal size to be further

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1 The "fishermen" referred to were probably vessel owners.
reduced to five fish per pound. The same author notes that lane snapper 33 ounces in weight and measuring 10-12 cm, were commonly caught in 1891. There is strong evidence, then, that growth overfishing was already occurring in these stocks in the early part of the century.¹

As far as can be ascertained from available materials, then, the first two decades of the century saw a fishing industry in general decline but one in which selective fishing pressure may have had a negative impact on some stocks which were favoured in the market. Government action with respect to the fishery, in general, was ineffectual.

7.3 FISHERIES DEVELOPMENT: 1928-1945

Cuban fisheries experienced a resumption in growth during the 1930s. The major impetus seems to have been the enactment by the Machado government, in 1927, of the Customs-Tariff Law, "arguably one of the most important pieces of economic legislation of the early republic" (Pérez, 1988: 250). The law was not directed specifically at the fishing industry but had the aim of promoting the expansion of Cuban industry and agriculture in general by decreasing import duties on fuel, raw materials and machinery and by increasing tariffs on the import of manufactured goods, including canned food. This protection provided a stimulus to the processing sector of the fishing industry and resulted in the first Cuban fish canneries being built in the 1930s (Martinez, 1948: 7; Baisre, 1987, 264: 36).

The 1930s also marked the successful passage of the General Fishery Law (Ley General de Pesca y Reglamento para su Ejecución) (República de Cuba, 1939) which covered all aspects of extractive, processing and marketing

¹ Modern regulations with respect to this species specify a closed period from 1 April until 30 June and a minimum legal size of 18 cm length (MIP. Dirección de Regulaciones Pesqueras, 1990: 16).
sectors of the fishery, and formed the basis for all subsequent fisheries legislation until 1981.\(^1\) The 89 articles of the Law established state ownership of all fluvial and marine fauna, as well as Cuban jurisdiction in waters up to three nautical miles from the coast. In addition, it provided for the regulation of fishing gear, marine and freshwater pollution and protection of species and the environment, as well as providing penalties for infractions. It also attempted to regularize the fishery by making mandatory the registration and licencing of fishermen, vessels and processors. Enforcement of the regulations was the responsibility of the coast guard service of the Cuban navy (\textit{Marina de Guerra}) to which all fishery related matters had been transferred, from the Ministry of Agriculture, in 1934.\(^2\)

The General Fishery Law has been criticized by later Cuban writers for its lack of scientific basis. According to Buesa (1992) and Baisre (1987, 264: 36), it was mainly constructed by two naturalists (Sánchez Roig and Gómez de la Maza) and many of the regulations were drawn from the experience of fishers and fishery officials or were copied from American regulations. The result, was that the biological bases of some regulations, such as minimum sizes and lengths of closed periods, were subsequently found to without scientific foundation (Buesa, 1992).

The degree to which regulations were observed is difficult to evaluate. That infractions occurred is certain. Buesa (1992) referred to nets being burned by the Coast Guard as punishment, and to the practice of lobster fishers continuing to fish during the closed period and storing their catch in hidden corrals to be sold immediately after its end.\(^3\) The end of the lobster closed season brought on a glut of the animals in the market and, consequently, low

\(^1\) Decree-Law No. 704, 1936, put into effect by Decree No. 973, 1939.
\(^2\) Decree-Law No. 108, Jan 8 1934.
\(^3\) The use of haul seines was prohibited in nursery areas close to the coast.
prices. As a consequence, the only way that fishers could hope to obtain an adequate return was to deliver large quantities of lobster immediately after the end of the closure. The result was that the fishery was subject to the type of time interception externality described in Chapter 2, as fishing progressively extended further and further into the closed period. The Law also prohibited fishing with explosives because, according to its preamble, many stocks were being exhausted by this practice. However, a condemnatory article in the fishing journal _Mar y Pesca_ in 1957 (Sánchez Roig, 1957: 5) indicates that the prohibition was not completely successful. It is not possible to assess to what extent such illegal practices went on, but it is likely, given the length of the Cuban coastline, the remoteness of many fishing settlements and fairly widespread corruption in enforcement agencies, that they were fairly common.

Post-revolutionary observers (Baisre, 1987, 264; Pérez Puentes, 1986: 32) have contended that, while the Fisheries Law provided theoretical protection for the marine environment and its resources, it was, in reality, conceived to protect the interests of the dominant classes. It was reported in 1943 (Ojeda Cintra, 1943: 96) that the National Fishery Council, "heeding innumerable petitions from fishermen" suspended closed periods for all mullet species and for Nassau grouper and was considering a similar suspension for lobster and other crustaceans. It seems, therefore that it was not necessary for powerful outfitters or fishers to break the law. They could simply apply pressure to have regulations changed or suspended. Little seems to have been done, in addition, to enforce the prohibition on the emission of industrial wastes, especially from sugar refineries, into coastal waters.
7.3.1 Fisheries Research

Basic fisheries research does not seem to have been regarded as important during the pre-war period. For example, Planas noted that one of the members of the National Fisheries Council, General Molinet, a fisherman who later became the Minister of Agriculture "could not see the relationship between oceanography and fishing" (1933: 54). During this period, therefore, fisheries research was conducted by only a small number of individuals who were members of university faculties (University of Havana, the University of Villanueva, University of St. Tomás de Aquino), worked for the National Fisheries Council (Dr. Mario Sánchez Roig and Sr. Federico Gómez de la Maza) or were amateurs such as Miguel L. Jaume, a bank manager with an interest in molluscs (Buesa, 1992). The bias of research was toward biology and it was only in the 1950s that topics such as fishing methods and the socio-economic conditions of fishermen and their families were subject to investigation.

7.3.2 The Catch

Statistics on the quantity and value of landings, by species, began to be collected in 1935. The relationship between these registered landings and the actual catch by Cuban fishing fleets, as is true in most countries, is somewhat problematical. Several points are worth noting. Firstly, some landings (e.g. lobster, oyster, stone crab) are given, not by weight but by dozens of animals. Conversion factors must, therefore, be employed to give an approximation of the weight of landings. Secondly, the sponge catch is not included. Thirdly, while a "boom" in the shark fishery is reported as occurring during World

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1 Cumulative statistics for the period were published in República de Cuba (1952, 1955).
2 Here, the following conversion factors were used: lobster = 1 lb; oyster = 0.5 oz (Frias, MIP oyster specialist, 1994, reported by Pérez, 1994); stone crab = 0.5 lb.
War II (Baisre, 1987, 264: 36; Martinez, 1947b), the official statistics show a decrease in the catch of shark species during this period. A possible explanation is that shark landings statistics may refer to weight of products, such as skins, fins, etc., rather than the total catch. These statistics, therefore, must be treated with caution but while totals for individual species or years may be suspect, it is likely that trends over time give a fairly accurate picture of the development of fisheries.

Total landings increased from 1935 to a maximum of 8 621 mt in 1937 before decreasing slightly, but still remaining above 8 000 mt for several years. However, the onset of World War II and the danger of submarine warfare in adjacent waters, caused a precipitous decline in landings which reached a minimum of 4 755.8mt in 1942 from which time growth resumed (Fig. 7.3). During this decade, a significant proportion of the catch came from the Campeche Bank (Fig. 7.4). However, wartime curtailment of fisheries had a more severe impact on these distant water fisheries and their proportion of the total catch decreased from 39% in 1935 to 19% in 1945 (Figs. 7.4). Loss of the fish supply from the Campeche Bank resulted in intensification of the fishery on the insular shelf which showed increases in landings in the years after 1942, aided by the lifting of the closed period on mullets and groupers mentioned above.

Landings from the shelf during this period were made up overwhelmingly of fish (over 80%) although crustaceans (especially lobster) showed an increase from 8% to 14% of the total, a trend which was to continue in the post-war period (Fig. 7.5). The greater proportion (an average of 61%) of these landings came from species of the coral reef-seagrass complex

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1 The sources for Figs. 7.3, 7.4 and 7.5 were: República de Cuba (1952, 1955); and Suárez Caabro and Duarte Bello (1961).
Fig. 7.3. Total National Landings: 1935-1955
and this proportion showed an increase during this period, a result partially of an increase in the lobster catch and partially of intensification of the snapper and grouper fisheries to replace the catch lost from the Campeche Bank. Catches from the estuarine-littoral zone showed a corresponding relative decrease and those from the oceanic complex remained insignificant, although it must be remembered that official statistics underestimate the size of the shark catch. From these statistics it is not possible to determine the geographical distribution of the catch within the insular shelf but it seems that the food fishery was still the major fishery and Havana the major market, so that those shelf areas closest to the capital must have continued to be exploited.

Overall growth in the industry during the 1930s and 1940s was further reflected in the number of fishers which increased from an estimated low of 1 500 in 1931 (Canet, 1955) to 3 435 in 1943 (República de Cuba, 1943) and to 7 993 in 1946 (Fiedler, 1947). This apparent doubling of the number of fishers in only 3 years seems rather a large increase but may indeed have occurred under the stimulus of wartime demand which, as we have seen led to increases in landings from the shelf after 1942.

In 1943, almost half of all fishers in the country were located in the province of Havana and two-thirds were in the westernmost three provinces (Fig. 7.6). This western bias was also apparent in landings in the mid-1930s which showed that, as in the past, Havana was by far the major fishing port in the country, accounting for 48% of all landings (including the catch from outside of Cuban waters). Caibarién, on the northeast shelf, with only about 8% of the total catch was second in importance. Landings in other ports were smaller, serving local markets and provincial capitals.

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1 The source for Fig. 7.6 was República de Cuba (1943).
Fig. 7.6. Fishers by Province: 1943
7.3.3 Consumption

Colonial consumption patterns persisted very strongly into this period. In the 1935-1939 period, on average, Cuba imported 12 471.1 mt of seafood per annum with a value of $1 553 334. In terms of quantity, this was almost 20 times greater than seafood exports, in terms of value, 2.2 times greater (Truslow, 1951: 915, 916, 921, 922). Thus, large quantities of cheap fish were imported while small quantities of higher value products, especially sponges, lobster and crab were exported (Figs. 7.7; 7.8). Dried fish, overwhelmingly cod, made up 62% of imports and canned sardines an additional 24% by value.

Havana was still the largest single market for marine products in the country. Fresh fish, almost 50% of which came from Gulf of Mexico fisheries, made up by far the largest proportion but oyster, shrimp, crab and lobster were also consumed. About 40% of total national production was directed to the capital (Martinez, 1948: 48). Fresh products were also consumed, in much lesser amounts, in provincial capitals. As in the colonial period, imported fish were still directed toward the countryside with cod and stockfish being the most popular (60% of imports for the period 1937-1941) followed by canned sardines (25%) and many other salted, dried and canned products. However, the sources of cod had changed. Before the war, Spain had been replaced as the supplier by Norway, Iceland, the United Kingdom and Newfoundland, but Cuba was cut off from the European countries during the war and Canada became the main source. Sardines were supplied by various Latin American countries, Spain, Portugal and the United States. For the period 1937-1941, before patterns were disrupted by the war, Cuba continued to import more marine products (10 302 mt) than it produced (7 859 mt).

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1 The Cuban peso and the United States dollar are both represented by the $ sign. Here, $ will refer to the peso and the dollar will be designated US $.
2 The source for Figs. 7.7 and 7.8 was Truslow (1951: 915-916; 922).
Fig. 77. Imports: 1935-1939
Fig. 7.8. Exports: 1935-1939

a. Mean Annual Quantity

Mean Annual Quantity, 1935-1939: 638 mt

b. Mean Annual Value

Mean Annual Value, 1935-1939: $686,640

- Fresh Fish
- Lobster and Crab
- Frog Legs
- Sponges
7.3.4 Fisheries

This period marked the expansion of the fishery into the oceanic complex with the intensification of the shark fishery during World War II and with the origin in the 1930s, of the fishery for small tunas. At the same time, exploitation of the coral reef-seagrass complex intensified with growth in the lobster and sponge fisheries during the 1930s. All of these fisheries have continued to the present, often with little change in fishing gear and methods. Their characteristics during this early period in their development are, therefore, worth examining.

7.3.4.1 Lobster fishery. Little mention of a lobster fishery can be found in the Cuban historical record during the nineteenth and early twentieth centuries. It is likely that, as in the Florida Keys (Labinsky, Gregory and Conti, 1980: 29), it originated as a bait fishery in support of scale fisheries which, as we have seen, began to experience some development in Cuba after 1868.

The fishery probably began on the northeast and northwest shelves to provide bait for the scale fisheries supplying the capital. Given the close connections that existed between Cuba and the United States during the late-nineteenth and early-twentieth century, it may be surmised that the gear used was similar to that in Florida where fishing was done with castnets, gillnets, haul seines and 2- or 3-tined spears called "grains" in Florida, *bicharra* or *pincharra* in Cuba (Labinsky, Gregory and Conti, 1980: 30; Sánchez Roig and Gómez de la Maza, 1952: 92), all of which were included in Cuban-Spanish fishing gear.

The development of a food fishery for lobster in Florida occurred after the building in 1912 of the Overseas Railroad which provided transportation for exports to northern cities (Labinsky, Gregory and Conti, 1980: 30). Given the intensification of relations between the newly-independent Cuba and the
United States in the post-War of Independence period along with the economic stimulus provided by World War I and the expansion of sugar production, it may be supposed that the idea of lobster as a luxury food item spread to Cuba during that period. Buesa (1962: 23) reports that lobster prices to fishermen in the 1920s were so low that intensive fishing occurred only during the autuminal (winter) migrations of November to January. During the remainder of the year, lobsters were only fished for bait to be used in the mutton snapper trap fishery.

The commercial fishery for lobster appears, like other fisheries, to have received a stimulus from the 1927 Customs-Tariff Law. As noted previously, since landings were given in dozens of animals, it is impossible to be precise about the total quantity of the catch. In addition, Martinez (1948: 6) noted that landings were not available from all regions of the country and that fishers did not report their total catches. However, it is probable that the catch averaged somewhere between 500 and 600mt and that the fishery grew, albeit slowly, in the pre-war period.¹ Landings decreased during World War II but recovered to pre-war levels after 1942.

Lobsters are found throughout the Cuban archipelago but their abundance is greatest on the southwest shelf, followed by the northwest and northeast ones. They are less common on the southeast shelf where fluvial influence is much higher. The distribution of fishing centres in 1944 (Martinez, 1948: 18) reflects both variations in natural abundance and proximity to the Havana market and port, through which exports took place (Fig. 7.9).² Ninety-three per cent of production in 1944 originated from ports on the southwest shelf with La Coloma alone accounting for 51% of the

¹ Florida's spiny lobster fishery averaged 775 t/ann during the same period.
² The source for Fig. 7.9 was Martinez (1948: 18).
FIG. 7.9. Lobster Fishing Ports 1944
national total, a reflection probably of the spatial distribution of lobster populations within the Gulf of Batabanó. Recent studies (Páez, Revilla and Baisre, 1991) indicate that the western part of the Gulf has greater abundance of the species as a result of a combination of factors: higher biomass of seagrass (especially *Thalassia testudinum*) and associated zoobenthos, a larger area of limstone and sandy-muddy bottoms, and greater interchange with open ocean waters.

Fishing gear changed during this period. The bully net (*chapingorro*), possibly introduced from Florida where it began to be used in the 1920s (Labinsky, Gregory and Conti, 1980: 30), became the most common catching method. The bully net consists of a mesh bag attached to a circular metal hoop which is fixed to the end of a long wooden pole. It was used with a subsidiary tool, the pincho (*tarentín* in Caibarién), a thin, metallic rod attached to another long wooden pole. The fisher stood in the bow of a small boat with his knees resting against the bulwark, leaned over and searched for lobsters or lobster refuges with the aid of a glass-bottomed bucket (*vidrio*). The *pincho* was introduced into likely holes and, when the lobster emerged, it was caught in the bully net and scooped into the boat and, eventually delivered to the mother vessel where it was kept alive in the live-well, through which sea water circulated, until delivery to port. Four to seven fishers formed the crew of a live-well mother ship, powered by sail, which took them and their one-man auxiliary boats to the fishing grounds. This was, obviously, a type of fishing restricted to shallow waters, usually no more than about 4 m in depth. The bully net continued to be the main lobster fishing gear used in the archipelago into the 1970s but also used in shallow waters were the spear (*bicharra*) which had the disadvantage that lobsters

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1 This method is still in use in Caibarién on the northeast shelf.
could be injured or killed in being caught, thereby reducing their freshness on delivery, an important consideration in the Cuban tropical climate. In Pilón in Oriente a type of gear called a lasso (lazo) was used for catching lobster. It consisted of a pole with a nylon loop at the end which could be tightened after it had been passed over the lobster, thus ensnaring it.

Other types of nets and traps were employed in deeper water. They included a collapsing type, the pandonga similar to a trap still in use in Florida. However, more common was the cylindrical fish pot (nasa) constructed from Castillean cane or galvanized wire. The principal of these and other pots was that the lobster entered the pot by means of a funnel-shaped entrance (matadero) and could not then easily escape. While bait of various types was, and is, used in such traps in other Caribbean islands and in Florida, it was not commonly used in Cuba and it appears that the lobster entered the pot in search of refuge rather than food.

Baisre (1987, 264: 35) reported that the 1940s marked the introduction into the Cuban lobster fishery of what was to become an extremely important type of fishing gear in the 1970s. This was, essentially, a fish attraction device (FAD) or artificial refuge (jaula) constructed of coastal palm or other type of wood. It was first used in the Gulf of Batabanó and subsequently in other areas where reefs or rocky bottoms suitable for natural refuges were scarce. Such devices could be fished with pincho and bully net as they are today in Caibarién but, according to Baisre (1987, 264: 35), fishers secretly began using a small haul seine at this time. Fishers entered the water, surrounded the refuge with the net, then lifted it causing the lobsters to emerge to be caught in the net. The combination of artificial refuge and haul seine was to become one of the most important lobster fishing techniques in Cuba but not until much later.
Vessels and gear were generally owned by outfitters or larger processing plants (Martinez, 1948: 3) from which they were leased by fishers. Owners took 21% to 25% of the catch and the remainder was shared amongst the crew. Martinez (1948) reported average catches of 2 400 lb of live lobster per boat with larger vessels catching 4 000 lb. The catch was delivered daily to port.

Lobster fishing took place in all months of the year except during the closed season (from March to June) with peaks of production during the autumnal migrations described in Chapter 2 and during smaller, reproductive migrations (the 'male run', *corrida del macho* ) which occur from February to April. During these peaks, lobster were spatially concentrated and, therefore, could be caught relatively easily in large quantities.

At that time, there were two major markets--a local one, consisting essentially of Havana, and an export market in the United States and Europe. The capital took about 16% of the catch, mainly in the form of fresh, live lobster. Exports increased four-fold between 1935 and 1945 (Martinez, 1948: 7). While lobster tails were exported both cooked and fresh, packed in ice, the most common form was canned tails. In 1945, exports were valued at $585 811 (Martinez, 1948: 1).

The main concentration of processing plants with canning lines was on the southwest shelf, with three in La Coloma, one in Batabanó and one in Nueva Cerona on the Isle of Pines. Cooked and fresh tails went mainly to Miami while most of the canned lobster was sent to New York from where a significant amount was re-exported to Europe. The market, therefore, exhibited a type of crude reverse von Thünenism with fresh lobster being consumed locally, semi-processed lobster being sent to relatively nearby Miami and canned lobster being able to withstand shipping costs to New York and Europe.
Lobster fishing was governed by the General Fishery Law. Regulations included: a permanent prohibition against catching female lobsters with eggs ("berried" females, *hembras ovigeras*); a fishery closure of 84 lunar days during the reproductive period, usually from about March to June with small annual variations; establishment of permanent closures in lobster nursery areas; and a minimum legal size of 15 cm from the eye to the fork of the tail fin. The extent to which such regulations were observed by fishers is unknown. However, the continued use of spears must have resulted in the catching of undersized lobsters and berried females. Encroachment on breeding grounds occurred--Martinez (1948: 3) reports that La Broa Bay, a designated breeding ground, had been depleted of lobster by fishers who ignored the prohibition. As we have seen, similar encroachment on closed seasons during reproductive closures also occurred.

7. 3. 4. 2 Sponge fishery. The sponge fishery is little mentioned in the early part of the century. It is reported that 310,000 dozen sponges were exported in 1907 and that the fishery then went into decline until the 1920s (Grupo Cubano de Investigaciones Económicas, University of Miami, 1963: 484). However, the fishery experienced a period of rapid growth during the late 1920s and 1930s, with a peak of 1,111,577 dozen being landed in 1930 (Radcliffe, 1949: 44). Landings remained high (over 600,000 dozen) until 1938 (Kahn, 1950: 87). However, in 1939, the sponge beds of the Bahamas, Cuba and Florida were attacked by a blight (*el tizón*) believed to have been caused by a parasitic fungus, *Spongiophaga communis* (Firth, 1969: 668). This, combined with violation of fisheries regulations and damage caused by a hurricane in 1944, resulted in a precipitous decline in landings to only 16,266 dozen in 1947 (Radcliffe, 1949: 44).

As in the colonial period, fishing took place on the northeast and
southwest shelves with Caibarién and Batabanó being the only ports of landing. Live-well sloops acted as mother ships carrying four or five small row-boats (*chalanas*) from which fishing took place. The gear employed had been developed in the 19th century. The sponge was located by means of a glass-bottomed bucket and then torn from its base using a three-pronged rake (*pincharra*), a method which, unfortunately, could damage the sponges (Firth, 1969: 667). In addition, this was a method that could only be used in shallow waters so that overfishing of beds in such areas occurred.

During the 1930s, the sponge fishery was the most important export fishery in the Republic. Exports in 1930 amounted to 1 257 000 lb of sponges with a value of $956 000 (Radcliffe, 1949: 44). In the period 1935-1939, sponges accounted, on average, for 87% of the value of all fish exports (Fig. 7.8). The decline in production after 1939 resulted in an increase in prices so that in 1947, exports were still valued at $500 000 (Canet, 1949).

**7.3.4.3 Shark fishery.** According to Baisre (1987, 264) the shark fishery had a substantial history in Cuba. During the colonial period, the fishery had been carried out mainly for meat, which was sold fresh as steaks or cooked from street stalls, for fins which were consumed by the population of Chinese ancestry and for the bounty which the colonial authorities had paid for large sharks which were considered to be dangerous (Gómez de la Maza, 1943: 47). In the twentieth century, shark skins also became an objective of the fishery but major growth did not occur until World War II with the loss of the United States' supply of vitamin A consequent upon the curtailment of northern cod fisheries. Shark liver oil was found to have a high content of this vitamin and, as a result the fishery, which was conducted from ports all over the island, intensified.

As noted earlier, there are no statistics for total shark landings. This
may be a result of the fact that, unlike other fisheries, the flesh of the fish was not the most important part for consumption. Rather, fins, skin and oil were used and the meat, until the advent of the war, was often discarded.\(^1\) In the pre-war period, fins were both exported and consumed locally and skins were exported both to the U.S. and to Germany. However, liver oil became the most important export during the war and almost all of it was destined for the United States. While the fishery experienced a "boom" during this period, its relative importance within the fishing industry is indicated by the fact that exports in 1946 amounted to only $133,000 (cf. the $500,000 worth of sponge exports in 1947).\(^2\)

Ports all over the island were involved in the fishery but 17 of 22 listed by Martinez (1948) were located on the north coast where the insular shelves are narrower and the ports are, therefore, closer to the deep water of the shelf edge where fishing took place. The most important centre was Cojímar immediately to the east of Havana. The majority of processing centres were located in the two western provinces, possibly for ease of export from the capital.

Although 30 different species of shark were caught, the fishery relied most heavily on the night shark (tiburón de noche, *Hypoprion signatus*) which accounted for 60-75% of the catch (Martinez, 1948). Fishing was conducted throughout the year but, as with other fisheries, was concentrated during migration periods, with a peak during the female migration in May and June and a subsidiary peak during the male migration in September and October.

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\(^1\) Salted shark meat seems to have been sold as cod during the war (Howell Rivero, 1955).

\(^2\) According to Martinez (1948), production for the five-year period 1942-1946 amounted to 11,000 skins (6,000 of which were tanned), 18,000 lb of dried fins, 500,000 lb of salted meat, 164,000 lb of liver in brine and 61,000 lb of liver oil, all of which (except for the meat, some fins and a little oil) were exported.
Fishing was done from small boats, 15-18 ft in length, powered by oar and sail, crewed by two fishers and either owned by fishing companies or by the fishers themselves. While nets were used in Puerto Esperanza and Mariel and longlines came into use later, the most common type of gear during the war was the handline with baited single or multiple hooks. Fishing took place on a nightly basis. During the migration periods it occurred at depths of 20 to 30 fathoms but at other times sharks were fished at depths of 150 to 200 fathoms. Given the nature of the animal and the completely manual nature of the operation, this was a difficult and dangerous fishery.

The shark fishery suffered a collapse after the end of the war as a consequence partly of the resumption of northern cod fisheries and partly of the successful synthesis of vitamin A in the post-war period.

7.3.4.4 Pole-and-line fishery for small tunas. The other example of the expansion of Cuban fishing activity into the oceanic ecological complex was the fishery for small tunas which originated in the 1930s and, ultimately proved to be much more important than the shark fishery.

In spite of their migratory nature and the fact that they inhabit oceanic waters, small tunas have been subject to exploitation in the world ocean since prehistoric times. Pole-and-line fishing with live bait developed as early as the 17th century in Japan and similar methods were used in Madeira and the Azores (Ben-Yami, 1980: 1). In Cuba, there is no mention of the small tunas in the prehistorical and historical record until the late eighteenth century (Howell Rivero, 1953: 17) and commercial exploitation had to await the twentieth century. Unusually, the origin of the fishery for skipjack tuna (bonito, *Katsuwonus pelamis*), blackfin tuna (albacore, *Thunnus...

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1 This fishery will be referred to simply as the "tuna fishery" in the remainder of this dissertation.
*Atlanticus* and other small tunas (e.g. *comeviveres, Euthynnus allletteratus*) is known with some precision. It dates from 1932 when pole-and-line fishing techniques were introduced to Cuba by Masahiro Kitasaki a Japanese immigrant. Kitasaki and some 20 of his fellow countrymen who fished on the southwest shelf persuaded a local outfitter (Rosendo Camino) to build and outfit a tuna-fishing vessel appropriate to this Japanese fishing technique (Palomera, 1958: 34). The same outfitter carried out the first canning experiments at his *Compañía Ambrosía* in Batabanó in 1935 (Baisre 1985, 264: 60).

While fishing may have continued throughout the 1930s, it did so as a seasonal activity. Intensification and expansion of the fishery did not occur until 1941 when, under the stimulus of wartime demand, new vessels began to be built. Ironically, in the following year Japanese fishers were restricted to occupations on shore (Rawlings, 1953: 10). Their influence, however, remained in both fishing methods and in eating habits in the Batabanó area where the consumption of raw tuna (*crudito*), the Japanese "sashimi", was common (Rawlings, 1953: 9). Since real expansion of the fishery did not occur until the late 1940s and early 1950s, it will be considered in detail in the next chapter.

### 7.3.5 Human Impact

There is little information concerning the impact of fisheries development on marine resources during this period. The preamble to the General Fishery Law notes that both sponge and stone crab fisheries in the very shallow waters of the northeast shelf had been almost destroyed by pollution from sugar refineries and other industrial wastes being discharged into the rivers of the region. In addition, conditions in Havana Bay had not
improved since the 19th century. Fish brought to the capital by live-well vessels were stored in flat-bottomed scows (*cachuchas*) anchored outside of the harbour (Martinez, 1948: 30). No information could be found with respect to lane snapper stocks in the Gulf of Batabanó which, as we have seen, were possibly subject to growth overfishing in the early part of the century.

The period between Independence and the end of World War II was characterized by an apparent decline in fishing activity that lasted until the late-1920s and was followed by growth until the onset of the war. Unlike the situation in the colonial period, development was powered not only by demand from the Havana market but also by fisheries directed toward exports, especially to the United States. This latter segment of the industry was initiated by the sponge fishery which developed strongly and was then extinguished by disease and, possibly, overfishing. The shark fishery experienced a brief boom during the war but, with the synthesis of artificial vitamin A it, too, was subject to demise. The lobster fishery benefitted from the Customs-Tariff Law and became a new export industry. Dependence on the American market was strong. In the period 1937-1941, the U.S. accounted, on average, for 81% of the weight and 94% of the value of Cuban fish exports.

The establishment of a General Fishery Law in 1936, however weak its scientific basis and however poorly its provisions were enforced, must be regarded as a significant advance. This is confirmed, perhaps, by the fact that it remained the legal basis for fisheries in the country until the 1980s.
While there is a great deal of contentious debate about the level of development in Cuba during the post-World War II period, there is agreement among observers that social and economic life exhibited a number of fundamental problems. These were summarized by Mesa Lago (1981: 7) as follows:

1. Although the economy was growing, it was doing so only slowly.

2. The sugar industry was by far the most important in the country (Mesa-Lago uses the term monoculture with respect to it). It accounted for 84% of total exports, with all of the vulnerability brought by selling on world markets subject to frequent price fluctuations.

3. Cuba's connections with, and dependence upon, the United States, already mentioned in previous chapters, had increased during the period of the Republic. During the 1950s American investment in Cuba was the second highest of all countries in Latin America and two-thirds of the country's foreign trade was with its large neighbour.

4. In the late 1950s, 16% of the labour force was unemployed and 14% underemployed on an annual basis. However, during the sugar "dead season" (May to December) unemployment may have been as high as 20% of the labour force (Ritter, 1974: 50) and even higher in rural areas.

5. There were very strong inequalities in standards of living and in the delivery of social and health services between urban (especially the capital) and rural areas. Thus, for example, while the death rate and the infant mortality rate for the country as a whole were low compared with other Latin American countries, there were significant differences between cities and the countryside.
The rate of population growth slowed only slightly during World War II and then increased in the post-war period (Fig. 7.1a). The total population in 1945 (4,967,803) was three times greater and that in 1958 (6,548,300) was four times greater than the population at the time of Independence. By 1958, the most important concentration was still in the province of Havana, which contained 28% of the national total, including the capital agglomeration (with more than one million). Thomas (1971: 1096) noted that Havana, in 1953 "was a larger capital city in proportion to total inhabitants than any other in the world save the equally top-heavy London and Vienna." However, the population share of the other western provinces decreased while that of Oriente province increased from 28% in 1945 to 32% in 1958 (Fig. 7.1c). The urbanized proportion of the population increased during the period of the Republic, from 45% in 1919 to 56% in 1953 and the proportion living in cities with populations greater than 100,000 also increased, so that in 1953, one third of the population lived in the four cities of Havana, Marianao, Santiago de Cuba and Camagüey (Schroeder, 1982: 48; Thomas, 1971: 1095).

Consumption of marine products did not grow at the same rate as the population. Per capita consumption in the 1950s was somewhere around 4.8 kg/ann (Salmon, 1963: 37; Quiroga Ríos, 1959: 32).1 This compares with a per capita meat consumption of about 30 kg/ann (Thomas, 1971: 1103). Cultural attitudes to the eating of fish had obviously not changed significantly and additional barriers to consumption could be found in lack of freshness of fish away from the coast and in its price which, in Havana for example, was similar to that of meat, chicken and cheese (Quiroga Ríos, 1959: 20).2 As in

1 This was calculated by dividing the total national catch plus imports minus exports by the total population. Salmon (1963: 37) estimated consumption of edible portions at 3.6 kg/ann/cap.
2 Meat $0.383/lb; chicken $0.350/lb; local cheese $0.390/lb; fish $0.338/lb; frozen lobster $0.490/lb, (Quiroga Rios, 1959: 20).
previous periods, 90% of fish imports consisted of salted and dried cod and canned sardines which were consumed mostly in the countryside (Quiroga Ríos, 1959: 32).

8.1 GOVERNMENT AND THE FISHING INDUSTRY

As noted earlier, governments of the Republic had not shown sustained interest in the fishery. This neglect is not particularly surprising when the relative economic importance of the fishing sector is compared to that of the sugar industry. However, in the post-war period, the industry began to feel the impact of government programs designed to stimulate development and diversify the economy as a whole.

Action began in the immediate post-war period when the government of President Ramón Grau adopted several measures which affected the fishery directly (Martinez, 1948: 2). Several taxes which discouraged production were eliminated or suspended, 25 fishing vessels which were damaged by a hurricane in 1944 were repaired at a cost of $300,000, and a wharf was built at Batabanó. Further, as part of a post-war plan for agricultural development, the Ministry of Agriculture initiated a proposal in 1946 to invest $500,000 in the creation of 15 fishermen's co-operatives with the objectives of improving fishers' incomes, stimulating production and reducing retail prices (Martinez, 1947a).

The impulse to create co-operatives may have had its origin in a 1942 publication by Mario Sánchez Roig, an inspector in the Hunting and Wildlife Branch and Federico Gómez de la Maza, his assistant (Sánchez Roig and Gómez de la Maza, 1942). These two naturalists made a tour of fishing areas and ports between Cárdenas and Nuevitas on the north coast and at Batabanó and the Isle of Pines on the south with the aim of evaluating both fishery
resources and the state of the industry. They came to the conclusion that existing private enterprises were insufficient to successfully take and dispose of the catch and made a forceful proposal to the Minister of Agriculture for the creation of producers' co-operatives.

The proposal suggested that co-operatives be established at 12 locations: Bahía Honda and La Coloma (province of Pinar del Río); Isle of Pines and Batabanó (Havana); Cárdenas and La Broa Bay (Matanzas); Caibarién and Cienfuegos (Las Villas); Nuevitas and Santa Cruz del Sur (Camagüey); and Manzanillo and Gibara (Oriente). These ports were chosen because they were in locations where species suitable for salting, like the mullets, could be used to replace imported salt cod in the diet of rural populations. Each co-operative was to comprise 30 to 50 fishers. It would be supplied with a motor launch for towing fishing vessels to the grounds, four auxiliary vessels, a building for salting and appropriate equipment all at an estimated cost of $4 300 (Sánchez Roig and Gómez de la Maza, 1942: 14).

Under the government plan, co-operatives were established, as far as can be determined, in Mariel, Puerto Esperanza, Cárdenas and Matanzas on the north coast and La Coloma, Batabanó, Cienfuegos, Santa Cruz del Sur and Manzanillo on the south. The experiment was not a success. Suárez Caabro and Naranjo Betancourt (1954) in an inspection of major fishing ports in 1952 found that most co-operatives existed only in memory. In Mariel, a co-operative was established in 1945 with a motor launch, two row boats and fishing gear. In 1952, the co-operative had been abandoned, and a large part of the fishing gear had been sold by fishers in the bars of the town (Suárez Caabro & Naranjo Betancourt (1952a: 43). A more ambitious co-operative (Cooperativa de Marineros, Pescadores y Trabajadores de las Industrias Derivadas de la Pesca) was founded in Batabanó and took possession, in May
1947, of a fully-equipped cannery with a capacity of 20,000 cans of tuna, sardines or lobster per day, an ice plant, and a reduction mill to produce fish meal. These were built by the government and the $100,000 cost was charged to the co-operative as a loan re-payable over 20 years. Two fishing vessels were also to be turned over to the co-operative. However, Truslow (1951) reported that the cannery never operated, that a large tuna vessel had been leased or sold to other operators and that the whereabouts of several smaller co-operative boats was not known. With the exception, possibly, of Santa Cruz del Sur (Suárez Caabro and Naranjo Betancourt, 1952: Vol. 2: 230), the situation was similar in most other ports—the organization had disappeared and its equipment and fishing gear had either been sold or taken over by individual fishers. Private processors were no more supportive of co-operatives than were fishers. With reference to a government proposal for a National Fisheries Cooperative, Martinez reported that, "Two large private canneryes have expressed fear lest this subsidized cooperative in competing with them actually force them out of business" (1948: 17).

No attempt was made to revive these co-operatives or to create others but the idea did not disappear. A Japanese fisheries expert, I. Kajiyama, was commissioned in the latter part of the 1950s to study Cuban fisheries. He apparently spent almost two years (from January 1957 to December 1958) in the country and produced a report (Kajiyama, 1959) describing the Japanese system of fishing co-operatives and proposing a fisheries development program for Cuba based upon shelf fisheries organized on a co-operative basis on the one hand, and high seas fisheries organized as joint ventures with Japanese companies, on the other. As will be seen, post-revolutionary fisheries development shared some of the characteristics of this expert's proposal.
In spite of the failure of the cooperative program, the government continued to attempt intervention into the fisheries sector of the economy. The Bank for Agricultural and Industrial Development (Banco de Fomento Agrícola e Industrial de Cuba, BANFAIC), founded in 1950, financed a study of Cuban fishing ports which was carried out in 1952 by two fisheries biologists one of whom visited north coast ports, the other those on the south coast (Suárez Caabro and Naranjo Betancourt, 1954). In each port, they recorded the nature of public services and infrastructure, numbers of fishermen and vessels, processing installations and the nature of the fishery and the catch. In addition, information on social characteristics such as education, marital status and the number of dependents was gathered, and a sample of fishermen was interviewed about their own health and that of their families. The resulting comprehensive report (which unfortunately excluded the port of Havana) was published in 1954 and provides a valuable description of the fishery, the processing sector and the social conditions of fishermen and their families in the pre-revolutionary period.

Along with their 1942 call for the creation of co-operatives, Sánchez Roig and Gómez de la Maza (1942: 16) proposed the re-establishment of the National Fisheries Council which, during the 1920s and 1930s had been shuffled between various government departments and which, in addition, had become inactive. However, nothing was done for more than a decade in spite of a further call, by Fiedler (1947), the American Food and Wildlife official, for the creation of a national fisheries agency.

Fiedler's plea went unheard, but in 1955 a National Fisheries Institute (Instituto Nacional de la Pesca, INP) was created as an autonomous body with the mission of developing and protecting Cuban fishery resources.\(^1\)

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Membership of the new Institute was much wider than that of its predecessor, the National Fisheries Council. It included delegates representing 6 ministries, the National Economic Council, the Academies of Medical, Physical and Environmental Sciences of Havana, the National Federation of Amateur Fishermen, the College of Fishing Masters, fishers, outfitters, processors and retailers.

The INP seems to have been conceived not simply as a regulatory body but also as a tool for the development of what had come to be perceived as important but underutilized marine resources. Moreover, its mission had a social dimension: "To open large and new sources of permanent work, to expand and improve those already in existence and to raise the living conditions of fishermen and their families" (INP, 1957: 7). The regulatory function of the new body was to be carried out by a newly-created body of inspectors operating under the General Fisheries Law. A systematic scientific study of marine resources within jurisdictional waters and an evaluation of their potential to support fisheries was to be undertaken. Essential to this task was the compilation of a body of statistics relating to catches, to be collected by a delegation established in each fishing port, as well as inventories of the extractive sector (fishers, vessels, gear, boat construction and repair yards), the processing sector (freezers, coolers, processing plants) and the marketing sector (transportation facilities, retailers). In addition to its regulatory and scientific functions, the INP was also assigned an active role in development of the fisheries. This was to be accomplished by the creation of fishermen's cooperatives in the extractive sector, by the creation and maintenance of processing plants and by establishment of fisheries technical and vocational schools. The INP, lastly, was to have an information-dissemination function about fisheries and fish products which it would accomplish by means of the
publication of pamphlets, reports and a regular magazine, *Mar y Pesca*, which began publication in October 1956.

In its first year of operation, the INP took ownership of, repaired, and put into service, equipment and vessels belonging to the defunct fishers’ cooperatives. This included freezers and ice plants in Santa Cruz del Sur, Nuevitas and Nueva Gerona and 45 vessels of various types. Delegations were established in 23 ports and a body of fisheries inspectors was created, and plans were completed for a National Aquarium and for a new Fisheries Terminal in Havana. Development of a Cuban distant-water cod fishery and of a longline tuna fishery were contemplated (Anon., 1956: 18, 20).

Decree-Law No. 1996 issued on 27 January 1955 authorized an expenditure of $3,500,000 for the planning and construction of a fisheries terminal in Havana to replace two unsuitable docks used by the fishing fleet. The terminal was conceived of as an integrated facility, with docks, an ice plant, warehouses, freezers, a processing plant, a fish-meal plant, which would supply marine products to the country by means of an improved distribution network. Plans for a sales area were later added. Financing was to be supplied by the Economic and Social Development Bank of Cuba (*Banco de Desarrollo Económico y Social de Cuba*, BANDES). According to Quiroga Ríos (1959: 34), the major goals of the project were to provide improved facilities for the unloading, processing and storage of marine products, to decrease the amount of time spent in port by the high seas fleet, thereby improving its efficiency, and to improve the quality of fish offered to the public in the Unico market. Construction of the terminal began in 1958 in Regla, to the east of Havana across the bay, and was put into operation in 1961, after the Revolution. According to a 1957 publication (I.N.P., 1957), the government was also attempting to improve distribution networks within
A faltering first step toward Cuban participation in distant-water fisheries was made with the acquisition, in the Federal Republic of Germany, of a small cod trawler (39.31 m in length), commissioned as the "Bacaladero I", to fish for cod on the Grand Banks (Anon., 1958: 6-8). However, it seems that its activities were restricted to travelling to Newfoundland, buying green cod and bringing it back to Cuba for drying and salting. The vessel was converted into a tuna longliner in 1960.

Cuban scientific interest in the fishery intensified during the 1950s, resulting in the publication of a series of papers by a small group of university and government biologists (e.g. Pérez Farfante, 1953a, 1953b; Suárez Caabro, 1955b, 1955c 1956, 1958b, 1955c; Sánchez Roig and Gómez de la Maza, 1954a, 1954b). While these are rather specific in focus, four others (Suárez Caabro 1955a; Sánchez Roig and Gómez de la Maza, 1952; Naranjo Betancourt, 1954; Negociado de Hidrografía de la Marina de Guerra, 1954) attempted more general accounts of the fishery. In addition, the BANFAIC study of fishing ports, described above, was published in 1954.

A more systematic approach to fisheries research was signalled in the establishment, by BANFAIC, of a Fisheries Research Centre (Centro de Investigaciones Pesqueras, CIP) on 9 March 1952. The original personnel consisted of three marine biologists and a biochemist who were installed in a laboratory in Havana and who had the use of three small motorized fishing boats. An ambitious four-year program of research was begun in order to: expand knowledge of marine resources, such as oyster, lane snapper, lobster and pelagic fish, which were already being exploited; conduct explorations in search of Penaeid shrimp grounds; study primary production in Cuban waters; examine preservation, processing, storage and transportation
techniques; and to conduct a census in every fishing port.

The Centre completed and published the results of some important research (Pérez Farfante, 1953a, 1953b, 1954) but closed in 1955. According to Baisre (1987, 265: 37) this closure was a result of "lack of interest". However, Buesa (1992) indicated that it was the result of revolutionary activity by at least one of the Centre's members. Fisheries investigations in Cuba did not cease with the demise of the Fisheries Research Centre (See Suárez Caabro, 1955a, 1955b; Sánchez Roig and Gómez de la Maza, 1952, 1954a, 1954b) but a promising start to systematic research had, unfortunately, come to an end.

Cuban fisheries were also investigated by outsiders during this period. The first comprehensive accounts of the fishery in the post-war period were written by American officials of the Fish and Wildlife Branch of the Department of the Interior. Three of them visited Cuba for 2 months in 1942 and, with the cooperation of the Ministry of Agriculture, made a study of Cuban fisheries as part of a general survey of fishing industries and fish resources in the Caribbean (Fiedler, 1947). Five very detailed and valuable studies of the fishery, carried out by a foreign service clerk at the American embassy in Havana, were published in the immediate post-war period (Martínez, 1947a, 1947b, 1948, 1948c). In addition, the government invited two fisheries experts to visit the country: Quiroga Ríos of the FAO (1959) to evaluate the economic potential of the industry and to identify obstacles to its development; and Japanese expert Kajiyama (1959) to bring his knowledge of Japanese co-operatives and to suggest a fisheries development strategy.

To sum up, in the late 1940s and 1950s, Republic governments made some attempts at stimulating the development of the fishery. Success was mixed. On the one hand, co-operatives disintegrated, the Fisheries Research Centre disappeared after only a few years in operation and the Bacaladero I
was employed more as a packer than as a fishing vessel. On the other hand, a National Fisheries Institute had been established, construction of the Havana Fisheries Terminal had begun, research into Cuban fisheries had continued and some experiments in new types of fisheries were being considered.

8.2 THE NATIONAL CATCH

There is no single statistical source for this period, so arriving at precise figures for the catch presents some difficulties. Those landings statistics published by the Fisheries Office (Negociado de Pesca) from 1935 on, and used in the previous chapter, provide information for many species of fish, crustaceans and molluscs from 1935 to 1955. This is the major source for the following analysis. Supplementary information was obtained from: Suárez Caabro and Duarte Bello (1961: 53) who provided tuna landings from 1949; the INP which began to collect landings statistics by means of its port delegations in early 1956; Suárez Caabro and Naranjo Betancourt (1954) who supplied landings statistics for 1952 for the ports which they visited; and Salmon 1963 who provided some data for the later part of the 1950s.

In spite of the population's continuing reluctance to wholeheartedly embrace the eating of fish, the period after World War II was one in which, in spite of some annual variations (e.g. a strong decrease in 1951), landings more than tripled from a total of 5,582 mt in 1946 to 17,234.3 mt in 1958. (The latter figure represents registered landings but Salmon (1963: 34) considered the catch to be 25% higher at 21,414.1 mt). The proportion of landings from the insular shelf decreased immediately after the war with the resumption of the

1 Use of these data is complicated by the fact that, for example, no total figure is given for lobster landings. They are, instead, given as: live lobsters (in dozens), lobster tails (in kilograms) and whole lobster (in kilograms). Similarly shrimp landings are given as: fresh shrimp, dried shrimp and shrimp tails.
Campeche Bank fisheries but subsequently increased during the 1950s and accounted for 76\% of the total in 1955 (Figs. 7.4; 8.1).¹

Three significant changes occurred during this period. Firstly, although fish still constituted 79\% of landings by weight in 1955, there was a one-third increase in landings of crustaceans, a result of intensification in the lobster fishery and the introduction of shrimp trawling into shelf waters (Figs. 7.5; 8.2). Secondly, as a consequence, mainly, of expansion in the shrimp fishery, the proportion of landings from the estuarine-littoral complex increased from 33\% in 1945 to 38\% in 1955 (Fig. 8.3). However, the most dramatic change resulted from growth in the tuna fishery which increased the proportion of landings from oceanic waters from a negligible quantity of shark and bill-fish in 1946 to 20\% of the total in 1955. In the light of these increases in the other two complexes, landings from the coral reef-seagrass complex show a corresponding decrease from 67\% in 1946 to only 43\% in 1955.

8.2.1 Regional Distribution of Landings

Some approximation of the regional distribution of the catch can be obtained from the landings statistics collected by Suárez Caabro and Naranjo Betancourt (1954) during their survey of major fishing ports. For the purposes of this analysis, the ports on each shelf were grouped together and their landings totalled to give a total catch per shelf. Landings from ports, such as Cojímar and Cienfuegos, which may have come from more than one shelf, were treated separately. The following analysis, then, is based on the assumption that most fishing fleets exploited the area of shelf closest to their home ports.

¹ The sources for Figs. 8.1, 8.2 and 8.3 were: República de Cuba (1952, 1955); and Suárez Caabro and Duarte Bello (1961).
Fig. 8.1. Landings from Campeche Bank and the Insular Shelf
Fig. 8.2. Shelf Landings by Species Group

- a. 1946 (83% Fish, 13% Crustacean, 4% Mollusc)
- b. 1951 (62% Fish, 15% Crustacean, 3% Mollusc)
- c. 1955 (79% Fish, 4% Crustacean, 17% Mollusc)
The highest proportion (39%) of landings was made on the northeast shelf (Fig. 8.4).\(^1\) However, a large part of these (50% of the grouper, "much" of the snapper (Suárez Caabro and Naranjo Betancourt, 1954a: 205) especially in Caibarién, was obtained from the adjacent Bahama Banks. If these are removed, the proportion of landings from this shelf is reduced to a level somewhat closer to those of the southeast (33%) and southwest shelves (26%) and much superior to the northwest shelf, with 3%.

8. 2. 1. 1 **Northwest shelf.** (See Appendix III) On this narrowest and smallest of the four insular shelves, exploitation was based overwhelmingly on demersal fish and lobster, of the coral reef-seagrass complex. The by-catch shown in the Mariel area graph is from haul seine and trap fisheries and consisted of juveniles and fish of low value. Exploitation of other ecological complexes was restricted to some fishing for billfish in oceanic waters and oyster collection in the estuarine-littoral zone.

8. 2. 1. 2 **North coast of Havana province.** (See Appendix III) The absence of an insular shelf in this region is reflected by landings in the port of Cojímar which are completely composed of billfish and sharks of the oceanic waters complex which, in this region, is in close proximity to the coast.

8. 2. 1. 3 **Northeast shelf.** (See Appendix III) Exploitation of the coral reef-seagrass zone contributed the highest proportion of landings on this shelf. However, as noted above, a large proportion of these came from adjacent banks outside of the archipelago. Demersal fish were the most important group in landings from this complex (especially at its northwestern and southeastern extremities) but lobster and stone crab made small but significant contributions, especially in the Bay of Santa Clara (La Panchita)

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\(^1\) The source for Fig. 8. 4 was Naranjo Betancourt and Suárez Caabro (1954). Landings from Cienfuegos and Cojímar were omitted.
Fig. 8.4. Total Catch by Shelf: 1952
area. Landings from the estuarine-littoral zone averaged about one-quarter of the total, and were composed mainly of small pelagic fish but with a significant contribution of oysters from Nuevitas.

8. 2. 1. 4 Southwest shelf. (See Appendix III) The southwest shelf was the only one in which landings from the oceanic waters complex were of significance (10% of the total). While they included some pelagic shark, the largest proportion was made up of tunas which reached almost 50% of landings from Nueva Gerona and Caleta Grande (Isle of Pines) and almost 25% from Batabanó. The highest proportion of landings came from the coral reef-seagrass complex (75%). While a percentage of these was made up of demersal fish, this was the only shelf in which crustaceans (in this case lobster), rather than fish, were the most important group, making up 62% of landings. Catches in the estuarine-littoral complex were small, reflecting the physical characteristics of this shelf.

8. 2. 1. 5 South coast of Las Villas province. (See Appendix III) In the absence of an insular shelf to the east of the Gulf of Batabanó, Cienfuegos shares with Cojímar a location in close proximity to oceanic waters. However, landings here did not include any species of this complex but reflected exploitation of Jagua (Cienfuegos) Bay and, to a lesser extent of both the southeast and southwest shelves. As a result, pelagic fish, shrimp and molluscs (oysters and clams) of the estuarine-littoral complex made up the largest proportion of landings.

8. 2. 1. 6 Southeast shelf. (See Appendix III) The high proportion of landings from the estuarine-littoral zone continued into the southeast shelf, reaching its highest proportion in the Gulf of Guacanayabo closest to the influence of the River Cauto. Neritic fish, especially mullets, were the most important group but oysters were significant at the extremities of the shelf.
and shrimp were important in the Manzanillo area. Landings from the coral-reef seagrass complex were composed mainly of demersal fish but lobster were of some significance in the Gulf of Ana María (Júcaro).

8.3 THE FISHERIES

8.3.1 Fisheries of the Estuarine-Littoral Complex

8.3.1.1 The mullet fishery. As we saw in Chapter 2, the mullets (Mugilidae family) reach their greatest population concentrations in the estuarine and lagoonal areas of the southeast shelf with smaller ones being found in the Bays of Nipe and Nuevitas on the northeast coast. The fish spend part of the year in such estuarine-lagoonal areas but, in the fall months of October to December, they form into dense, often spherical schools (Howell Rivero, 1955) in river mouths and lagoons and then migrate into deeper shelf waters to spawn, a movement called the corrida in Cuba. The fish are particularly vulnerable to the fishery in their passage, by means of river channels and lagoon exits, from littoral waters into those of the shelf. They are similarly vulnerable on their return migration, the arribazón, in the rainy season during August and September.

The mullet fishery is amongst the most ancient in Cuba. There is evidence from the first Spaniards that aboriginal peoples used corrals in estuarine waters and lagoons to catch the fish of this family. It seems possible that this fishery continued into and throughout the colonial period, firstly, because of the accessibility of the fish during their migrations and, secondly, because, according to Alvarez-Lajonchere (1978a: 6), the Spanish were already familiar with the fish of this family from the Mediterranean.

Once caught, the fish were cleaned, split and, if present, the roe was carefully removed. Longitudinal cuts were made in the skin to allow salt
penetration and the fish were submerged in clean seawater for half an hour to remove any remaining blood. They were then dried, salted, stacked in layers about one metre deep on wooden pallets and pressed under weights such as bags of salt for seven days or more, before being sent to market in boxes. Female roe, also salted, dried and pressed, was a popular item in the markets in the 1950s. Mullet flesh was also used as bait in the shark and other fisheries (Martinez, 1948).

8. 3. 1. 1. 1 Vessels and gear. The wooden boats employed in the fishery were generally small, 3 to 5 m long and, in some places, operated from a larger mother-boat. The most widely used type of gear was a gillnet (lisero) with a mesh size of 5 to 6 in. They were operated according to several different methods which generally involved spotting a school of fish by its disturbance of the water surface, then surrounding it with the net. This operation was done using a single boat, rowed gently, or two boats with a double net. Once the school was enclosed, the fishers hit the water with their oars to frighten the fish into the net where they became entangled. A variation of this (boleo) involved taking one end of the net into the boat, after closure, and gradually tightening the circle. In an older variation, once the school was surrounded, the ends of the net were crossed and one was taken into the boat which was then rowed in ever-tightening circles so that the net spiralled around the school of fish. This increased the probability of catching fish which tried to escape by jumping over the net. Castnets were often used but mainly as an auxiliary gear to fish inside the gillnet circle so that more of the trapped fish could be caught. In addition, harpoons were used to catch larger fish.

8. 3. 1. 1. 2 Catch. Mullet landings showed a decreasing tendency during the pre-war period but the closed season for the species was suspended in 1943 and the fishery thereupon began to grow, albeit not without
interruption, until 1955 (Fig. 8.5a).¹ The average catch in the post-war period was 86.38mt. Almost all of the mullet fisheries occurred at the mouths of the Cauto and other rivers in the Gulf of Guacanayabo on the southeast shelf.

8. 3. 1. 2 Other scale fisheries. Populations of mojarras (Gerreidae fam.), have a similar distribution to the mullets and, in the post-war period, were caught on much the same scale (Fig. 8.5b). The estuarine-littoral complex is also home to a number of pelagic species which had probably been subject to exploitation for some time. Sardines (Clupeidae fam.) and anchovies (Engraulidae fam.) could not compete with canned imports and so were caught mainly for bait to be used in other fisheries rather than for domestic consumption. Mackerels (Scombridae fam.), as we have seen, had been fished in the Florida Keys in the nineteenth century and had probably been subject to fisheries in the archipelago from that time. There is little description of the fishery, although catches were quite high (average 354.8 mt) in the post-war period (Fig. 8.5c). It took place especially on the southeast coast and was done by trolling (al curricán). The fish were eaten fresh.

8. 3. 1. 3 The shrimp fishery. The shrimp fishery has so far received only passing mention in this dissertation. The time of its origin is impossible to establish but the species were probably exploited during the colonial period and a "traditional" fishery persisted into the early 1970s. However, the fishery experienced a dramatic increase in growth with the introduction of trawling by motorized vessels in 1953.

As we have seen, two species of commercially-exploited Peneid shrimp, pink shrimp (P. notialis) and white shrimp (P. schmitti) inhabit the estuarine-littoral complex throughout the archipelago but especially in the

¹ The source for Fig. 8. 5 and 8. 6 was República de Cuba (1952, 1955).
Fig. 8.5. Landings from Fisheries of the Estuarine-Littoral Complex: 1935-1955

- b. Mojarras
- d. Shrimp
- a. Mullets
- c. Mackerels
Gulfs of Ana María and Guacanayabo, La Broa Bay and in many pocket bays. White shrimp populations were fished in the vicinity of the Cauto delta in the Gulf of Guacanayabo, and in the lagoons of Tunas de Zaza. Both species were important in Jagua Bay.

The traditional fishery in the Cauto delta area operated in inshore waters and exploited stocks of white shrimp before their offshore migration, when they were made up mostly of small juveniles (*camarón chico*). Fishing was done in shallow waters using castnets set from small boats or skiffs. Fishers prepared bait which consisted of balls of clay mixed with fermented, salted small fish (*engoo*). These were strewn around the boat and their location marked by poles stuck in the sea bottom. The shrimp were attracted by the bait and caught by castnet. Fishers set up bases (*ranchos*) in the mangroves at El Megano, Estero del Remático and La Salina from which fishing took place and where processing occurred.

Small shrimp were processed by being placed in a large pan or tub with salt amounting to 20% of the weight of shrimp and water. They were cooked over a fire for about half an hour, then taken from the water, drained and placed on a mat of woven palm to dry. After 5 or 6 hours, the shrimp were placed in a jute sack which was beaten with a stick, to remove the heads, legs and carapaces. Lastly, the meat was separated from the inedible parts using a sieve (Suárez Caabro and Naranjo Betancourt, 1954b: 270). This product provided an important source of protein for poorer families (Sánchez Roig and Gómez de la Masa, 1952: 203) and was very popular in Havana to which 50% of the production was sent in the 1950s (Baisre, 1987, 264: 39). The fishery in Jagua Bay was another source of supply for the Havana market. Fishing methods were similar to those in the Gulf of Guacanayabo but fishing also took place at night with lights, and shrimp up to 17 cm in length were caught
(Pérez Farfante, 1953: 231) and sent to Havana packed in ice.

The commercial shrimp fishery in Cuba changed fundamentally in 1953 with the introduction of shrimp trawling by motorized vessels. This was the combined result of research carried out by the newly-instituted Fisheries Research Centre (CIP) and entrepreneurial initiative. The research centre was well aware of the rapidly growing demand for shrimp in the United States (Pérez Farfante, 1953: 231) and the insufficiency in the supply in spite of the diffusion of fisheries along the American and Mexican coasts of the Gulf of Mexico. As part of this expansion extensive banks of pink shrimp were discovered close to Cuba in the area between Key West and the Dry Tortugas in 1949. With the development of improved technologies, geographical spread of these fisheries was accompanied by vertical spread into successively deeper waters farther from the coasts. With this knowledge, CIP scientists set out to conduct a taxonomic study of shrimp species in Cuban waters and to document their horizontal and vertical distribution in order to discover if there were concentrations in deeper waters adjacent to those being exploited by the "traditional" fishery in inshore areas.

As a result of this research and the personal knowledge of the Director of CIP, an experimental fishery was conducted in La Broa Bay by the yacht "Aida" owned by the entrepreneur Sr. Torwald Sánchez of the Del Valle fish company (Pérez Farfante, 1953). The vessel was fitted with a depth sounder and used a shrimp trawl 36 ft long with a mouth 12 ft wide. Between April 19 to June 14, two hundred sets, lasting 30 minutes each, were made at night in an area of 1 000 km² in the Sound and extending out into the Gulf of Batabanó.

According to Buesa (1992), the Director of CIP, Isabel Pérez Farfante, had been brought up in the village of El Rosario on the north shore of La Broa Sound and, although there was no commercial fishery in that area, she knew that some shrimp had been caught there in the past.
Based on the very promising results of the experimental fishery, (in one area of La Broa Bay, 70% of the pink shrimp caught were between 14 and 17 cm in length), Sr. Sánchez purchased an American shrimp vessel, the "Ulda Velma," in Biloxi, renamed it the "Camarón I" and began catching 2 000 lb of shrimp per night (Pérez Farfante, 1954: 180). "Shrimp fever" broke out (Baisre 1987, 264: 39). Eleven relatively small imported vessels powered by 80 to 150 hp motors were brought into operation in 1953. Each one towed a single net of the "flat", the "Mexican" or the "balloon" type the latter being the most popular (Suárez Caabro, 1958a: 7). An average of 7 000 to 8 000 lb of shrimp "of good size" were caught each night. The fishing fleet continued to increase in size into 1954. At its peak, 33 vessels, many from Havana which had been previously fishing shrimp in the Dry Tortugas, caught 20 000 lb of shrimp per night (Suárez Caabro, 1958a: 1). A closure was imposed in February but when the fishery re-opened, the catch per vessel had decreased to 185lb or even to as low as 90 lb (down from 630 lb in February) per night (Pérez Farfante, 1954: 180). The pink shrimp population in La Broa Bay thereupon collapsed and the first shrimp trawl fishery in Cuba, an open access one, had apparently exhibited in only one year, how it is possible to convert a non-self-regulating fish stock into a self-regulating one by heavy fishing pressure. This process will be discussed in detail in Chapter 14.

The collapse of stocks in the Sound did not, however, end the shrimp trawl fishery in Cuba. Some vessels returned to the Dry Tortugas until stocks there were exhausted in 1956 but CIP research and exploration by vessel owners and others had led to the discovery of additional shrimp banks in the Gulfs of Ana María and Guacanayabo. Santa Cruz del Sur quickly became the principal shrimp fishing port and processing centre. In 1958, 22 vessels, each one now using two nets, operated from the port. The trawl fleet also tried to
expand into the Cauto estuary but the inshore fishers of Manzanillo resisted the introduction of trawling into their area until 1966 because they feared that it would destroy fishing grounds and bait balls.

8. 3. 1. 3. 1 Catch. Shrimp landings, which had been showing an upward tendency in the post-war period (the annual average went from 176 mt between 1939 and 1945 to 270 mt between 1946 and 1952), showed an increase in 1953 more than double the previous year, the result of the La Broa Bay fishery (Fig. 8.5d). The collapse of the same fishery halved catches in the following year but a strong increasing trend resumed in 1955 and the shrimp fishery from this time onwards derived the major part of its catch from the trawl fleet which, as we will see, grew substantially in size after the Revolution.

8. 3. 2 Fisheries of the Coral Reef-Seagrass Complex

8. 3. 2. 1 Scale fisheries. (Fig. 8.6a) Although their catch decreased in relative importance during the post-war period, demersal fish of the coral reef-seagrass complex still constituted the most important single fish group. It was made up mostly of members of the Lutjanidae family (yellowtail, lane, mutton and Cuban snappers) along with the Nassau grouper (Serranidae fam.). Landings dropped during the war, recovered after it, but showed fairly strong annual variations. The average annual catch in the post-war period was somewhat under 3 000 mt.

Fishing took place on all four shelves but the southwest one, with the largest area of the coral reef-seagrass complex, was the most important. While haul seines were used in shallow waters, the major method of catching these demersal fish in the Gulf of Batabanó was by various types of trap. Large cylindrical traps (91 cm high, 45 cm wide) constructed of galvanized wire
Fig. 8.6. Landings from Fisheries of the Coral Reef-Seagrass Complex: 1935-1955
and using live grunts for bait, were set singly to catch groupers in deep waters. A smaller cylindrical trap, constructed of Castillian cane and set, without bait, in lines of up to 50, were used in the shallow water snapper fisheries. Each trap was covered by branches to conceal it and to attract fish in search of refuge (Suárez Caabro, 1955a: 92). Both types of trap were also used by fishers from Puerto Esperanza on the northwest shelf. In addition, Suárez Caabro (1955a: 97) reported the use in the Matanzas area of a type of trap which he called a Jamaican (jamaiquina). One variant was large (5 ft long, 1.5 ft high), 'S'-shaped with two entrances. A smaller version was heart-shaped (nasa de corazón). Both were constructed of Castillean cane and, after being baited, were set in lines. According to Buesa (1962: 9) the S-shaped variant had been accidentally left behind in Matanzas Bay by a Haitian vessel in 1933 and, as a result, it was named the Haitian trap, then the Jamaican trap and was renamed the Antillean trap by the personnel of CIP in the 1960s.

8.3.2.2 The lobster fishery. Vessels and gear in the lobster fishery did not change fundamentally in the post-war period. The demand and price of lobster in the U.S. continued to rise during the 1950s (Labisky, Gregory and Conti, 1980: 34) and the fishery in the Cuban archipelago began to experience spectacular growth in the middle of the decade (Fig. 8.6b) to the extent that the catch in 1956 was six times greater than in the previous year and the average catch for 1956-1959 (4,939.9 mt) was eight times higher than the average for the previous decade (1946-1955: 590.3 mt) (Buesa, 1972: 38). Just over half of all fish exports in 1958 were made up of fresh or frozen crustaceans (2,300mt), most of which were lobsters. In 1946, the value of exports of fresh lobster amounted to only $67,813 but this rose to $1,700,000 in 1955 and to $2,900,000 in 1957 (Grupo Cubano, 1963: 684). It is difficult to account for the abruptness
of the rise in the lobster catch but a re-orientation in exports from canned to fresh lobster which occurred in the latter part of the decade may have had some impact.

8.3.3 Fisheries of the Oceanic Waters Complex

8.3.3.1 Tuna fishery. As we have seen, the tuna fishery originated in the 1930s but significant development had to await the post-war period. The fleet expanded to 45 vessels by the late 1950s, with little change in vessel design or in fishing gear or methods and, indeed, the fishery of the 1990s preserves a great many of the traits of the original one. Much of the following account of the pre-revolutionary fishery is taken from a report by J. E. Rawlings (1953), a representative of the U.S. Fish and Wildlife Branch who investigated the fishery in 1952, and from a study done by J. Suárez Caabro and P. Duarte Bello (1961) in the immediate post-revolutionary period.

8.3.3.1.1 Vessels and crew. The typical vessel in the fishery was a shallow-draft sloop (balandro) with a gaff-rigged mainsail and a flying jib (Rawlings, 1953: 10) ranging from about 9 to 18 m in length. Sails were used only for auxiliary power. All vessels were powered by motors from 27 hp to 165 hp in size mounted toward the stern. Forward of the motor, in succession, were situated: a live-well with circulating sea water for bait, an ice-hold for the catch, and some simple crew berths. The after-deck was usually covered by an awning to protect the catch from the weather, and two charcoal burners for cooking. No heads (sanitary services) were provided. Extending across the stern and around each side for about 1.5 m was a narrow wooden platform (balcón) from which fishing took place. A tube of galvanized metal and rubber, 13mm in diameter, surrounded the platform. It was either perforated or had pieces of hose with shower heads at the end.
extending from it. During fishing operations, water was pumped through this system so that it sprinkled onto the surface of the sea. Vessels had no navigational equipment, with the exception of a compass, and only some had radio-telephones. Navigation was done by landmarks (por estima). A dinghy (chalana) 4.5 m in length, powered by a small outboard motor, was carried amidships for use in the bait fishery.

Vessels were typically crewed by 7 men: a master, who was in charge of and responsible for all operations, engineer, cook, iceman, baitman or "chummer" and two fishers. During fishing operations everyone fished, except the chummer. The catch was divided as follows: 25% to the boat owner who paid for fuel and ice, with the remainder divided amongst the crew who paid for their own provisions. If, as was usual, the master was not the owner, he received 10% of the boat owner's share in addition to his fisherman's share (Rawlings, 1953: 21).

8.3.3.1.2 The bait fishery. The Cuban tuna fishery is a live-bait fishery and so it involves not one, but two, fishing operations: one for bait and one for tuna. The objective of the bait fishery was a group of small fish belonging especially to the Engraulidae family (called collectively manjúa, and including Anchoa cayorum, A. cubana, A. hepsetus and others) but also to the Atherinidae (cabezote, Atherinomorus stipes and others) and Clupeidae (Neopisthopterus cubanus, Sardinella brasiliensis) in proportions which varied from place to place (Rodríguez, 1989: 471). They are found in schools in shallow water over eel grass, sandy bottoms and reefs and were fished along the mangrove coasts of the keys on the outer shelf edge. All of the bait species are fragile and rarely live more than one day after capture.

In the early morning the vessel would stop close to a key on the outer shelf edge and anchor in shallow water. The dinghy was then launched,
carrying the bait net, a haul seine (chinchorro) and towing a floating bait receiver. The net was 64 m long by 2.1 m high with wings made of 1 cm cotton mesh and a cod-end with finer mesh (4 openings/cm). The cod-end terminated in a small metal-framed hatch 0.60 m high by 0.50 m wide to allow the transfer of bait from the net. When a school of fish was located, it was surrounded by the net. The wings were worked toward each other by fishermen standing in the water, often chest-deep, until the fish were enclosed by the cod-end. Alternatively one wing of the net might be attached to the shore and the net stretched out across the current until it intercepted a school of fish at which time the enclosing operation would ensue. The floating bait receiver (trapezoidal in shape: 0.8 m on upper side, 1.5 m on lower side, 1.3 m wide, 0.9 m high) was then brought up and the wire frame in the net attached to its entrance so that the fish could pass through. In Batabanó, the wire frame was not used and the net simply emptied into the the receiver but this caused more damage to, and loss of, fish. The receiver was then pushed back to the mother vessel and the bait taken out with a fine-meshed bully net and put into the live-well which was divided into 4 compartments with 5 cm diameter holes for seawater circulation. According to Rawlings (1953: 16), it was lined on the side with mesh to prevent the bait from escaping. Suárez Caabro and Duarte Bello (1961: 21), on the other hand, observed mesh on the bottom but not the sides. The bait-fishing operation was repeated until a sufficient quantity was obtained. If bait was not found, no tuna fishery was possible that day, an occurrence that does not seem to have been unusual (Rawlings, 1953: 17). The bait fishery had to be conducted every day because of the high mortality of the fish in the live-well as a result of restricted space and poor water circulation.

8. 3. 3. 1. 3 The principal fishery. Once sufficient bait had been
obtained, the vessel left the keys and headed for the shelf edge and passed over it into the parallel strip of deep water from 1 to 3 nm miles wide (called the "gulf" by Cuban fishers [García Ramón, 1970: 31]) in search of tunas. As noted earlier, schools of skipjack and blackfin tuna are found in association with seabirds and flocks of the latter were used by fishers to locate the fish. In addition, landmarks were employed to find areas where 'resident' schools of tuna (See Chapter 2) could reliably be found. On the south coast, such resident schools were also found in association with sharks whose fins were marked with a machete by fishermen for identification purposes.1 Two troll lines were also set from the stern and watched carefully for tuna strikes.

While the master steered the boat in the search, the fishers prepared themselves and their gear. Each fisher wore a canvas vest with only a single, left sleeve and, around the waist, a small bag (jolongo), made from automobile tire rubber, in which the end of the fishing pole rested. The pole was made from light and flexible bamboo (caña brava, [Bambusa vulgaris]) and was about 4 m long. The line and leader combined were of a length such that when the pole was lifted after a bite, the fish was at the height of the fisher's armpit so that it could be held there while the hook was removed. The hooks were small halibut type (5/8 in from tip to shank). Barbs were compressed against the shaft so that hooks could be more easily removed with less damage to the fish. A lead weight was attached to the shaft and the hook was partly covered by a feather.

When a school of fish was sighted, either by birds, sharks or "boiling" of the surface water, the vessel was slowed to a speed of about 2 knots (kt) and sailed in a circle to port or starboard while the chummer threw bait fish

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1 An interviewee in 1991 quoted fishers as saying "Yesterday was Pepito's school, we caught 500kg". Japanese tuna fishers do the same thing (Valle, Munaca and Hirtenfeld, 1988: 28).
overboard amidships. If the fish responded, the sprinkler system was turned on. There are two hypotheses about the operation of this system: one is that the disturbance of the surface conceals fishers from the fish; and the other is that it presents the appearance of prey. All crew members with the exception of the master, who steered, and the chummer, fished from the stern platform. Casts were made, fish caught, brought to the fisher’s armpit, held there while the hook was removed, and then thrown on deck. In heavy fishing, fish could be jerked off the hook directly on to the deck. The bite (*picada*) was usually very intense, lasting from a few minutes to half an hour. However, several schools could be successively intercepted in a short time period. It was not unusual for bait to be thrown overboard even when there was no sign of fish ("string chumming" [Rawlings, 1953: 14]). Rawlings considered this to be wasteful but fishers explained that the bait would die in the live-well anyway. A more cogent criticism of operations and one that is probably still applicable to the fishery relates to the concentration of all fishing operations at the stern of the vessel. Rawlings (1953: 14) noted that fish often took bait from amidships and were not, therefore, accessible to fishers in the stern. In pole-and-line fishing in other countries, such as Japan, fishers are distributed more evenly around the vessel and therefore have access to more fish (Ben-Yami, 1980: 9). On the completion of fishing, usually at sundown, the fish were washed, gutted (entrails thrown into the sea) and packed in ice in the hold to await delivery to the canning plant. From 1958 to early 1960, one enterprise used a packer to collect catches from fishing vessels thus allowing the latter more fishing time (Suárez Caabro and Duarte Bello, 1961: 26).

Rawlings (1953: 19) reported that the vessel from which he observed the fishery caught 1 180 fish (3 200 lb eviscerated) in 6 days. Significantly, however, this trip involved only a total of 12 hours fishing tuna, the
remainder being spent travelling and fishing for bait. In the 1960s, Ritzhaupt (1965: 54) noted even less fishing time - a total of 3 hours 48 minutes in a 4 day trip during which 2,721 fish with a weight of 5.4 tons were caught. An average catch of 1.2 tons/day was not unusual.

Before 1951, the fishing season began in March or April and ended in September or October and both fishers and vessels spent the off-season in the lobster fishery. However, in that year, the fishery expanded into a year-round operation.

8.3.3.1.4 Fishing area. The fishery began on the southwest coast with vessels operating out of Batabanó, La Coloma and Nueva Gerona. It expanded to the northwest coast operating from Arroyos de Mantua and Puerto Esperanza in 1948 (Salmon (1963: 26) so that the fishing area extended in a zone 3 to 5 miles wide more or less parallel to the outer edge of the shelf from Point Tabaco on the north coast to the Bay of Pigs on the south. Rawlings (1953: 20) reported a fleet of 23 vessels, 21 of which fished on the south coast. In 1958, there were 45 vessels with about 450 crewmen (Suárez Caabro, 1961: 15).

8.3.3.1.5 Catch. Reliable landing statistics exist from 1949 (Suárez Caabro and Duarte Bello, 1961: 53). Growth was very rapid from 1949 (587.1 mt) to 1957 (2,125 mt) with an average of 1,308.4 mt for the period. The catch of 1957 was followed by an abrupt drop of more than 50% in 1958 after which the upward trend resumed (Fig. 8.7).¹

More than 90% of the catch in this period was composed of blackfin tuna and skipjack tuna, the remainder being other tuna-like fish. According to Suárez Caabro and Duarte Bello (1961: 53), about two thirds of the catch were blackfin tuna but, since statistics were gathered as 'Bonito and Albacora',

¹ The source for Fig. 8.7 was Suárez Caabro (1961: 53).
Fig. 8.7. Landings from Fisheries of the Oceanic Waters Complex: 1949-1958
it was impossible to ascertain the exact proportions of species in the catch. Rawlings (1953: 18) estimated that 75% of the catch on the south coast was made up of blackfin tuna while a similar proportion on the north coast was skipjack. Comviveres (*Euthynnus alletteratus*) possessed dark flesh and were not accepted by the canneries. A *de facto* minimum size was in operation in that the canneries would not accept fish less than one pound in weight.

8. 3. 3. 1. 6 Processing. In the early 1950s, the tuna catch was canned by 5 companies which operated 7 canneries: 2 at Batabanó, 2 at La Coloma, 1 each at Nueva Gerona, Arroyos de Mantua and Cojímar. This had expanded to 9 plants in 1958 (Suárez Caabro and Duarte Bello, 1961: 15). More than 100 000 cases (each case contained 24 cans of about 9.5 oz each) of 'Tuna in Oil' were produced in 1952. All of this production was consumed within Cuba satisfying about 85% of the demand.

The post-World War II period was one of significant change in Cuban fisheries. Governments began to pay attention to the fishery by attempting to establish co-operatives, by setting up the National Fisheries Institute and the Fisheries Research Centre and by initiating the construction of the Havana fisheries terminal. Scale fisheries remained the most important in Cuba in terms of volume of catches but the crustaceans, lobster and shrimp gained increasing importance. The first introduction of industrial methods occurred in the shrimp trawl fishery and was quickly followed by the collapse of stocks in La Broa Bay. The lobster fishery, stimulated by demand from the United States, experienced spectacular growth in the late 1950s and, with development of the fishery for small tunas, exploitation expanded on a previously unknown scale into the oceanic waters ecological complex. The next chapter will attempt to evaluate the state of the Cuban shelf fishery and
of fishers and their families in the immediate pre-revolutionary period.
CHAPTER 9
THE FISHERY IN THE 1950s

The state of Cuban society and economy in the 1950s is a subject of rather contentious debate. As Pérez (1992: 56) has noted,

The impact of the Cuban Revolution on historiography was far-reaching. The Revolution changed profoundly the meaning of the past from which it originated, creating a need for both a new past and new ways to think about the past-ways that addressed issues of cause and context, antecedents and origins, sources and process. Questions about the kind of society the Revolution produced could not be separated from questions about the nature of the society that produced the Revolution.

A manifestation of this tendency is that supporters of the Revolution have had a vested interest in emphasizing what they perceived to be the deplorable conditions of social and economic life which existed in the immediately pre-revolutionary period. "In Cuba, new versions of the past were summoned to serve new visions of the future. The consolidation of the Revolution required not only reordering Cuba as it was known but also revising Cuba as it was remembered" (Pérez, 1992: 56). Such "new versions of the past" were not only the creations of supporters of the Revolution. Opponents looked at the same pre-revolutionary situation but saw a country with a standard of living, educational levels and possibilities for economic development among the most promising in Latin America.

9.1 POST-REVOLUTIONARY DESCRIPTIONS OF THE FISHERY IN THE 1950s

The situation with respect to the fishery reflects the more general one
described above. For example a description of the fishing industry from the Information Department of the Ministry of Foreign Relations published probably in 1964 (República de Cuba, 1964: 150), had this to say:

The Cuban archipelago is abundantly surrounded by a large variety of species of fish; Cuba has a longer coastline than several other countries which are renowned for their flourishing fishing industry; and it is situated at the very crossing of the currents along which the most important fish migrate. Yet, before 1959, Cuba did not even have the beginnings of a fishing industry!

Cuba's low production of fish was due to the lack of an adequate fishing fleet and to the use of primitive methods. There were only a few boats, run by Havana ship owners, for fishing on the high seas...

There were only 200 ship owners for the entire fishing industry, whose boats were unsafe, who cheated on weight and paid starvation wages. There was a whole chain of middlemen, most of whose profits came out of the low wages of the fishermen.

The exaggeration of parts of this description is apparent from what we have already seen about fisheries in Cuba.¹

A more informed view of the fishery was provided by Julio Baisre (1987, 265: 39), Director of Science and Technology in the Ministry of the Fishing Industry in the late 1980s and 1990s, the first person since the Revolution to attempt a comprehensive history of Cuban fisheries. He concluded an analysis of the pre-revolutionary fishery by describing its essential characteristics as follows:

1. It employed a high number of fishers in a subsistence fishery, using small boats, mostly without engines, with completely artisanal gear and methods and daily fishing trips.

¹ Bias in describing the past was not the exclusive property of the revolutionaries. A post-revolution study, ignoring the failure of the experiments of the 1940s, described co-operatives of that time in ideal terms as "true co-operatives of producers" (Grupo Cubano de Investigaciones Económicas de University of Miami, 1963).
2. Even in the most profitable fisheries (those for lobster and tuna) activity was markedly seasonal.

3. Fishing activities were dispersed in numerous ports which, with few exceptions, were without facilities for maintenance and repair of boats. They were also, except for limited installations for lobster and tuna, not provided with facilities for the processing and distribution of fish products.

4. Fishers were one of the socioeconomic groups with least income and poorest living conditions.

5. Research depended much more on the experience of fishers than on scientific knowledge of marine resources and environment, and was practically non-existent.

6. Only high quality species such as lobster, shrimp, snappers, groupers, mackerels, small tunas and a few other species could compete with cheap imported fish.

7. The socioeconomic situation, on one hand, and the lack of means of production on the other, have made over-exploitation practically impossible.

Baisre's view of the fishery in the 1950s is quite representative of post-revolutionary writers (see, for example, Mena, 1983: 59) and may, therefore, be legitimately employed as a framework for an evaluation of the the state of fishers and the fishery in the 1950s.

9.2 AN EVALUATION OF POST-REVOLUTIONARY DESCRIPTIONS OF THE FISHERY IN THE 1950s

The most important source for this evaluation is the study of fishing ports commissioned by BANFAIC in 1952 and carried out by Suárez Caabro and Naranjo Betancourt (1954).¹ The two investigators collected information

¹ The results of this study were summarized and supplemented in: Negociado de Hidrografía de la Marina de Guerra (1954). An exhaustive search by means of inter-library loans and Internet in North America, and of public, ministry and personal libraries in Miami and Havana was not,
on 36 ports accounting for 8,374 or 65% of all fishers. Supplementary information was obtained from contemporary reports by foreign experts (Quiroga Ríos, 1959; Kajiyama, 1959; and Salmon, 1963).

9.2.1 Fishers

The difficulty of establishing precisely the number of fishers must be acknowledged at the outset. Not all fishers were full-time registered workers. A fluctuating number of people who caught fish did so on a part-time basis during times of under-employment or unemployment in other industries. Their numbers, therefore, could only be estimated by observers. This, coupled with the lack of censuses, results in some fuzziness in the numbers given for the 1950s.

From the available information, however, it appears that the number of registered fishers grew from a low of 1,500 in 1931 to 3,435 in 1943, according to the Census of that year. According to Fiedler (1947: 166) "reliable estimates" gave a number of 40,000 full-time fishers in the mid-1940s but this is probably a gross exaggeration. Martinez (1948: 4) estimated that there were 9,000 permanent and 3,000 part-time fishers as well as 1,000 more in auxiliary trades such as sailmakers and carpenters. These plus 6,000 employed in packing, transportation and sale, made up a total of 19,500 people involved in the industry in the late 1940s. Canet (1949) and Truslow (1951) agree on a figure of 9,000 full-time fishers.

The BANFAIC study found 8,374 fishers in the 36 ports visited in 1952 but the summary of 44 ports published by the Navy (Negociado de Hidrografía, 1954) and repeated by later authors (Baisre, 1987, 265; Grupo Cubano de Investigaciones Económicas, University of Miami, 1963; Quiroga

unfortunately, able to locate a copy of this very important report.
Ríos, 1959) reported 12,930 "professional" fishers. Taking into account the different numbers of ports, these figures are not incompatible. Quiroga Ríos (1959: 9) added 10,000 workers in occupations related to the fishery as well as 112,650 family members for both groups, for a total of 135,580 people or about 2.3% of the total population directly dependent on the fishery in 1954. Thus the number of fishers in Cuba seems to have increased by almost four times in the decade prior to 1952. If the existence of some unknown number of unregistered fishers is acknowledged, it is possible that during this period the fishery was, to some extent, acting as an "employer of last resort" (Copes, 1986a), absorbing surplus workers from other industries. In spite of the increase in numbers, Salmon (1963: 22) calculated that the ratio of fishers to the general population in Cuba, at 1: 500, was still much lower than that in the Lesser Antilles (1: 200).

Neither the general population nor that of fishers was evenly distributed (Fig. 9.1a)¹. Approximately 500 fishers worked from the port of Havana (Martinez, 1948: 4). Excluding them, the largest proportion of fishers (43%) operated from ports on the northeast shelf. Caibarién had the largest single concentration (1,500) and, together with Isabela de Sagua and Nuevitas accounted for about 65% of the total on the north coast. Only 5% of fishers, on the other hand, operated from the ports on the northwest shelf. They were more evenly distributed on the south coast (southeast shelf: 21%; southwest shelf: 31%) with five centres, Cienfuegos (790) and Manzanillo (573), La Coloma (1,000), Nueva Gerona (526), Batabanó (800), each having more than 500 fishers. Seventy-four per cent of all fishers were located in ports on the

¹ The analysis of the distribution and characteristics of fishers is based on the BANFAIC (1954) study (Suárez Caabro and Naranjo Betancourt, 1954). Fishers were grouped according to their home ports which, in turn, were grouped according to their location with respect to the four areas of the insular shelf. There is no guarantee that all fishers from ports on the northeast shelf, for example, fished exclusively on that shelf.
Fig. 9.1. Fishers: 1952
northeast and southwest shelves.

As a group, fishers were experienced. Nationally (i.e. ports studied by BANFAIC, excluding Havana), 68% of them had fished for more than 16 years, 44% for more than 25 years (Fig. 9.1b). This may be partly a reflection of the scarcity of alternative employment but may also indicate that a fishing culture had come into being in Cuba. "For the greater part, Cuban fishermen constitute a group apart" (Canet, 1955). They were, "capable and hard working and excellent seamen (who) seem to have a definite pride in their calling" (Fiedler, 1947: 166).¹ Twelve ports had no fishers who had fished for less than 5 years indicating, perhaps, a problem of recruitment in the post-war period. However, 26 ports had up to 25% of fishermen in this lowest class, those with the highest being located on the southeast shelf (Niquero, Manzanillo, El Remático, El Megano).

There is no question that there had been a great increase in the number of fishers in Cuba in the post-war period. However, the implication, in Baisre's statement above, that this number was somehow too high is challenged by the low ratio of fishers to the total population in Cuba, with its extensive insular shelves and marine resources compared with that in the Lesser Antilles with much poorer marine resources.

9. 2. 2 Vessels

In spite of the fact that all fishing vessels were supposed to be registered with the local maritime authorities, Martinez (1948: 5) reported that the registry was not up to date and that it included vessels registered in colonial

¹ Unfortunately this information raises a problem with respect to estimates of the total number of fishers in the country. If 62% of the 12 930 fishers in 1954 had been fishing for at least 16 years, it must be concluded that there would have been about 8 000 fishers in 1938. However, the Census of 1943 gives a figure of 3 435. These statistics must, therefore, be treated carefully but do seem to indicate a work force with some stability.
times but no longer in use, as well as a large number destroyed by hurricanes and others which had been withdrawn from the fishery for economic reasons. Estimates of their total numbers in the 1950s, as a result, vary quite widely: 12,000 (Fiedler, 1947: 167); 6,863 (Suárez Caabro and Naranjo Betancourt, 1954); 7,345 in 1954, 8,100 in 1958 (FAO, cited in Salmon, 1963: 29); and 5,772 (Salmon, 1963: 29). It must be remembered that Fiedler estimated the number of fishers at 40,000 so his high estimate for vessels is no surprise. However, Salmon’s estimate, which he considered to be an overestimate by one or two thousands, is puzzlingly low. Considering that Suárez Caabro and Naranjo Betancourt actually visited centres of fishing activity, there is a basis for considering their estimate to be fairly accurate. However, they visited only 36 ports, albeit the most important ones, so that the total number of vessels was probably somewhat greater than 7,000. If their estimate of the number of fishers is also accepted, however, this would give an average number of fishers per vessel of less than two. This may be explained by the large number of very small and auxiliary vessels in the fleet (Salmon estimated that 20% of the total fleet was made up of such vessels (1963: 29). In the face of such variation, the precise total number of vessels in the Cuban fishing fleet in the 1950s must remain undetermined.

All vessels were of wood construction and the overwhelming majority, with the exception of some larger schooners from New England and Nova Scotia, were built in Cuba. "The Cuban shipbuilders have proved to be apt, and almost any type of fishing vessel can now be built locally" (Fiedler, 1947: 167). The major means of propulsion were sail and, for small boats, oars. In 1952, only 6.4% of vessels had motors but this proportion had increased considerably, although in a "rather indiscriminate manner", by the end of the decade (Quiroga Ríos, 1959: 7). To post-revolutionary observers the paucity of
motors in the vessels is a certain sign of the poor condition of the fleet. However, it should be pointed out that, with the exception of the most industrialized fishing nations, such a situation was not unusual for an inshore fleet in the 1950s, especially in the developing world. Even in Japan, in 1955, 99% of the small-boat fleet was without power (Brandt (1984: 123).

The type of vessel in use varied with the type of fishery and the distance of fishing grounds from the home port. In the 1950s, five fleets could be distinguished: the Campeche bank schooner fleet, the tuna fleet fishing in oceanic waters along the shelf edge, a small sports fleet on the north coast, the shelf fleet, fishing in the more or less protected waters of the estuarine-littoral and coral-seagrass complexes, and the shrimp trawl fleet operating on the southeast shelf.

The essential character of the Campeche Bank fleet had not changed since the 19th century. The typical vessel was a two-masted schooner with a live-well, powered only by sail. In the 1950s, the fleet was composed of 57 such schooners of varying ages: 48% were more than 25 years old and one was built in 1882. However, Salmon noted that, because of the high quality of Cuban wood and construction techniques, the age of the fleet offered no hindrance to its operations. The typical vessel was of 35 tons, 20 m long, 6 m wide, with a 3 m draught and a live-well with a capacity of 10 000 lb of fish. In the post-war period, live-wells began to be replaced with ice-holds of 30 000 lb capacity and motors were also added, at first as auxiliary power, later replacing sail as the main means of propulsion. At the beginning of the 1950s, 37 of the vessels had ice-holds and 20 had live-wells (Truslow, 1950: 917). Such vessels carried a crew of 12 fishers. Some vessels were larger, up to 30m, with a cargo capacity of 45 000 lb (Salmon, 1963: 26). According to García Ramón (1970: 45), radios and echo-sounding equipment were added to some vessels in the
1950s. Most of the schooners were owned by fishing companies, although some were in private hands (Fiedler, 1947: 167).

The tuna fleet in the 1950s was made up of 45 mother vessels and 60 auxiliaries (Salmon, 1963: 30). As we have seen, all of the mother vessels were rigged with sails but these were used only for auxiliary power. An additional number (310) of powered launches of diverse sizes and design operated in a sports fishery, especially from the region around Havana from which migratory billfish of the oceanic complex, here close to the coast, were fished.

Apart from the tuna fleet, the only completely powered fleet in Cuba in the 1950s operated in the shrimp fishery which dated from mid-decade. Most vessels were of a standard design developed in the American fisheries of the Gulf of Mexico. On average, they were 13 m long, 3 m wide with 1.4 m draught, with 165 hp motors, 4-6 berths, an ice-hold with a capacity of 10 t, outriggers and carried a crew of 4 to 6. However, Cuban vessels (criollos), often with a wheelhouse in the stern rather than forward as in the American vessels, were also adapted to this fishery. These tended to be smaller, with less powerful engines (Baisre and Zamora, 1983: 5). All vessels, about one dozen in total, operated a single shrimp trawl with otterboards.

The shelf fleet, exploiting the relatively sheltered waters and varied ecological complexes of the macrolagoons, was much more varied in its composition. The largest vessel was a single-masted, sail-powered sloop (balandro) which traditionally was equipped with a live-well. A typical example was 12 m long, 3.5 m wide, with a 1.5 m draught, had a live-tank with a capacity of 3 600 lb and a crew of five. During the 1950s, they too began to be modified by the addition of motors and replacement of the live-wells by ice-holds (Salmon, 1963: 27). These vessels and two-masted ketches (guairos)
were also used for fishing shallow areas, like Cay Sal Bank and the Bahama Banks outside of the shelf. In 1952, there were a total of 537, only 80 (15%) of which had motors.

The overwhelming majority of vessels fishing the sheltered waters of the shelf were smaller sail- and row-boats of various types involved mainly in daily fishing or in making very short trips. Eighty-five per cent of all fishing vessels in the Republic were made up of such types (Quiroga Ríos, 1959: 7). As would be expected in a situation where smaller vessels were built in ports all over the archipelago, they exhibited great variety. They included dugout canoes (cayucos), perhaps direct descendents of aboriginal ones, which were small and suited to shallow inshore waters. They were widely used in the region of Cuayabal on the southeast shelf (Suárez Caabro and Naranjo Betancourt, 1954: 221). Various sizes of row boats (cachuchas de remo) were in use by occasional fishers and as auxiliary vessels with mother ships in both scale and small tuna fisheries. Small sail boats with movable keels and live-wells were widely used. The general term for these was chalana (Salmon, 1963: 27) but vessels of different design were often named after a particular port - e.g. el vivero de Caibarién, la chalana de Tunas de Zaza, and la lancha Cienfueguera.

With respect to distribution of the shelf fleet (Fig. 9.2), the largest number of vessels operated from ports on the northeast coast (Cárdenas, Isabela de Sagua, Caibarién, Nuevitas) with Caibarién having almost three times as many vessels as any other port in the Republic. Vessels were more evenly distributed on both south coast shelves with the larger ports of Batabanó, Cienfuegos, Santa Cruz del Sur and Manzanillo having the largest numbers.1

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1 The source for Figs. 9.2 and 9.3 was: Suárez Caabro and Naranjo Betancourt (1954).
Fig. 9.2. Number of Vessels by Port: 1952
An inspection of the proportion of fishers using various types of vessels in the ports studied by BANFAIC in 1952 indicates some interesting patterns in their distribution (Table 9.1). On the southwest shelf, where fisheries were based on species of the coral-reef-seagrass complex (e.g. lobster and lane snapper), the live-well sloop was by far the most common vessel. The fishers of Cienfuegos, on the other hand, fishing mostly within the shelter of the large pocket bay, overwhelmingly (75%) used small sail- and row-boats (botes and cachuchas). In the Santa Cruz del Sur area, in contrast, the troll fishery for various types of mackerel was the most important and motor launches were the preferred type of vessel. In the mullet and juvenile shrimp fisheries of the Manzanillo area almost half (49%) of fishers used row-boats which allowed fishing in shallow estuarine waters.

On the north coast, almost all fishers (98%) in Puerto Esperanza, involved mainly in trap and haul seine fisheries, employed live-well and ice-hold sloops exclusively. In Cojímar and in other ports with relatively easy access to the migratory billfish and sharks of the oceanic waters complex, on the other hand, motor boats of various types were common. Motor launches or sloops were used for the same purpose in Caibarién and Nuevitas but were also employed for fishing banks outside of the insular shelf.

Baisre's characterization of the fishing fleet, therefore, while essentially accurate, simplifies a rather more complex reality. Vessels were varied and seem to have been quite well adapted to requirements of the various fisheries and to ecological conditions on the fishing grounds. Although only a small proportion of the total fleet was powered, the proportion was increasing, especially in the shrimp and tuna fisheries in which power was essential. It is likely that these fisheries were the leading edge of a process of modernization

1 The source for Table 9.1 was Suárez Caabro & Naranjo Betancourt, 1954.
Table 9.1
Fishers by Port and Vessel Type

<table>
<thead>
<tr>
<th>South Coast</th>
<th>Percentage of Fishers</th>
<th>Vessel Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nueva Gerona</td>
<td>8</td>
<td>tuna vessels</td>
</tr>
<tr>
<td></td>
<td>44</td>
<td>live-well sloops</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>motor launches</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>row boats (cachuchas)</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>sailboats</td>
</tr>
<tr>
<td>La Coloma area</td>
<td>2</td>
<td>row boats (botes and cachuchas)</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>ice-hold sloops</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>live-well sloops</td>
</tr>
<tr>
<td>Batabanó</td>
<td>3</td>
<td>row boats</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>ice-hold sloops</td>
</tr>
<tr>
<td></td>
<td>92</td>
<td>live-well sloops</td>
</tr>
<tr>
<td>Cienfuegos</td>
<td>75</td>
<td>row boats</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>sailboats</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>motor launches</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>live-well sloops</td>
</tr>
<tr>
<td>Júcaro</td>
<td>9</td>
<td>row boats</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>sloops (live-well and ice-hold)</td>
</tr>
<tr>
<td></td>
<td>72</td>
<td>motor launches</td>
</tr>
<tr>
<td>Santa Cruz del Sur</td>
<td>100</td>
<td>motor launches</td>
</tr>
<tr>
<td>Guayabal</td>
<td>10</td>
<td>motor launches</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>row boats</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>canoes (cayucos)</td>
</tr>
<tr>
<td>Manzanillo and Niquero</td>
<td>49</td>
<td>row boats</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>motorized sloops</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>sail boats</td>
</tr>
<tr>
<td>Location</td>
<td>Percentage of Fishers</td>
<td>Vessel Type</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>Puerto Esperanza</td>
<td>98</td>
<td>live-well sloops</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>row boats</td>
</tr>
<tr>
<td>Mariel area</td>
<td>100</td>
<td>row boats</td>
</tr>
<tr>
<td>Cojímar</td>
<td>60</td>
<td>motor boats or launches</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>row boats</td>
</tr>
<tr>
<td>Matanzas area</td>
<td>40</td>
<td>motor boats</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>motorized row boats</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>row boats</td>
</tr>
<tr>
<td>Isabela de Sagua</td>
<td>57</td>
<td>motor launches</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>row boats</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>sloops</td>
</tr>
<tr>
<td>Caibarién</td>
<td>4</td>
<td>row boats</td>
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<tr>
<td></td>
<td>64</td>
<td>sail boats</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>motor launches or sloops</td>
</tr>
<tr>
<td>Nuevitas</td>
<td>80</td>
<td>motor launch or sloops</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>sailboats</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>row boats</td>
</tr>
<tr>
<td>PlayaLa Panchita</td>
<td>47</td>
<td>sailboats and row boats</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>live-well and ice-hold sloops</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>motor launches</td>
</tr>
<tr>
<td>Carahatas</td>
<td>90</td>
<td>sailboats and row boats</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>motor boat (chalanitas)</td>
</tr>
<tr>
<td>Puerto Padre</td>
<td>90</td>
<td>sail &amp; row boats</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>motor launch</td>
</tr>
<tr>
<td>Gibara</td>
<td>37</td>
<td>motor launches</td>
</tr>
<tr>
<td></td>
<td>63</td>
<td>sail and row boats</td>
</tr>
</tbody>
</table>
which, however haphazardly, was already underway.

9.2.3 Fishing Gear

The fishing gear and methods in use in the 1950s were those of Spain in the colonial period as described in Chapter 4, with the exception of the bully net, the Antillean trap, the shrimp trawl and the tuna pole-and-line. There is no question that, except for the shrimp trawl fishery, all of the fishing gear in use in the archipelago was artisanal. As we will see in subsequent chapters, such manual gear has persisted in the Cuban shelf fisheries, in spite of attempts to modernize and industrialize fishing methods. Gear types like the gillnet, haul-seine, traps, and the various types of hook and line possess the advantages of being uncomplicated, cheap to construct and operate, and can be operated in areas, such as bottoms with patch reefs, where larger scale gear like purse seines would be inappropriate. In fact, in spite of the implied criticism in his statement with respect to fishing gear, Baisre himself has often pointed out that the nature and variety of gear in the archipelago is well-adapted to the different conditions on each of the four parts of the insular shelf.\(^1\) This is not to suggest that all types of artisanal gear are of equal value. The castnet, for example, while having the advantage of being cheap, is not a particularly efficient gear for catching marine animals.

The single exception to the artisanal nature of fishing gear was the shrimp trawl net which required a powered vessel and which was set and pulled by a hydraulic winch. Its introduction into Cuba was not without incident. It met with resistance in Manzanillo, the major shelf area with a traditional shrimp fishery.\(^2\) Local fishers were successful in keeping the gear

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2. A trawl vessel was destroyed by an arson fire in this area in 1959 (Buesa, 1991).
out of the area until 1966.

Thus fishing gear in the 1950s was overwhelmingly artisanal but this presented advantages in that it was relatively cheap, easily constructed, adapted to the types of vessels in use, and to the varying ecological conditions of the insular shelf.

9.2.4 Duration of Fishing Trips

The length of fishing trips depended on the type of fishery, vessel and gear involved. In the Havana distant-water fleet, schooners with live-wells spent 30 to 40 days at sea in the summer, 25 to 27 days in winter while those with ice-holds made trips of 25 to 27 days both summer and winter (Martinez, 1948: 4). Larger coastal sloops and shrimp trawlers made trips up to 10 days in length but there is no question that a large proportion of the fleet made daily trips to sea. However, in the 1950s, an increasing, although undeterminable, number of boats began to pack fish in ice holds (neveros) allowing vessels to make longer trips.

9.2.5 Seasonality in the Fishery

A substantial number of fishers (43%) fished for more than 150 days per year (Fig. 9.3). Given time-off, time required for repairs to vessels and gear, and to acquire supplies, as well as poor weather, which, as we have seen (Chapter 3), is quite common in the fall, this is a fairly high proportion and seems to confirm the existence of a sub-cultural group of what might be called "fisher-folk" (Sauer, 1965: 267). It is interesting that the southwest shelf, the major supplier of the Havana and export markets, is the one with the highest percentage of fishers working more than 150 days per year. However, this is not to deny that the fishery had an important seasonal and casual component.
Fig. 9.3. Fishers by Days Fished per Year: 1952
Some proportion of these permanent fishers participated in more than one fishery. In the early period of the tuna fishery, for example, fishers also worked in the lobster fishery.

About one-third of fishers worked for less than 120 days per year and 14%, worked for less than 90 days. The southeast and northeast shelves show the highest percentage of the fishing labour force working less than 90 days per year (20% and 22.9% respectively; Santa Cruz del Sur 73.3%; Playa de la Panchita 80%). Both Baisre (1987, 265) and Canet (1955) have noted that workers in the sugar industry turned to fishing during the "tiempo muerto" (literally "dead season") of that industry. According to Suárez Caabro and Naranjo Betancourt (1954b: 193) most of the fishers in Caibarién, the port with the largest number in the country, were also sugar loaders. Workers in other agricultural sectors also fished. Tobacco field-workers living in Cortés on the southwest shelf, for example, were engaged in the fishery when not working in the fields (Suárez Caabro and Naranjo Betancourt, 1954a: 17). In Caleta Grande on the Isle of Pines, fishers were also occupied in logging, charcoal burning and farming (Suárez Caabro and Naranjo Betancourt, 1954a: 120).

When considering the population of fishers in the 1950s, then, a distinction must be made between, on the one hand, a permanent group of "fisherfolk" for whom commercial fishing represented a way of life and, on the other, an undetermined number for whom the fishery was a form of alternative emploment, an "employer of last resort" during the dead season of the sugar industry and off-seasons of other agricultural activities.

9.2.6 Ports

Suárez Caabro and Naranjo Betancourt (1954) visited 36 fishing ports which together accounted for 8 374 fishers. It is clear, however, that there
were many more ports in the archipelago. Salmon (1963: 21) listed 78 centres which satisfied his definition of a port as a "landing place for fish with transportation facilities" (Salmon, 1963: 20). There were, in addition, an unspecified and unnamed number of fishing hamlets which did not possess such facilities and from which, it is supposed, subsistence fishing occurred. Most of the ports, especially the larger ones, were built originally for other purposes, such as coastwise trade and, especially, the export of sugar (Salmon 1963: 20). At best, therefore, fishing vessels had a separate dock but often had to share with other types of vessels.

Salmon (1963: Appendix I) classified the ports into primary, with fairly high production and good communications and, and secondary with few fishers and low development prospects. They were widely distributed with eighteen primary and 24 secondary ports located on the north coast and 16 primary and 20 secondary on the south coast. Approximately 60% of all ports were located in the eastern regions of the country (southeast coast: 10 primary, 11 secondary; northeast coast: 12, 13; southwest coast: 6, 9; northwest coast: 6, 4). Surprisingly, not all fishing ports were located on the four insular shelves, especially in Oriente province where 18 of the 21 ports were adjacent to narrow shelves or in pocket bays.

9.2.7 Infrastructure

Infrastructure support for the fishing industry in the ports of the 1950s, as Baisre suggested, could not be described as good. Only 47.2% of them had a separate fishing dock. More seriously, fewer than one-third of them had an ice-plant, a lack which had serious consequences for both the quality of fish and the economics of the fishery since ice had to be transported from elsewhere (Canet 1955). Few ports possessed any type of cold storage facilities.
such as freezers, refrigerators, or coolers (Canet, 1955). Fish were landed at a shed at the end of the dock, those from live-well vessels were killed, gutted and packed in boxes with ice to await transportation. In Cuban temperatures, this must have had an impact on the condition of the fish which could not have helped its marketability.\(^1\) Fish were transported in wooden boxes with ice, by rail or truck. Quiroga Ríos (1959: 17) inspected the conditions of transport and found that: the wooden boxes used to pack the fish were often very worn and, therefore unhygienic; insufficient quantities of ice were used; and rail cars and trucks were uninsulated so that delays would cause the ice to melt. As a result, fish frequently arrived at the market in very poor condition (Quiroga Ríos, 1959: 32; see also Salmon, 1963: 32).

9.2.8 Vessel Repairs

Some 30% of ports had facilities for boat repairs but only 14%, the larger multi-purpose ones, for boat construction. However, according to Salmon (1963: 23), "Cuba enjoys an excellent tradition of construction of wooden boats which dates from the time that the island was the obligatory stopping place for all Spanish fleets." There were, according to the same author, carpenters' workshops in all fishing ports. These must have supplied a large proportion of the vessels in the small-boat fleet. Subsistence fishers and those who used row-boats and other very small vessels for daily fishing presumably built their own and certainly repaired, painted and caulked them as well as making their own sails (Suárez Caabro and Naranjo Betancourt, 1954: 14). Mechanics were scarcer than boat-builders and were restricted to the repair and

\(^1\) "The sanitary conditions that prevail in general, here (Isabela de Sagua), and in all Cuban ports, are deplorable; when fish are killed they are left on the floor of the shed for hours before being refrigerated or put into boxes with ice" (Suárez Caabro and Naranjo Betancourt, 1954: 176).
installation of imported motors for all types of vessels, not just those in the fishing fleet. They were, therefore, found only in the larger ports. (Salmon, 1963: 23).

9.2.9 Processing

Fish buyers were fairly widespread (in about 70% of ports), fish companies and processing plants much less so. Industrial processing of marine products was mostly restricted to canning, especially of small tuna and lobster. In addition, two plants in Cojímar extracted shark liver oil and one in Santa Cruz del Sur canned clams, mackerel roe and turtle meat. The only processing plants on the entire north coast outside of Havana were the ones in Cojímar. Nine of the remaining plants, canning lobster and tuna, were located in the ports on the southwest shelf (La Coloma, Batabanó, Nueva Gerona) and the last, in Pinar del Río, was a plant which canned lobster tails. Industrial processing of marine products, therefore, was overwhelmingly concentrated in the province of Havana.

Baisre's assessment of fishing ports, therefore, is generally accurate in terms of the industry infrastructure. Docking facilities for vessels as well as handling and transportation conditions for fresh fish were clearly inadequate. However, while vessel maintenance and repair yards existed in a restricted number of ports, carpenters and other construction and repair personnel were more widely distributed and many fishers appear to have had the skills to maintain and repair their own vessels, as is common in artisanal fisheries in other parts of the world.

9.2.10 Socio-economic Conditions

The conditions of life of fishers and their families in the immediate
pre-revolutionary period were deplored by contemporary and later observers. Canet (1955) described them as "precaristas del mar"\(^1\) with a "miserable means of life". An editorial in *Mar y Pesca* refers to "thousands of fishing families exhausted by hunger and misery" (Anon, 1957: 3).\(^2\) Later observers are even more emphatic. García Ramón (1970: 47), echoing general post-revolutionary opinion, describes fishers as the "poorest and most miserable members of the Cuban population except in odd large ports...many lived in improvised shacks on shore and used rudimentary craft." They were "one of the groups most reticent about new ideas and organization."

Fiedler (1947: 167) was more optimistic with respect to fishers themselves who, he thought, although individualistic, were capable of engaging in co-operative efforts. It must be remembered, however, that observers of Cuba in the 1950s tended to compare the social and economic situation in Cuba, not to those in other Latin American or developing countries, but to those in the United States (Pérez 1988: 295-297). This was a comparison which Cuba could not win. Similarly, post-revolutionary accounts of life in the 1950s tended to depict conditions as being as poor as was possible, in the reinterpretation of history discussed at length by Pérez (1992: 56).

9.2.11 Social Facilities in Ports

The BANFAIC survey also examined the social facilities within the fishing ports. Although this information accounts for only 65% of fishers and does not include Havana, the frequency of occurrence of such facilities can be

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\(^1\) "Precaristas" were landless peasants of the colonial period.

\(^2\) "Cuando nuestra patria ofrece el triste espectáculo de miles de familias pescadoras agotadas por el hambre y las miserias." (When our fatherland offers the spectacle of thousands of fishing families exhausted by hunger and misery).
compared, with care, to that for the country as a whole, as described by Thomas (1971: 1095-1107).

Urban-rural differences in the provision of services were particularly marked in Cuba because the prevailing rural settlement pattern, unlike that in Spain where the population tended to concentrate in agricultural villages, was of dispersed single family homes. The provision of services to the latter would have been extremely expensive and, in fact, the Revolutionary government’s solution to this problem was to concentrate the rural population in new settlements. Those fishers and their families who lived in, or close to, ports which had other functions, such as sugar export, would have had greater access to urban services than the general rural population.

In 1958, one-half to two-thirds of houses in the country had electric light. However, as a result of a dispersed settlement pattern only 9% of rural homes compared to 87% of urban ones, had electric light. Since 63.8% of the fishing ports were supplied with electric power, it is probable that, on average, more fishers’ houses than rural houses had electric light.

Eighty-five per cent of rural houses had to use rivers for their water supply (Thomas, 1971: 1096) and 64% of fishing ports did not have a piped water supply. In the important port of La Coloma, for example, not only was there no piped water, there was also no well or reservoir so that water brought from a source 5 km from town was sold to the inhabitants in 5 gallon cans.

House ownership among fishers at 69.6%, was close to the national average but the quality of houses was quite variable and in smaller centres, they were often of the traditional *bohío* type. These were constructed of planks with palm-leaf roofs and earth floors and were often dispersed along the shoreline. In some places, such as Júcaro, they were mounted on piles
(stilts) because the area was subject to daily flooding by tides. Houses of more prosperous fishers were roofed with corrugated iron or tile and had cement floors (Suárez Caabro and Naranjo Betancourt, 1954a: 194). In larger ports, fishers houses tended to be closer to the urban norm (e.g. Batabanó [Suárez Caabro and Naranjo Betancourt, 1954b: 680]) whether concentrated in a separate neighbourhood as in Cienfuegos or dispersed throughout the urban area as in Cojímar.

Havana had more than half of all the doctors in the country in the 1950s. However, the organization of the health service was such that each of the country's 126 municipios employed one doctor who worked for a nominal fee. In addition, visits to clinics or hospitals were free (Thomas, 1971: 1105). The situation in the ports was probably better than that in the countryside in general (47% had access to a doctor, 22% a hospital). This, in itself, is no great recommendation since in this aspect the split between rural and urban society, especially that of the capital, was particularly pronounced. However, the BANFAIC survey found surprisingly good health among fishers and their families. The majority of fishers (65%) were classified as being in good health. In Batabanó, for example, it was reported that fishers were individually healthy with great physical strength and good teeth, at least when they were young. The only illnesses reported were colds and flu. The majority of fishers' spouses (61.3%) and children (56.3%) were also in good health and it was pointed out that fishers' children did not suffer from parasites to the same extent as did children in the countryside. It is difficult to discern meaningful patterns in the proportion of the fishing population classified as having poor health but the proportions seem to be higher in more remote locations and also in the eastern part of the country.

Every fishing port visited by the investigators had a primary school and
31% had secondary schools. Thus, the children of fishing families in these ports had access to at least a basic education. It is not known, however, how many of them were able to take advantage of it. Fifty-six per cent of fishers were literate compared with a national rate of 76.4% (Schroeder, 1982: 120). They range from a low of 11% in remote El Remático at the mouth of the Cauto, to a high of 89% in Cojímar adjacent to Havana.

Fiedler reported in 1947 (1947: 4) that 500 fishers in Havana were members of the "only fisherman's union", the Sindicato Unico de la Industria de la Pesca. In the early 1950s, fishers in eight additional ports were union members but the national average was still only 10.4%.

9.2.12 Fishers' Incomes

The most common method of selling fish was a bilateral agreement between fishers and buyers in the individual ports (Salmon, 1963: 31). With the exception of Havana, where there was an agreement among fishers for a minimum price, buyers were in a monopoly situation and almost always gave fishers low prices. This was compounded by the fact that, there being few storage facilities, larger catches could not be easily handled and the resultant glut usually led to a decrease in prices. There was little incentive, therefore, for fishers to increase the catch. Fish buyers were also often outfitters who supplied fishers with gear, food and other necessities so that fishers were often in debt to those to whom they had to sell their fish. Processing plant owners were also often owners of fishing vessels and, in return for a guarantee to buy the catch, could set prices at any level they chose. In addition, while consumers paid different prices for different classes of fish, fishers were paid almost the same, usually low price no matter the species (Quiroga Ríos, 1959: 26). The situation, then, "at the moment of landing,
presented to the fishermen all of the inconveniences of the liberal system without the advantages of free competition" (Salmon, 1963: 31).

The only wholesale market in the country was located in the "Mercado Unico" in Havana. Here, middlemen (commission agents and wholesale merchants) controlled the distribution of fish to stall-holders in the markets, to fish stores and to roving sellers. Retail prices in the capital for marine products, as a result, tended to be high. They varied in a hierarchy determined mostly by accessibility to the port. Thus, in ascending order of prices were: retailers in the Mercado Unico, retailers in the Carlos III and Vedado markets, roving sellers who sold to homes close to the markets, fish stores and markets in working-class neighbourhoods (barrios populares), roving sellers in central working class neighbourhoods, fish stores and markets in rich neighbourhoods, roving sellers in rich neighbourhoods and roving sellers in non-central neighbourhoods without fish stores or markets.

In the provinces, fish buyers and sometimes fishers and roving sellers were often able to establish tight control of the fish supply and, therefore to maintain elevated prices. The result was that at all points of sale, middlemen took a commission and in the inland towns and in Havana, transportation costs were added so that according to the Marina de Guerra report (1954, cited in García Ramón, 1970: 49) the price of fish on average could rise as much as 300% between fisher and retail buyer. Even the distant water fleet which delivered direct to Havana, often anchored outside of the harbour for as long as 25 days to await a favourable market situation before delivery (García Ramón, 1970: 48).

Fishers were generally paid on the basis of a fixed share of the landed value of the catch. Daily and casual fishers were often simply paid by the fish. In the Havana distant water fleet, operating costs (ice, fuel, oil, bait, salt,
commissions) were deducted from the landed value of the catch and the remainder split into 3 parts - one to the outfitter and 2 to the crew. A percentage was deducted from the crew share for social security and food and the remainder divided among the members (Quiroga Ríos, 1959: 18). According to Martinez (1948: 4), crew shares (from 10-12 in total) were not equal: experienced fishers and the master received 1 full share, inexperienced fishers a half share and novices one quarter share. From his share, the outfitter paid for gear, vessel maintenance, and his part of social security. In the late 1940s, the average income of masters was $3 000, that of fishers $1 200 per year (Martinez, 1948: 4). In Batabanó, the crew received two thirds of the landed value of the catch and from it had to pay for ice, food and fuel. Wages averaged $350 to $500 per annum and some fishers earned as much as $900 (Martinez, 1948: 4). The national average per capita income for the years 1945 to 1950 was $300 (Truslow, 1951: 1046). Fishers in these two ports, then, earned above the national average but it must be remembered that the Havana distant-water fleet was unionized and that 85% of the fishers in Batabanó were union members.

Salmon (1963: 37), using incomplete values for landings in 1957 and 1958 published by INP, calculated an average per capita annual income for fishers at $305 which, although below the 1958 national average of $356 (Thomas 1971: 1104), placed fishers in the uppermost bracket of working class incomes (Salmon, 1963: 37). Kajiyama (1959: 12) calculated the gross annual incomes of fishers in the tuna fleet at $525. Quiroga Ríos (1959: 25) who, it should be noted, spent most of his time in Havana, considered that "the situation of Cuban coastal fishermen seems to be economically and socially

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1 It is recognized that average annual income per capita, especially on a national basis, is an exceptionally crude measure of the real conditions under which people live. In the case of the fishery, however, there is no substitute. See Thomas (1971: 1103) for a discussion of this topic.
superior to those of other Latin American countries."

However, as we have seen, there was an undetermined number of subsistence fishers who probably had little cash income, so that incomes must have varied from fishery to fishery and from place to place.

Some, perhaps many, fishers and their families, especially in remote locations, undoubtedly lived in the type of misery depicted in post-revolutionary photographs of dirty children, naked or with few clothes, playing outside of wretched shacks built on the shore (Baisre, 1987, 264: 37). However, as we have seen, these images were not an accurate description of the socioeconomic conditions under which all fishers and their families lived. On the other hand, although average annual per capita incomes for fishers were reasonably high for working-class Cuba and compared to fishers in other Latin American countries, they were extremely poor compared to the only country, the United States, which mattered when such comparisons were, and still are, made. Fishers, in addition, were in a state of chronic indebtedness to outfitters and fish-buyers who exercised a great deal of control over the industry, and realized the greater part of the profits from it.

9.2.13 Scientific Research

As we have seen, fisheries research in Cuba was still in its infancy in the 1950s. The first Cuban attempts at description of the fishery date from this period (Sánchez Roig and Gómez de la Maza, 1952; Suárez Caabro, 1955). The survey of ports carried out under the auspices of BANFAIC was an important attempt by a government agency to discover the nature of the fishery and the condition of fishers throughout the archipelago. Scientific research began to be undertaken by the personnel of the Fisheries Research Centre whose studies of the shrimp resource led to the creation of a new industrial fishery
(Pérez Farfante, 1953a). The collapse of that same fishery stimulated the Marine Lab of the University of Villanueva in Havana to begin the first systematic oceanographic survey in Cuban waters when, in December of 1957, water salinities, temperature, dissolved oxygen and plankton and currents were recorded in the western part of the Gulf of Batabanó. However, despite such promising beginnings, there is no question that fisheries research in Cuba in the 1950s was in a very underdeveloped condition.

9.2.14 Subsistence and External Trade

The question of the subsistence nature of the fishery and that of imports and exports, may be usefully considered together.

It has already been established in Chapter 4, that development in the fisheries of the nineteenth century was a result, not of a growing population who regarded fish as a staple food and fishing for subsistence, but of an urban-based demand, especially in the capital, for high quality seafood, combined with an overseas demand for sponges. We have also seen that the situation did not change substantially during the twentieth century. National consumption per capita remained low and its historical spatial pattern persisted. Per capita consumption of fresh seafood in Havana, at 6.05 kg of edible portions/cap/ann, was twice that of the rest of the country (3 kg Salmon, 1963: 37). With only about one-fifth of the population of the country, the capital consumed about 65% of total fish, and 37% of shellfish production (Quiroga Ríos, 1959: 12) (Fig. 9.4).

Habaneros ate more fish than their fellows in the countryside but their tastes were quite conservative. Although hundreds of species were caught by fishers, only a small number of favoured ones were sent to the Havana

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1 The source for Fig. 9.4 was: Suárez Caabre and Naranjo Betancourt (1954).
market, the remainder being discarded or eaten by fishers and their families. In the market, in 1956, sales of fresh and frozen seafood amounted to 4,941.5 mt of fish, 582.6 mt of shrimp, about 390 mt of oysters and 200 mt of lobster and smaller amounts of crabs, clams, octopus, squid and turtles (I.N.P., 1957). Tastes were even more restricted in that about 70% of fish sales consisted of the demersal groupers (44.8%) and snappers (25.7%) and a further 12% were pelagic mackerels. A large proportion of the demersal fish were caught outside of the Cuban shelf on the Campeche Bank. Canned tuna was also eaten. More than 100,000 cases (one case contained 24 cans of about 9.5 oz each) of "Tuna in Oil" were produced in 1952 and all of it was consumed within Cuba, satisfying, as noted previously, about 85% of the demand. Observers of the time lamented the underutilization of shelf species consequent upon the nature of the capitalinos' tastes in seafood (Howell Rivero, 1955, Quiroga Ríos, 1959: 32).

The other engine of fisheries development in Cuba, the export fisheries, gained in importance during the post-World War II period. In 1948, the imbalance of imports over exports was 14 times with respect to quantity and 10 times with respect to value while in 1958, the corresponding figures were much lower at 4 times and 1.6 times (Figs. 9.5a-b). As we have seen, this period saw the beginnings of real growth in the lobster fishery and the introduction of industrial gear and methods into the shrimp fishery. As can be seen from Fig. 9.5a, just over half of all exports in 1958 were made up of fresh or frozen crustaceans (2,300 mt), followed by fresh or frozen fish (37%; 1,600 mt)\(^1\). The crustacean class was made up mainly of lobster destined for the U.S. market. Fisheries for export, then, had increased significantly in importance during the 1950s.

\(^1\) The source for Fig. 9.5 was: Salmon (1963: 35).
Fig. 9.5. Exports and Imports: 1958
The pattern of consumption outside of the major cities remained similar to that of the past. Observers in the 1950s (Quiroga Ríos, 1959: 32) ascribed this to the fact that the quality of fresh fish (packed in ice) was extremely variable with distance from ports of landing. However, the persistence of the dietary preferences of 19th century slave society should not be discounted. As noted above, while exports increased, imports remained high and, at 16 600 mt in 1958, they were of the same order of magnitude as domestic landings. From Fig. 9.5b, it can be seen that 72% of imports were of "salted or smoked fish", mostly cod from Norway and Canada and 27% were of "canned fish or crustaceans", mostly sardines, tuna and squid from Spain (Salmon, 1963: 35; Quiroga Ríos, 1959: 32).

In 1958, then, fresh fish and shellfish caught in the archipelago and in the distant waters fisheries, were consumed mostly by the urban middle-class and wealthy while cheap imported dried cod and sardines were eaten by both urban and rural poor but especially the latter. While subsistence fishing must have occurred in the archipelago, the persistence of colonial dietary preferences and the magnitude of fish imports, suggest that it is unlikely that large numbers of Cubans were engaged in purely subsistence fishing. The fishery continued to be overwhelmingly commercial in nature.

9.2.15 Overfishing

Given the growth in fish landings which occurred after 1959 (landings in the late 1980s were four times as high as those in the late 1950s), it is clear...

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1 Salmon (1963: 34) gives a figure of 17 234.3 mt and a corrected one of 21 414.1 mt for domestic landings in 1958.
2 In the late 1940s and early 1950s Norway supplied more than half of the cod while Canada supplied 40%. The Norwegian legation had a representative, paid by that country's association of fishers, whose sole job was to look after cod imports to Cuba and other Caribbean countries (White, 1955).
that, in general, the resources of the insular shelf were not being exploited at anything approaching the maximum level. However, it is also certain that instances of over-exploitation had occurred.1

Although catch statistics are absent for the entire history of the fishery, with the exception of the last 60 years, and historical evidence is scanty, it is apparent that the two marine creatures, turtle and manatee, with flesh most resembling the meat of land animals were the first to feel the impact of human exploitation. The three species of turtle which can be found in Cuban waters, loggerhead turtle, hawksbill turtle, and green turtle, were consumed in great numbers by the Spanish fleets operating from Havana in the colonial period (Carr, 1973: 14). Green turtle was especially favoured and was an important food in Cuba in the 17th century (Suárez Caabro, 1988: 26). The animals were particularly easy to catch when they came on to the beaches to lay their eggs which were also favoured eating. Ponce de León reported catching 170 turtles in one night in the Dry Tortugas in 1513 (Rivero Muñiz, 1958b: 10). According to Carr (1973: 106), green turtles used to nest on the Caribbean beaches of the archipelago but the colony has been almost wiped out by human exploitation. While they are still caught in Cuban waters, their numbers are now much reduced throughout their range.

Manatees, inhabitants of littoral, lagoonal and estuarine waters, were also vulnerable to capture by human beings. They were exploited for their meat which was dried and salted, for their fat which was used to grease the bottoms of Spanish ships (Covington, 1959: 115) and for their skins. García Ramón (1970: 27) mentioned their scarcity in the mid-nineteenth century and the General Fisheries Law of 1936 prohibited not only their capture but also the import of their meat or skins from outside of the country (Article 39) as

1 “Over-exploitation”, in this context, refers to biological over-exploitation.
well as the possession of objects, such as whips, made from their skins (Article 40). These prohibitions imply that the manatee population in the archipelago, like that of the turtles had been greatly reduced.

As we have seen, the occurrence of growth over-fishing seems to be suggested by the evidence from the lane snapper fishery in the Gulf of Batabanó in the early years of the twentieth century. In the absence of landings statistics for the early part of the century, it is difficult to establish whether this had any lasting impact. Landings showed a slight increase from 1935 to 1940, averaging 766 mt. then, for an as yet undiscovered reason, fell to only 32 mt in 1941. They increased again after that year but showed some variation from year to year and a lower average (643 mt) than before the war. Whether this was a result of heavy fishing pressure is not known but the popularity of this fish and the proximity of the fishing grounds to the Havana market make this a possibility. As will be seen in a subsequent chapter, lane snapper stocks in the southeast Gulf of Batabanó have also suffered from overfishing in the 1980s.

The collapse of the La Broa Bay shrimp fishery of the 1950s has been attributed to overfishing. Baisre and Zamora (183: 4), for example, call it the first documented case of overfishing in Cuba. The fishery lasted only about 16 months from the first discovery of the stocks to the collapse of the fishery. There was no control over the number of vessels which could enter the fishery. Ten months after the first experimental fishery began, there were 33 vessels operating in the area in what Pérez Farfante (1953b: 98) called a "race for pink gold." In February 1954, the average catch per vessel was 630 lb per night. This dropped to 185 lb in May and 90 lb in July (Pérez Farfante, 1954: 180). It is not clear whether the fishery was then closed or whether it was simply abandoned by fishers.
On the face of it, this short fishery presented an apparently classic example of the logical consequences of exploitation of a valuable common-use resource under conditions of open access. However, Pérez (1994) has recently commented on this topic. While agreeing that 33 vessels were too many for this restricted area, he notes that the decline in the catch per vessel noted above conforms to what could have been expected from the seasonal behaviour of the shrimp biomass. Both pink and white shrimp stocks in the bay are comprised of practically a single cohort the biomass of which reaches a minimum in July-August as older shrimp die and the subsequent cohort begins to recruit. In addition, the nursery area is small with shallow water which is subject to wind-driven circulation, and lacks natural sanctuaries to protect at least part of the stocks. As a result, shrimp stocks in the bay are susceptible to environmentally-induced population crashes. It appears, then, that overfishing may not have been the sole cause of the collapse of the fishery.

Overfishing also seems to have occurred in the sponge fisheries as a result of the decrease in production consequent on the blight which struck in Cuban waters in the late 1930s. As a result of the cut-off of supplies from the Mediterranean during World War II, demand soared and the average value of one dozen sponges rose from $0.58 in the period 1935-1939 to $10.04 in 1946 to $8.14 in 1947 (Radcliffe, 1949: 44). According to Radcliffe (1949: 45), this resulted in overfishing and proposals to close the fishery for five years.

A last, more indirect, example of over-exploitation occurred in the stone crab fishery where the damage to stocks seems to have come not so much from overfishing, although that might have been a contributory factor, but from destruction of the species' nursery areas on the northeast shelf by pollution from sugar refineries and other industries (República de Cuba, 1939:
3).

Baisre's point about the inability of the Cuban fishing fleet, with its small vessels and artisanal methods, to overexploit the resources of the insular shelf, in general, is well taken. However, it is obvious from the above examples that, especially in the case of high demand, high value species, traditional fishing gear and methods provided no intrinsic protection for stocks. It is interesting to note, on the other hand, that the most unequivocal example of stock collapse came with the first introduction of industrial fishing into Cuban waters.

This discussion has shown that Baisre's description of the Cuban shelf fishery in the late 1950s shares the characteristics of post-revolutionary writing described in the introduction to this chapter. To repeat the quotation from Pérez: "In Cuba, new versions of the past were summoned to serve new visions of the future. The consolidation of the Revolution required not only reordering Cuba as it was known but also revising Cuba as it was remembered" (Pérez, 1992: 56). It seems to this observer that the fishery was not a traditional subsistence one of the type common in countries, like the Phillipines or Indonesia, with large fish-eating populations. Rather, it was, and had been for much of its history, commercially-oriented to both a domestic urban market concentrated mainly in the capital, and to an export market for high value species like sponges, lobster and shrimp, especially in the United States. While enjoying only sporadic support from government and lacking in basic scientific research, the fishery appeared to be in the early stages of a transformation toward more intensive exploitation of high value marine resources such as lobster, shrimp and small tunas. Many fishers worked also in other industries and many, with their families, lived and
worked in extremely poor conditions. However, many, especially in the larger ports, could be counted in the upper levels of the working-class and shared urban rather than rural living and health conditions. Lastly, in spite of its generally low level of technology, the fishing fleet was capable of destructive exploitation of high-demand shelf species.

It is impossible to know what complexion the Cuban shelf fishery would have possessed today if it had continuing developing along the lines established in the 1950s. The "Triumph of the Revolution" in January, 1959 changed the trajectory of fisheries development in fundamental ways which will be examined in Part IV.
PART IV
POST-REVOLUTIONARY FISHERIES EXPANSION: 1959-1976
CHAPTER 10
GOVERNMENT POLICY AND THE FISHING INDUSTRY 1959-1968:
CO-OPERATIVES AND MODERNIZATION

We have seen that fisheries development in Cuba in the pre-revolutionary period was driven principally by the demand for marine products in urban areas especially the capital, on the one hand, and in external markets, especially the United States on the other. This situation changed fundamentally after 1959. With the accession to power of the revolutionary forces, the fishing industry became subject to a process of government-driven modernization which took Cuban fisheries development in directions in which it would surely not otherwise have gone.

The history of the post-revolutionary industry may conveniently be divided into two periods, before and after 1977. In that year, a combination of falling catches in the shelf fisheries and the introduction of 200 mile exclusive economic zones in the world ocean, called the Cuban fisheries development strategy of the time into question and resulted in fundamental changes in the industry. Part III will examine fisheries development during the first of these two periods. This chapter attempts to document the impact of government economic policy on fisheries policy and organization from 1959 until 1968, a decade of modernization and incomplete collectivization. Chapter 11 will examine the performance of the industry during the same years. The last chapter will trace the full nationalization of the fishing industry and its impact on fisheries development and on marine populations of the insular shelf.

The revolutionary forces did not take power on the first of January,
1959 with fully-developed political, social or economic policies. Economic goals, and the strategies for achieving them, developed once they were in power and changed, often radically, in the ensuing years. The attempt to trace and explain these changes has given rise to a great many publications which, although often conflicting in detail, generally agree on recognizing several distinct periods in the economic thinking of the government (see, for example, Alvarez, 1990; Azicri, 1988; Edelstein, 1985; Mesa-Lago, 1981; Ritter, 1974; Zimbalist, 1985). From the perspective of fisheries development, three stages between 1959 and 1968 may be identified: 1959-1961; 1961-1963; and 1964-1968.

10.1 THE IMMEDIATE POST-REVOLUTIONARY PERIOD: 1959-1961

The development of the fishing industry in Cuba in the immediate post-revolutionary period occurred in the context of a rapid, increasingly radical transformation of the entire social, economic and political life of the country and the re-orientation of its foreign relations and trade from the United States toward the Soviet Union and other socialist countries. The government in this early period was characterized by a "lack of leadership coherence" (Zimbalist, 1985: 215). According to Ritter (1974: 64) there were at least four identifiable political groups each with different ideas about the problems facing the country and about how to solve them. However, in spite of a great deal of confusion, the Revolution began to show tendencies toward radicalization, along with a deterioration in relations with the United States, and increasing contact with the Soviet Union. New measures were introduced in four major areas. Firstly, urban reform was initiated by means of reduction in mortgages and rent, and prohibition on ownership of houses except for personal use. These effectively ended speculation in urban
property. Secondly, the Agrarian Reform Law of May 1959 had the twin objectives of stimulating economic development and improving the living standards of the rural population. Large and medium-sized agricultural holdings were expropriated and re-organized into agricultural co-operatives, state farms and cane co-operatives. Thirdly, there was a progressive nationalization of industry that began with the expropriation of assets of supporters of the previous regime and others who had left the country, as well as those who were considered to be counter-revolutionary. It then progressed to American and other foreign-owned companies. Lastly, a system of central-planning was introduced with the creation of the Central Planning Board (Junta Central de Planificación, JUCEPLAN) in early 1960.

The outcome of the first 3 years of rather chaotic change was an economy in which all of the banks and 85% of industry had been nationalized, most agricultural land had been re-organized into state farms or co-operatives and the whole was organized by means of central-planning. In the social sphere, income distribution had become more equitable, education, health and other public services were universally accessible and equality of opportunity had increased (Ritter, 1974: 63). In politics, "a pluralistic though oligarchical congressional democracy was replaced by a highly centralized and personalistic system" (Ritter, 1974: 63). The direction of Cuban foreign relations had also become radically re-oriented during this period, a deterioration in relations with the United States having culminated in the imposition of an American trade embargo in October of 1960. At the same time, contacts with the U.S.S.R. had increased and that country had provided technical assistance, trade credits and an agreement to purchase one million tons of sugar per annum from 1960-64 at guaranteed prices.

Given the confusion that prevailed during the early post-revolutionary
period, it is not surprising that no precise policy was articulated with respect to fisheries. Its absence, however, did not prevent the government from taking action. In early 1959, a tour of the archipelago (Salmon, 1963: 39) including a census of fishing ports (Milera, 1993) was undertaken and, as a result, a number of measures with respect to fisheries and the fishing population were quickly introduced. The thrust of the ensuing changes, which affected all sectors of the industry, makes it clear that the principal aim of revolutionary policy during this time was to improve working and living conditions for fishers and their families.

10.1.1 Administrative Structure

In the new political situation, fisheries were initially made the responsibility of a new government agency, the Office for Marine Development (Oficina de Fomento Marino Cubano) under the leadership of Commander González Líñez who had been in the Sierra Maestra with Fidel Castro. The Office had a tri-partite responsibility for coastal development, for the merchant marine and for fisheries.

However, with the passage of the Agrarian Reform Law in May, 1959, responsibility for fisheries was moved to the newly-created Department of Fisheries within the National Institute for Agrarian Reform (Instituto Nacional de Reforma Agraria, INRA). Fidel Castro was the president of INRA and the revolutionary geographer, Antonio Núñez Jiménez, was executive director in charge of day-to-day operations.¹ The director of the Department of Fisheries was Porfirio Alar, a communist fisher, also a political appointee.

¹This appointment seems to have been an example of guerrillismo administrativo: "This appointment explained some of the errors in judgement committed in the next two years: Núñez Jiménez was, according to Professor Dumont, 'better fitted to organize a meeting or ride a horse, banners in the wind, to occupy the territory of the United Fruit company, than to organize, rationally, the socialist sector of agriculture'" (Thomas, 1971: 1218).
appointee with little knowledge of the fishing industry outside of the artisanal shrimp fishery in Manzanillo, according to Buesa (1992). Another communist, Salvador Pérez Olivera was made sub-director to run the Department. During the years that fisheries were under the INRA umbrella, Fidel Castro paid very close attention to them: "Fidel has always had a thing about the sea. He loves fisheries. He loves to go fishing" (Buesa 1992). This personal interest, allied with the revolutionary impulse to improve the lives of fishers and fishing communities, may help to explain the quantity of scarce resources invested in this rather unimportant economic sector during these early post-revolutionary years. The Department of Fisheries translated revolutionary policy into a series of rapid and far-reaching actions which included: the grouping of fishers into co-operatives, eliminating middlemen, nationalizing processing companies, raising and stabilizing fish prices, initiating a program of vessel construction, building communities for fishing families; and resuming scientific research.

10.1.2 Co-operatives

The creation of co-operatives was the central focus of the re-organization of the fishing industry during the early post-revolutionary period. As noted earlier, unsuccessful attempts at forming such cooperatives had been made by the government of the Republic so the idea was not a new one.¹ However, it seems likely that the roots of the new organizational structure lay not in the experiments of the 1940s but in the general reform of agriculture embodied in the Agrarian Reform Law of May, 1959, of which

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¹ Appreciation of the utility of co-operatives in the fishing industry was also more widespread. "Western experts (FAO 1949: 48-49) endorsed the organization of middlemen-ousting auctions and cooperatives as necessary phases in fisheries development everywhere" (Emmerson, 1980: 66).
cooperatives were an integral part.¹

Fishing co-operatives were described in 1960 as "an alliance of free association with democratic control" (JUCEPLAN, 1960: 32). However, while the first part of this description may have been accurate, the second part was not. As in the agricultural co-operatives (Thomas, 1971: 1218), managers were not elected nor hired by the members, but were appointed by the Department of Fisheries. Nor did the co-operatives have financial or administrative autonomy. These aspects were controlled by the same Department which also carried out such functions as the preparation of budgets, collection of statistics and issuing of fishers' identification cards (Buesa, 1992; Salmon 1963: 47).²

This arrangement resulted in a degree of paternalism in the relationship between co-operatives and fishers which was succinctly, if unconsciously, portrayed in Fig. 10.1, a cartoon from Mar y Pesca (Navarro, 1960: 18) which shows the co--operative, represented by a figure wearing a suit, reaching down to rescue the grateful fisher from a whirlpool of misery, mistreatment and ignorance.

The co-operatives took over those functions, previously performed by private outfitters, dealing with the extractive sector of the industry. They maintained and repaired vessels and began to build new ones. Under the direction of the manager and an accountant, they supplied fishers with gear, fuel, provisions and technical services and they bought the catch. The only tasks they did not perform were the processing and distribution of the catch which became the responsibility of state enterprises.

¹ According to Thomas (1971: 1218), the idea of co-operatives was a last minute inclusion into the Agrarian Reform Law, indicating, perhaps, that the government's aim in creating them may have been political rather than economic.

² With respect to co-operatives in general, there was an expectation that, at some time in the future, managers would be elected and profits distributed among its members (Thomas, 1971: 1325).
Fig. 10.1. "SAVED FROM THE WHIRLPOOL!"
In the early years, each co-operative included the following basic physical plant: an office, a dock and shed for landing fish, facilities for storage of the catch, including a refrigerator and a fuel storage facility. The aim was that each one would eventually also possess a boat-repair and maintenance yard, a motor-repair shop, an ice plant, cold storage or salting facilities, and a fish store for direct sale to the public. Their function was not, however, to be restricted to the economic sphere. They were also to be the vehicle for the provision of social and health services to fishers and their families and so were to include housing provided by the Rural Housing Department of INRA, storage for potable water, a dispensary and a "peoples' store".

Membership in co-operatives appears to have been voluntary, and not all fishers joined them so that they had a mixed character. Many fishers who owned their boats either sold or donated them to the co-operatives which thereupon took over responsibility for their maintenance and repair while the former owner remained in command. However, a Ministry of Foreign Relations report (República de Cuba, n.d.: 151) states that in the early 1960s, 60% of fishers owned their own vessels. These fishers delivered their catch to the co-operative and were paid by the amount of fish caught. The co-operative supplied them with equipment and provisions and repaired their boats for a charge of 10-15% of landings (García Ramón, 1970: 69). Members, on the other hand, used vessels owned by the co-operative and were paid on the basis of a share in production.

In the first year after the Revolution, 32 co-operatives and 12 sub-cooperatives were formed with 8 more of the former and 14 of the latter being added in the next year (INRA, 1961: 5). Salmon (1963: 46) reported a total of 49 co-operatives (including 5 interior ones producing frog legs) and 35 sub-co-operatives, for a total of 79 coastal locations from which fishing took place.
Later publications (Achurra Larrain, 1967: 17; Salnikov, 1966) show fewer co-operatives so that some consolidation seems to have occurred.

10.1.3 Vessel Construction

The revolutionary government quickly undertook a program of new vessel construction with the primary aim of improving the working conditions in the fleet. Subsidiary aims of the program, in line with the broader goal of industrializing the economy, were to increase employment opportunities in remote coastal locations and to develop a source of income through the export of fishing vessels (Salmon, 1963: 49). In order to accomplish these aims, boat yards were built at various locations and by early 1961, there were 15, employing 552 workers (Fig. 10.2).\(^1\) The distribution of the yards shows a bias towards the eastern regions of the country.

A number of basic vessel designs, named according to the Greek alphabet, were employed to build a series of motorized wooden vessels ranging in size from the 7.74 m (25 ft) \textit{Eta} to the 23.22 m (75 ft) \textit{Lamda}. (See Appendix IV).\(^2\) Vessels were built in series beginning with those of the simplest design and progressing to more complex ones. A total of 204 were built by the end of 1961. The overwhelming majority (93%), being destined for the shelf co-operatives, were of the smallest two types (Fig. 10.3).\(^3\)

10.1.4 Elimination of Middlemen and Nationalization of Processing

The term "middleman" embraced a large number of those involved in the fishing industry. It included: fishing outfitters, whether individuals or companies; proprietors of processing plants; fish-buyers and transporters;

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1 The source for Fig. 10.2 was: Salmon (1963): 49.
2 The diagrams in Appendix IV were adapted from those in MIP (1985).
3 The source for Fig. 10.3 was: Salmon (1963): 46.
Fig. 10.2. Boat Construction Yards by Province: 1961
Fig. 10.3. Types of New Vessels: 1961
importers and exporters; ice plant and freezer owners; and owners of boat construction and repair yards, especially if they were in a monopoly situation (Salmon, 1963: 44). The elimination of such middlemen was accomplished by the Ministry for the Recovery of Misappropriated Assets, formed in the first half of 1959 and authorized to confiscate the property of supporters of the deposed dictator (Batistianos), the corrupt, exiles and counter-revolutionaries (Ritter, 1974: 70).1

The resultant nationalization of the means of production in the fishing industry was incomplete during this early period. It affected some 200 outfitters and 300 of the most important fishing vessels (Salmon, 1963: 44). Many fishers who owned their vessels avoided confiscation by either selling or donating them to co-operatives as mentioned above. In addition, an undetermined number of fishers remained independent and outside of the co-operative system. Boat repair and construction yards as well as engine repair shops were also subject to incomplete nationalization so that co-operative and private yards were in competition for scarce resources and for labour, especially for carpenters and mechanics.

Nationalization of the industry outside of the extractive sector was more advanced. Almost all canning and freezing plants became the responsibility of the Department of Fisheries of INRA, fish buyers, transporters and the wholesalers of the Mercado Unico in Havana and other markets in the provinces were put out of business and so were importers and

1 What Emmerson (1980: 66) called the "Manichean contrast" between evil middleman and good-hearted but gullible fisherman was not restricted to Cuba. The quote he supplies from an Indian fisheries expert could have been written by a Cuban revolutionary. "The fishermen of West Bengal had been consigned to an abyss of hell due to unscrupulous exploitation by a section of middlemen and capitalists who have brought about ruination and almost complete extinction of (the fishing) community ... The most heartening feature is that these (fishermen), even amidst such a catastrophe, have still in them a golden heart, honesty and integrity, valour and patriotism and a social spirit (of) which the nation can be really proud" (Saha, 1970: 100).
exporters who were supplanted by a state enterprise. In conjunction with the elimination of buyers, fish prices, both landed and retail, were fixed by the government at levels higher than the pre-revolutionary ones. Ice plants and freezers were also nationalized but often had to supply other users in addition to the fishing industry so that the ice supply remained a problem for a time.

10. 1. 5 Communities

A program of construction of planned communities for fishing families was initiated and carried out by the Department of Rural Housing of INRA. The first community, with 450 homes, was inaugurated on July 25, 1960 in Manzanillo and others were subsequently built in Caibarién, Pilón and elsewhere. The objective of the program was to better the living conditions of fishing families and in this it must be counted as successful. It was also, however, in conjunction with other changes in the industry, intended to improve fishers themselves. A description of the typical Cuban fisher appeared in a report published by JUCEPLAN (1960: 7). According to it, the typical fisher was so brutalized by the physical environment and the conditions of work that he developed conservative attitudes to innovation in fishing and anti-social attitudes on shore. This was a man who had to forget his brutal life and so turned to drink (thereby encouraging the growth of bars and prostitution) before returning to his miserable family and worse shack. Cuban revolutionary authorities should not be overly criticized for attempting to change such a poor specimen by placing him in decent housing. While this may have been a simplistic solution, it was one that met with widespread acceptance in the developed world in the post-World War II period and the Cubans, at least, tried also to improve the conditions of work.
10.1.6 Education

The general educational level of fishers and their families, like that of other sectors of the rural population, was raised by the National Literacy Campaign of 1961, after which it was estimated that the national rate of illiteracy had dropped to 3.9% (Rudolph, 1985: 43). However, the revolutionary government regarded the improvement of fishers' skills as essential for fisheries development and, consequently, two fishing schools, one at Cayo Loco in Cienfuegos, the other at Cayo Largo in the southeastern Gulf of Batabanó, were opened in the early 1960s (Salmon, 1963: 53; Buesa, 1992). Students received training in navigation, fishing techniques and machinery with the ultimate aim of producing vessel masters with skills more appropriate to the modern fleet then under construction. Also, 1 600 children of fishers, between the ages of 6 and 16 years, were given instruction in a "scholastic centre" in Varadero in 1961.

10.1.7 Scientific Research

As we have seen, the Fisheries Research Centre (CIP) closed in 1955 and fisheries research in general faltered somewhat in the latter part of the 1950s with few published works appearing in the second half of the decade. This is not particularly surprising given the political situation in the country at the time.

The Fisheries Research Centre re-opened in April 1959 at the initiative of González Líñez. It was led by the former acting-director, the shrimp biologist Isabel Pérez Farfante, who began to recruit workers. Farfante,

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1 The membership of the Fisheries Research Centre in 1960 was as follows: Isabel Pérez Farfante, director; José T. Acosta Jiménez, biologist; René J. Buesa Más, technician; Luis Rojas Carballosa, ichthyologist; Milagros Alemany, biologist; Eduardo Peón, chemist; Carmen Chiaramonte, secretary; Jesús Mayor, fishing gear technician; Leonel Saroza, superintendent (Buesa 1960: 1).
however, soon left the country for political reasons. It seems that she was not alone. Salmon (1963: 52) notes that the work of the Centre would have been much improved had a number of its biologists not left the country. The directorship of the organization, which now had 12 workers, was taken over in August 1960 by René Buesa, a medical student at the University of Havana until it was closed down in 1958, and a fisheries technician at the centre (Buesa, 1992).

The Fisheries Research Centre became, and has remained until the present, the most important research branch of the fishing industry. It reoccupied the building used in the 1950s in Baracoa, 25 km from the city. According to Buesa (1992), it was a beautiful building with lots of facilities. However, Salmon (1963: 52) noted that its remote location combined with a lack of telephones and public transport resulted in lost hours and fatigue for some staff who spent up to two-and-a-half hours travelling morning and evening. It had, he pointed out, four research vessels but no transportation for its staff.\(^1\) The Centre's major activities in this early period were a mixture of basic oceanographic research and more practically-oriented fisheries research such as tests of new gear (Buesa, 1960). It also attempted to correct the statistical system of the industry. In time, the Centre and its workers, Cuban and foreign, became the major source of innovation in the industry.

The Centre was not, however, the only research organization during this time. The Cuban Institute for Technological Research (Instituto Cubano

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\(^1\) This situation is being repeated in Cuba today during the Special Period in Peacetime. In the years when gasoline was in plentiful supply, most workplaces, including the Ministry of Fisheries, had their own fleets of buses which picked up workers at collection points and transported them, free of charge, to work. There was, consequently, no impulse toward spatial rationality in the relationship between the location of home and work. The result was that, with the severe gasoline shortages of recent years, many workers travelled long hours to work often on foot or by bicycle or, sometimes, did not bother to go at all.
de Investigaciones Tecnológicas, ICIT) was taken over by the Ministry of Industries and did some studies on sardine (Suárez Caabro et al., 1961) and tuna fisheries (Suárez Caabro and Duarte Bello, 1961) before turning to sugar research. It was later replaced by the Centre for Technological Research of the Fishing Industry (Centro de Investigaciones Tecnológicas de la Industria Pesquera, CITIP) which, later, was amalgamated with CIP.

In late 1959, the National Aquarium (Acuario Nacional) was opened by the Ministry of Public Works under the directorship of biologist Dario Guitart. When the "reactionary" (República de Cuba. Comité Estatal de Ciencia y Técnica, 1978c: 5) University of Villanueva closed, two of its fisheries researchers, Suárez Caabro and Duarte Bello, moved to the Aquarium to continue their investigations. However, both of them soon left the country. The research functions of the Aquarium were taken over by the Department of Marine Biology of the Academy of Sciences in late 1962 and this, along with some functions acquired from CIP, became, in turn, the Institute of Oceanology of the Academy of Sciences.

In the first few years after the Revolution, therefore, the Cuban fishing industry and its workers and their families were subject to fundamental changes emanating from the policies of the revolutionary forces. In the confusion of these first years, there was no explicit fisheries development policy but the changes implemented by the government were overwhelmingly directed at improving the working conditions of fishers and improving their lives and those of their families. Partial steps toward the nationalization of the industry were taken by the introduction of cooperatives, with voluntary membership, and by the state take-over of buying, wholesaling, processing and transportation of fish. A beginning was made on
the improvement of port infrastructure by dredging, building new docks and boat yards and by the provision of refrigerators and, in some cases, ice plants. Work conditions were improved by the introduction of new vessels, although some early designs were poorly adapted to the ecological conditions of the shelves. Fishers who were co-operative members shared in the revenues from higher production, and all fishers benefitted from the stabilization of prices at a higher level so that incomes increased during the three years 1959 to 1961 by about 60 or 70%, over 1958 (Salmon, 1963: 66). New communities were built and education and health services were improved.

Thus, in only a few years, the revolutionary government had succeeded in bringing about many of the changes which previous governments had desired but had not accomplished. Some of this success must be attributed to the fact that this was a time when great optimism and receptiveness to change were widely diffused throughout the population of the country. As we have seen, however, changes did not progress at the same speed throughout the country and not all went smoothly. In the rush to improve and modernize, traces of condescension by technocratic revolutionaries toward fishers and their artisanal vessels, gear and methods can be detected.

10.2 THE INTRODUCTION OF SOCIALISM: 1961-1963

A second period in Cuba’s post-revolutionary economic history can be dated from the unsuccessful invasion in April 1961 by a U.S.-backed force at the Bay of Pigs (Playa Girón) on the south coast. In the same month, Fidel Castro publicly declared the "socialist" nature of the Cuban Revolution. Whether Castro had always been a communist or whether his conversion was a pragmatic reaction to American hostility, or had some other source is a
topic of vigorous debate in the literature on Cuba. The question is not of relevance here. What is relevant is the fact that this period seems to have marked the victory of the economic program of the Cuban Communist Party (Partido Socialista Popular, PSP) in the competition of ideas which characterized the first period.

For the first time, a clear articulation was made of the economic development model to be adopted. Following the example of the Soviet Union in the 1930s, the engine for economic development was to be heavy industrialization, involving steel and electricity production, heavy engineering, machine tools and the like. Production of such goods would allow diversification of the economy and would decrease dependence on the exterior by means of import substitution. The dependence on sugar monoculture, despised by the revolutionaries, was to be reduced by increasing diversification in agriculture. All of this was to be achieved by a planning system modelled closely on that of Czechoslovakia and constructed with the aid of Soviet and Czechoslovakian planners (See, for example, Edelstein, 1985; Mesa-Lago, 1981).

JUCEPLAN, with responsibility for preparing annual and medium-range plans, was at the centre of the new economic organization. Its membership included many members of the Council of Ministers so that there were close connections between the political leadership and the planning process. In accordance with the new system, the first four year plan for the fishing industry was introduced in early 1962.

Fisheries policy articulated during this period was consistent with the comprehensive National Plan for Economic and Social Development (Mena Millar, 1983: 59). In 1961, the basic objective of the fishery was defined as being to obtain constant growth in catches so as to: increase the level of
consumption of fish by the population; to diversify the economy by creating sources of employment in activities related to the fishery; and to improve the living conditions of fishers and their families (Mena, 1983: 59). Fisheries development, therefore, still emphasized social objectives but growth was also seen as a vehicle for creating employment by industrial diversification and, by import-substitution, to improve the country's balance of payments. The increase in catches upon which this strategy depended was to be achieved mainly by the creation of a Cuban distant-water fleet and by the inclusion of the shelf co-operatives into the state sector.

Some comment is perhaps in order with respect to the fundamental objective. It is clear that a constant increase in catches is logically impossible. However, it is probable that the original statement, having been made at a time of post-Revolutionary optimism, had a fairly large rhetorical component and was meant to indicate a desire only to substantially increase Cuban fish catches. In addition, it is possible to conjecture that there were two further sources of such optimism both of which were more directly connected to the fishing industry. The first was the underexploited nature of the shelf fisheries accompanied by a sense that they possessed a large potential for development. The second source of optimism was related to the perceived potential of distant water fisheries. The tremendous growth of distant water fleets in many countries during the late 1950s and 1960s demonstrates that Cuba was far from alone in its belief in the huge development potential of the marine resources of the world. In fact, in the view of fisheries experts in eastern Europe and the Soviet Union:

Further development of marine fisheries cannot be halted by a scarcity of living marine organisms. According to Eastern fisheries scientists man presently utilizes only a part of fish species in the upper trophic level. After these species are depleted, it is possible to substitute other
species located at lower trophic levels or species not presently utilized because of technological and economic reasons (Kaczynski, 1977: 401).

Due to the importance of the distant-water fleet in Cuban fisheries policy, a brief description of its growth will be given here.

10.2.1 Distant-Water Fleets

The revolutionary government's interest in distant-water fisheries had already been pre-figured in speeches by Fidel Castro as early as May of 1960. "Hay que hacer, además, para lo alto. Así que vamos a organizar flotas para pescar en los bancos al objeto de lograr un aumento urgente de la producción." Later, on May 30, 1962 he further articulated the vision of fishing industry expanded beyond the Cuban shelf: "Vamos a un programa de desarrollo de la pesca para lograr cientos millones de libras. Pero, ¿dónde? Pescando en el océano, saliéndonos de la plataforma y pescando fuera" (quoted in Mar y Pesca, April, 1972: 27). The revolutionary government's attitude toward the artisanal fisheries of the shelf is indicated by his statement that "Ya no será el pescador de la chalana de remos y de vela; será el pescador con medios de producción cada vez más modernos, con barcos cada vez más grandes; ya no serán sólo los pescadores de plataforma, serán los pescadores que se adentren en el Océano" (quoted in Mar y Pesca, April, 1972: 27). As we have seen, Cuba already exploited waters outside of the shelf by means of the Havana Bay schooner fleet but what the leader had in mind was something much more modern—an industrial distant-water-fleet. The possibility of such a fleet had already been presaged by the abortive experiment of the Bacaladero I in the late 1950s. The idea may have persisted and was certainly reinforced by the strengthening of the connection with the socialist countries, many of
which (the Soviet Union, Poland and the German Democratic Republic) possessed such fleets.

Development of a distant-water fleet, it was thought, would not only ensure a relatively cheap and bountiful supply of protein for the Cuban population but would also act as a vehicle for raising the technical level of the fishing industry as a whole. While it may seem strange for a country such as Cuba to invest scarce resources in an industry in which it had absolutely no experience, it should be remembered that the early 1960s were a time of widespread optimism about the huge potential of the resources of the world ocean.

The Cuban Fishing Fleet (Flota Cubana de Pesca, FCP), a state enterprise, began operations in June of 1962 with two 27 m Polish trawlers (Girón I and Girón II) which were used for experimental fishing (Baisre, 1987, 267: 34). It soon acquired, from the Soviet Union, five SRT-R side-trawlers (50.8 m in length) which began fishing in the Gulf of Mexico. Five Japanese tuna longliners were added in 1963 and eventually became the nucleus of a separate distant-water tuna fleet (Flota Atunera). Crews were educated in special fishing schools (e.g. Escuela Superior de Pesca. Andrés González Líneas) and trained on board ship by foreign experts.

The FCP continued to grow during the 1960s and the first half of the 1970s. The last stage in its development occurred with the acquisition of 26 super-trawlers in Spain which were brought into service between 1974 and 1978. These were factory ships, 106 m in length, aboard which fish were processed, canned, and packed frozen. The fleet also possessed a full complement of support vessels such as fuel tankers and refrigerated packers which allowed it to fish in the Atlantic, Pacific, Indian and Antarctic Oceans. All of the constituent vessels of this fleet were built overseas (Soviet Union,
Spain, Japan, Italy) and, therefore, their purchase represented a substantial outlay of Cuban hard currency reserves.

The origin of another distant-water fishing fleet, the Gulf Fleet (Flota del Golfo, FG) dates from 1963. Its new vessels, of Lamda and Ro, and later, Sondero types, fished in the same waters as the Havana Bay Co-operative (Co-operativa de La Bahía de La Habana) which had been formed from the schooner fleet which fished in the Gulf of Mexico in the pre-revolutionary period. The new fleet fished for grouper (cherna americana) using bottom longlines rather than the handlines of the schooner fleet.

The construction of shore-based support facilities for the various distant-water fleets was an important part of the national fishing policy. Cuba and the Soviet Union signed a bilateral agreement on the 25th of September of 1962. It included plans for the construction of a new fishing port in Havana to service both Cuban and Soviet distant-water fleets. Construction began in early 1963 and some parts of the port went into operation in 1965, the whole being completed in 1969. The port includes extensive docks, freezer facilities, a reduction plant, mechanical and electrical repair shops, a floating drydock and other facilities (Baisre, 1987, 267: 37).

10.2.2 Wholesale and Retail Distribution

The elimination of private wholesalers, described above, made the creation of a state distribution system necessary. Its centrepiece was the Fisheries Terminal in Regla on the eastern shore of Havana Bay, the construction of which had begun before the Revolution, and which was completed in 1960 and went into operation in 1961 (Salmon, 1963: 69). The terminal became the replacement for the Mercado Unico in servicing the Havana market. It received fish from the Gulf of Mexico schooner fleet and
from other ports, in ice or live-wells, and stored them in cold storage facilities. In addition, a number of provincial "reception centres," also with cold storage facilities, were set up and fish moved from them to the Terminal in 20 ton refrigerated trucks, and to provincial capitals in smaller ones. The reception centres themselves were supplied with fish by the co-operatives which kept part of the catch for local consumption. Salmon (1963: 54) reported that, although wooden boxes were still in use for transporting fish, they were repaired or replaced more frequently and that sanitary conditions were generally good. However, he noted some irrationalities. In one example, after trucks had brought fish from a co-operative to a reception centre, the same fish were subsequently distributed to consumption centres back along the same road. At the end of 1961, reception centres had been established in Pinar del Río, Santa Clara, Ciego de Ávila and Camagüey.

Retail distribution also changed during this period. Capitalist distribution was replaced by socialist distribution on the basis of quotas. Fish, in pre-determined quantities, was delivered to work-place cafeterias, schools, hospitals and other institutions, as well as to restaurants and retailers (Salmon, 1964: 54). The retail distribution system was also extended into the countryside by means of refrigerated trucks in an attempt to replace imported salt cod with fish caught by Cuban vessels. This represented a rather ambitious and generally successful attempt to replace the old retail distribution system.

10.2.3 Co-operatives

Nationalization in the industry progressed with incorporation of the shelf co-operatives into the state sector in 1962 (the "Year of Planning") under the "State Fishing Co-operative Enterprise" (Empresa Estatal de Cooperativas
They became, therefore, subject to the central planning system. In 1961, a boat-building program, named the "Girón Victory Special Plan" (Plan Especial Victoria de Girón) after the Cuban victory at the Bay of Pigs in April, was inaugurated and the number of boatyards was reduced. Additional types of vessels were built, including Ro (18.3 m; 60 ft) and Sondero (18.9 m; 67 ft) which, along with the Lamdas, were destined for the fisheries in the Gulf of Mexico. All of the new vessels were powered, mostly by Soviet and East German engines (Brady, 1967: 26).

10.2.4 The Economy

This period was not a good one for the Cuban economy in general. As a consequence of inclement weather, a decrease in the area planted, labour shortages and organizational problems, sugar harvests fell during 1962 and 1963. The resultant decrease in revenues caused difficulties in the financing of the industrialization and diversification programmes. Industrialization also faced increased costs of production because of a lack of qualified personnel in the planning-organizational superstructure and in the new industrial plants, and difficulty in obtaining raw materials and spare parts because of the American trade embargo and the re-orientation of foreign relations. It is difficult to underestimate the difficulties encountered by the Cuban economy as a result of the necessity for re-orientation from the United States to the Socialist bloc, especially with respect to raw materials, machinery and spare parts.

Cuba subsequently returned, in 1963, to the cultivation of sugar as the engine of economic development. The area planted was expanded and the

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1 At the same time, the Second Agrarian Reform Law continued the nationalization of agriculture by eliminating medium-sized farmers and mandating that farmers sell a portion of their production to the state at fixed prices.
target of a harvest of 10 million tons in 1970 was announced. In addition, livestock farming was to be expanded with a view to exporting meat. This made the fisheries development strategy crucial for the maintenance of the the protein intake of the population.

10.3 EXPORT-BASED DEVELOPMENT: 1964-1970

With the failure of the industrialization strategy, a debate ensued about the organizational and development strategy which would replace it. Briefly, on one side was Ché Guevarra whose aim was to build socialism ahead of the material base, by means of the development of workers' and managers' consciousness and creation of the "new man". The characteristics of this Centralized Budgetary System of Finance (called "Sino-Guevarism" by some) were the following: highly centralized finances and decision-making; all enterprises were considered part of a single economic organization and no cash transactions occurred between them; prices were determined by state planners; production quotas were established for workers; and workers were encouraged by moral rather than material incentives. This model was applied in the industrial sector to about one-third of the enterprises.

The other side of the debate was represented by the Popular Socialist Party (Partido Socialista Popular, PSP). Its Self-Financing System was more pragmatic in believing that the development of socialism would follow that of the economy. The central authority was responsible for developing national plans but enterprises had some autonomy and were to produce profits; wages were related to production; part of the profits were to be returned to the national budget, some retained for re-investment and distribution. The model was applied in the agricultural sector.

This brief transitional period ended in the summer of 1966 when Fidel
Castro announced new directions in economic organization which, in effect, represented the adoption of the Guevarist model of economic development. During this period, collectivization of the economy increased, material incentives were reduced or eliminated and replaced by moral incentives with the ultimate aim of eradicating wage differentials, and state enterprises were reorganized and reduced in number. Planning was increasingly taken over by the political leadership and medium-range and annual macro-plans prepared by JUCEPLAN were replaced by sector plans and special plans to deal with urgent problems.

A new element, consistent with the export-based economic model, was added to Cuban fisheries policy during this period. To the objectives previously articulated was added that of expanding exports of high value fish products primarily but not exclusively from the shelf fisheries (Mena, 1983: 60). To facilitate this objective, responsibility for the export of marine products was moved from the Ministry of External commerce (Ministerio de Comercio Exterior) to Caribbean Exporting (Exportadora del Caribe) a new enterprise within the INP (Mena Millar, 1985a: 8).

The fundamental characteristics of Cuban fishing strategy for the next decade or so were, therefore, put in place during this period: distant-water fisheries to supply large amounts of cheap protein for the domestic market; and shelf fisheries for the production of high value species for export.

The importance of the new fisheries strategy was reflected in an administrative change which removed responsibility for the fishing industry from INRA and gave it to a newly-created, separate ministerial-level organization, the National Fisheries Institute (Instituto Nacional de Pesca, INP). The new organization was

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1 According to Cuban sources (INP, 1964: 1), the National Fisheries Institute (Instituto Nacional
in charge of programming and directing of all policies of development, exploitation, regulation, improvement, conservation, industrialization, distribution and sale of products of the sea, rivers and lakes as well as the exploitation of interior waters in accordance with plans set by the Party and the Government (INP, 1967b:1).

To carry out its tasks, it began with three enterprises. The extractive sector was grouped together as the Cuban Fishing Fleet (Flota Cubana de Pesca, FLOCUPES) which had responsibility for all catching operations and also vessel maintenance and repair. Processing companies and wholesalers were replaced by the Fish and Shellfish Processing Company (Conservera de Pescados y Mariscos, ECOPEMAR) which had responsibility for the canning and freezing of all lobster, small tunas, sardines, cod, squid and frog legs, the processing of sponges and the storage and distribution of all fish and shellfish. The third enterprise, Fishing Supplies (Suministros Pesqueros, EMSUPES), provided the fishing co-operatives with fishing gear, spare parts, combustibles and general stores. In 1964, a fourth enterprise, the Fishing Port of Havana (Puerto Pesquero de La Habana), already mentioned, began to be constructed.

In the next several years (and in line with changes in the direction of fisheries objectives and policy), the INP expanded and its branches were further subdivided. In 1967, it consisted of seven enterprises and two dependencies. The extractive sector, reflecting the growth in fisheries outside of archipelagans waters, was now divided into three branches: the Cuban Fishing Fleet (Flota Cubana de Pesca, FCP), the Gulf Fleet (Flota del Golfo, FG)
and the Co-operative Fleet (*Flota Cooperativa*, FC). The first of these, consisting of tuna longliners and large, distant-water trawlers participated in ocean fisheries in various parts of the world. The second consisted of about 100 Cuban-built vessels which replaced the traditional schooners of the pre-revolutionary fishery and which employed bottom longlines to fish for demersal species in the Gulf of Mexico. The last, the co-operative fleet, had responsibility for the fisheries on the shelf. In 1966, this sector produced 75% of the total national catch.

Processing and wholesaling remained with ECOPEMAR, supplies to co-operatives with EMSUPES, and the Fishing Port of Havana, built under a 1962 agreement between Cuba and the Soviet Union, had been completed and was in operation to provide maintenance and supplies for, and to receive the catch from, the distant-water fleet.

As a result of problems with shortages of materials and labour the number of small, often competing, boatyards in the co-operatives, had been reduced and consolidated into one enterprise, the *Victoria Girón* Shipyards. The enterprise included 12 yards, the most important in Cárdenas and in Chullima on the Almendares River in Havana. Vessel construction continued and design improved with the production, in 1965, of the *Cayo Largo* (18.3 m; 60 ft), an indigenous design which became popular and widespread in the shelf fisheries.

The two dependencies were the Fisheries Research Centre and the Centre for River Repopulation (*Centro de Repoblación Fluvial*) involved in the introduction of new species and the protection of existing ones in rivers and reservoirs.
10.4 EXTERNAL CONTACTS

Cuban fisheries development during this period did not take place in a vacuum. As we noted in Chapter 6, some foreign experts had visited the country before the Revolution and had given advice on fisheries. After 1959, external contacts not only continued but increased a great deal. They were of two types: bilateral contact with various countries especially, but not exclusively, with other communist countries; and participation in United Nations programmes operated by the Food and Agriculture Organization (FAO).

FAO assistance was significant in the development of shelf fisheries in the 1960s and 1970s by means of the FAO Technical Assistance Program and United Nations Development Programs (UNPD) which brought anywhere from one to five international experts per annum to the country (Mena Miller, 1992: correspondence). Such experts (e.g. Holt, 1962; Salmon, 1963; Achurra Larrain, 1967; Appleyard and Saetersdal, 1969) came to the country as teachers, consultants, planners and to make evaluations of the fishery.

Bilateral assistance also came from individual countries bringing experts from Japan, Spain, France, Italy, Israel, North Korea, China, Poland, Bulgaria and the Democratic Republic of Germany (I.N.P., 1967: 30). However, the most important bilateral programmes were a result of the agreement between the Soviet Union and Cuba which was signed in September 1962. Socialist experts worked in the Fisheries Research Centre (CIP) investigating the oceanography of nearby waters, such as the Gulf of Mexico and the Caribbean (e.g. Boldanov 1966; Tapanes 1963) and in distant waters such as the Grand Banks and the waters off of the American east coast. They were also involved in investigations and evaluations of the physical characteristics and resources of the shelf, of fishing gear and techniques (Obvintsev and Terejov,
1966; Okonski and Vaujin, 1975), visited and evaluated shelf co-operatives (Okonski, 1964; Pogodin, 1966) and made general evaluations of the industry (Ritzhaupt, 1963; Salnikov, 1966). Many foreign technicians also worked at day-to-day jobs in the fisheries Research Centre (Appleyard, 1969: 4).

The extent of foreign participation in Cuban fisheries research (and the rapid growth of CIP) can be deduced from a 1964 listing of CIP personnel (Baisre, 1964: Foreward). Out of a total of some 90 workers, about 20 were from countries such as the Soviet Union, China, Japan, Poland and Scotland and were assigned to sections such as resource exploitation, ichthiology, crustaceans, molluscs, oceanology, technology and aquaculture. In addition, Cuban students studied under scholarship programs in the Soviet Union.

This chapter has traced the nature of the changes which occurred in the economic policies and strategies of the revolutionary government from 1959 to the mid 1970s. It has also attempted, where possible, to follow corresponding changes in fisheries policy and in the organization of the industry during the same period. By the late 1960s, the fishing industry was the responsibility of a ministerial level organization, the National Fisheries Institute, which administered a two-pronged fisheries strategy: to provide cheap protein to the general population by means of an industrial trawler fleet fishing in distant waters; and to export high value products like lobster, shrimp and tuna from the fisheries on the insular shelf. A large part of the industry had been completely nationalized but private fishers still operated within the co-operative system. In the next chapter, the performance of the industry during the same period will be examined.
CHAPTER 11

This chapter will examine the development of the shelf fishing industry from 1959 until 1968, a time during which it was dominated by state co-operatives but still contained a large number of private fishers. This was a period during which modernization of the industry and expansion of catches were of paramount importance and one in which the beginnings of its transformation to a completely nationalized industry can be traced.

11.1 THE PRIMARY SECTOR

11.1.1 Cooperatives

As we saw in the last chapter, the revolutionary government created 49 co-operatives and 35 sub-cooperatives in the years up to 1963. In their establishment and early development, problems were experienced with respect to their distribution, to the supply of facilities and services, and to personnel (Salmon, 1963: 47; Okonski, 1964: 9-10).

11.1.1.1 Distribution. Co-operatives were not well located with respect to shelf resources. Their distribution in 1961 is shown in Fig. 11.1.1. The smallest number was in Matanzas, a province encompassing a short stretch of the north coast bordered by shelf only in its eastern part (Fig. 11.2). Oriente, the largest province in total area, contained the largest number of co-operatives. However, with the exception of the Gulf of Guacanayabo and some pocket bays, the shelf along the coasts of this province is very narrow, so that it contained the second smallest number of fishers and produced the

1 The source for Fig. 11.1 and 11.2 was (INRA, 1961).
Fig. 11.2. Some Characteristics of Fishing Co-operatives: 1961
second lowest catch of any province. In 1963, Salmon (1963: 46) found that Oriente, with 16% of fishers and only 11% of the national production, had 30% of the country’s co-operatives (Fig. 11.2). He attributed this situation to poor communications, the number of isolated fishing villages (some no larger than a half dozen houses and a half dozen small fishing boats (García Ramón, 1970: 69), and to the desire of the revolutionary government to decrease the concentration of fishing activity in the western part of the country. It may be pointed out, in addition, that Oriente was the poorest region of the country and that it was the original refuge of the rebel army and, as such, was particularly favoured by the government.

11. 1. 1. 2 Facilities and services. It is not surprising, given the chaotic conditions in the country in the first post-revolutionary years, that the provision of facilities and services did not occur at the same rate everywhere. For example, Salmon (1963: 47) noted that mobile refrigerators were installed in some places without electricity, or with generators which lacked parts. Scarcity of ice was identified as a problem in the failure of some co-operatives to fulfill their plans (INP, 1964: 50).

11. 1. 1. 3 Personnel. A disproportionate amount of the work of administration and co-ordination fell to the manager-accountant team, the competence of which varied because "it is very difficult to find 50 good managers that at the same time were good revolutionaries, production co-ordinators, organizers of communities of fishermen and chiefs of a fleet of fishing boats" (Salmon, 1963: 47). This was a reflection of two problems which were common in the economy as a whole. The first was the emigration of large numbers of professional and technical personnel.\footnote{In 1960, the country suffered a net loss of 62,379 persons, in 1961, 67,468 persons. Emigrants, on average, were better educated than those who stayed behind (Ritter, 1974: 93). Cuban fishers also left for Florida in the late 1950s and early 1960s (Labisky, Gregory and Conti, 1980: 34) but...}
compounding the first, was the practice of "guerrillerismo administrativo" in which appointments to managerial positions were often made on the basis of revolutionary credentials rather than technical or professional qualifications.

An evaluation of co-operatives carried out five years after the Revolution (INP, 1964) found that there were still many problems in the co-operative system. The quality of accounting was low everywhere (INP, 1964: 50), the majority of co-operatives did not fulfill plans, and most did not make a profit. The most successful co-operatives were those in Havana and Camagüey provinces. The reasons given for poor performance were "unjustified stoppages" (INP, 1964: 53), low technical level of the vessels and gear, lack of ice, difficulties with engine spare parts, especially from the United States, and stoppages as a result of security problems, especially on the northeast coast.

11.1.2 Fishers

It is difficult to gauge the reactions of fishers to the quite substantial changes which occurred during this period. As we saw in the last chapter, not all of them became co-operative members but, at the same time, it does not seem that they left the country in large numbers.

There seems to have been some tension between fishers with traditional skills, developed through years of experience, and new, technically-trained ones. Okonski (1964: 10) noted their conservatism of the former: "Fishermen with lots of experience cannot imagine that a young person can learn as much or even more than them in a much shorter time by their numbers are difficult to estimate. Craig (1973: 131) cites a figure of 17 000. However, this is probably more fishers than the total in Cuba at the time. Fagen, Brody and O'Leary (1958: 19) have calculated that, between 1958 and 1963, only some 1 500 people employed in agriculture and fishing emigrated to Florida, so it seems unlikely that large numbers of fishers left the country in the early 1960s.
means of professional supervision. In the twentieth century, knowledge of fishing techniques," he continued, "has ceased to be a professional secret handed down from father to son." Fishers, he noted, were also resistant to innovations diffusing from central state organizations like the Fisheries Research Centre (Centro de Investigaciones Pesqueras, CIP) (1964: 9). For example, he found the idea to be widespread that machine-made nets were inferior at catching fish to hand-made ones. He also found that co-operatives had no gear workshops, fishers had a low level of knowledge about gear and decisions about its use were made by individual vessel masters without reference to the management of the co-operative.¹ Lestev and Obvintsev (1969: 295) noted that the co-operative fishery still contained private fishers who prized their secrets and did not share their experience with others. Knowledge of useful fishing methods, as a result, was not diffused from co-operative to co-operative nor from region to region within the archipelago.

There is no very reliable information about numbers of fishers for the 1960s but they seem to have decreased during the decade, as result, probably, of the progressive removal of part-time workers from the industry (Salmon [1963: 65] estimated a decrease of 10%). There were an estimated 12 000 fishers in 1963 (Buesa, 1964: 24), more than 9 000 (5 000 of whom were full-time), in 1965 (Appleyard and Saetersdal, 1969: 5), and 9 000 in 1967 (INP, 1967a: 29).

11.1.3 Vessels

The co-operative fishing fleet changed during the early post-revolutionary period as a result of both the aggressive vessel-construction program described in the last chapter, and the incorporation of formerly

¹ Okonski's comments about the conservatism and individualism of Cuban fishers, coming from an observer from a European country with modern, collectivized fisheries, should be taken with some reservation.
private vessels. As was the case with the co-operatives, the transformation of the fleet did not proceed without problems.

11. 1. 3. 1 Vessel construction. Salmon (1963: 84) evaluated the first few years of the vessel building program. All of the new vessels were of what he called a "classic" American fishing boat design. They possessed more comfortable crew quarters, had larger fish storage facilities, were faster and had a greater radius of action than traditional vessels, but had little shade on deck, no auxiliary sail and lacked "local adaptations." In the case of the Ro 60, this meant that the vessel lacked a shallow draft which prevented its use for shrimp fishing on the southeast shelf. In general, the new designs did not represent, in Salmon's opinion, an improvement over the indigenous motorized sloop (balandro). In addition, new vessels were not necessarily introduced into the most productive fisheries. The situation was further aggravated by the fact that vessels were built by series which, while saving in costs, resulted in inappropriate vessels being delivered to many co-operatives. Salmon (1963: 85) concluded that "a whole fleet has been constructed without previous study of its precise purpose." It seems that, in the rush to improve the fleet, traditional vessels which had been well-adapted to the varying conditions of the four shelves, were replaced by well-constructed, modern ones which were, however, standardized and not, therefore, well-adapted to the varying physical conditions throughout the archipelago.

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1 According to Buesa (1992) all of the designs were done by one person, a friend of Fidel Castro, who already had them in hand.

2 Buesa (1992) described the logic underlying the vessel-building program: "If you tell (Fidel) that if you had a good boat you could catch 2 000 tons of fish, he thinks that if you have 10 boats you can catch 20 000 t and if you have 100 etc. So let's build 1 000 boats". That such thinking was not untypical is suggested by Socialist agronomist René Dumont (1970: 214) who noted "Fidel Castro was a magnificent fighter, and he is a born educator, but he continues to underestimate the technical and economic difficulties. He believes himself to be more capable than other people of finding the very best solutions, and always reasons like a guerrilla. His economic errors have cost Cuba dearly."
11. 1. 3. 2 Incorporation of private vessels. Salmon (1963:45) also noted that many of the vessels which were initially transferred to the co-operatives by their owners were in very poor repair, while those which remained in private hands tended to be in much better condition. However, the co-operatives had control over spare parts which, especially after the imposition of the United States trade embargo in October 1960, were in very short supply (Okonski, 1964: 10) and which were directed toward their own boats first. The result was that many otherwise excellent boats of the private fleet gradually deteriorated and were taken out of service. The mixed nature of vessel ownership, then, tended to cause a general deterioration of the fleet, at least in the first few years after the Revolution.

11. 1. 3. 3 The co-operative fleet. Buesa (1964: 17) notes that a census of vessels conducted in 1963, although it contained omissions and included vessels that did not fish all year, was probably the most accurate count in the early 1960s. It found a total of 3,829 vessels, 40% of which were less than 6.2 m (20 ft) in length. They were distributed as follows: Zone A: 1,241 (32.4%); Zone B: 613 (16.0%); Zone C: 564 (14.7%); and Zone D: 1,411 (36.9%).\(^1\) As with co-operatives and boatyards, the eastern regions of the country had the largest proportion (69.3%) of the national total of vessels but produced only 54.9% of the national catch. Appleyard and Saetersdal (1969: 5) reported a shelf fleet in 1965 which contained a total of 3,348 vessels. There is no way to ascertain whether this represents a real decrease in the number of vessels since 1963. The majority of vessels were still small, 68% being less than 7.4 m (24 ft) in length (Fig. 11.3a), but 76% had motors, although there were spare parts for only 17.8% of them. Lestev and Obvintsev (1969: 288) reported that there were

\(^1\) The division of shelf waters into four zones, A, B, C and D, corresponding loosely with the southeast, southwest, northwest and northeast shelves, dates from this period (Buesa, 1992).
Fig. 11.3. Some Characteristics of the Shelf Fishing Fleet: 1965
650 different makes and models of engines in the co-operative fleet.

Lestev and Obvintsev (1969: 288) reporting, probably in 1965 or 1966, did not supply any vessel numbers but state that all vessels were made of wood and were seaworthy. More than half of the motorized fleet possessed only very small engines (10 hp and less) (Fig. 11.3b) and about one-third of vessels had no means of storing the catch. Thirty percent still employed live-wells, and only 24% had insulated ice-holds (Fig. 11.3c). Lack of power and storage facilities were reflected in the fact that fully 38% of the fleet still had an average trip length of 1-2 days while for almost 50% the maximum was 4 days (Fig. 11.3d). The shelf fishing fleet at mid-decade, therefore, was still in the process of a transformation which was proceeding rather unevenly.

11.1.4 Fishing Gear

In keeping with the general process of modernization to which the industry was subject after the Revolution, new types of fishing gear were introduced into the fisheries. The sources of innovation seem to have been a mixture of Cuban and foreign. Many of the foreign experts made explicit studies of fishing gear and techniques and made suggestions to improve them (see, e.g., Okonski, 1964; Okonski and Vaujin, 1971; Lestev and Obvintsev, 1969; Obvintsev and Terejov, 1966). It appears, however, that Cuban innovations prevailed during the 1960s.

The Fisheries Research Centre was important in testing and diffusing new fishing gear. The first publication of the resuscitated Centre (Buesa, 1960) reported the results of an evaluation of five types of lobster traps: two commonly used in Florida, a Mexican one, and two Cuban ones including the Antillean trap described previously.\(^1\) The Antillean trap, constructed of

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\(^1\) The vessel used for the experiments was the "Aida" owned by Sr. Thorwal Sánchez (Buesa,
wire mesh, and the Florida trap, constructed of wooden laths, gave the best results. The yield of the former averaged 1.35 lobsters/day/trap, that of the latter, 0.95 lobsters/day/trap. It was also found that: employing bait in traps, which was, and is still, the practice in Florida, gave no advantage; traps covered with brush to provide shade, caught more lobsters; and traps set singly rather than in lines fished better. The results of this experiment were diffused throughout the industry. Buesa (1962: 10) reports that the co-operative in Santa Cruz del Sur on the southeast shelf constructed 1 300 Antillean traps for use in the Twelve Leagues Labyrinth (Laberinto de las Doce Leguas). In 1964, average yields of 3.2 kg of lobster per day, or almost four times as much as other types of traps, were obtained. During the 1960s, the bully net and the Antillean trap were the most commonly used gear in the lobster fishery.

The use of fish attraction devices (FADs) in both scale and lobster fisheries is reported from this period but it is not clear how widespread they were. In the scale fishery the FAD consisted simply of mangrove brush set on the bottom to concentrate fish artificially before surrounding them with a haul seine (chinchorro). According to Lestev and Obvintsev (1969: 295) they were used in only a few co-operatives. FADs (pesqueros) consisting of a framework of coastal palm trunks (yuraguano [Coccolivrinax maraguana]) were also employed in the lobster fishery in the Gulf of Batabanó. According to García Ramón (1970: 105), they were invented in the 1950s by a fisher from this region and came into widespread use in the Gulf by the early 1960s.³

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1 This type of trap is still in use in the Florida Keys.
2 There is no good translation for this word so, following Cruz and Phillips (1994: 324), pesquero will be used here to refer to this type of lobster FAD.
3 No other reference has been found to this use of FADs in the lobster fishery but García Ramón conducted a case study of the Batabanó fishing co-operative, so it is likely that she was quite familiar with its activities.
In general, the eastern European and Soviet experts complained about the lack of mechanization and standardization in fishing gear and recommended that the levels of both be increased. Salmon (1963: 90) was more cognizant of the value of traditional fishing techniques and pointed out that fisheries development in France and Spain had occurred, not as a result of technical innovation, but from the diffusion of successful traditional methods from one region to another throughout the country.

In spite of the innovations described above, and of the urgings of eastern European experts, fishing gear employed in the shelf fisheries in the mid-1960s remained much the same as that employed in the 1950s. The main types of gear were haul seines, small traps, longlines, handlines and bully nets each of which caught 15% of the total catch,\(^1\) and castnets, gillnets, spears and other gears which accounted for the other 10% (Lestev and Obvintsev, 1969: 292).

11.1.5 The National Catch

Total national landings in 1968 (37 605.4 mt) were 60% higher than those in 1959 (22 450.9 mt). However, growth was not constant during the period. Landings increased slightly in 1959 (22 450.9 mt) over 1958 (Fig. 11.4)\(^2\) but those in 1960 showed a fairly substantial increase. Part of this may have stemmed simply from better reporting but it is likely that, with the post-revolutionary increase in prices, fish which would have been discarded as worthless before the Revolution were now kept and delivered to port. The catch dropped somewhat in 1961 as a consequence, probably, of the events surrounding the Bay of Pigs invasion in April. In the shrimp fishery, the

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1. The other 15% was caught with trawl nets on the Campeche Bank.  
2. The source for Figs. 11.4 -11.11 was García-Arteaga and Claro (1987).
catch decreased from 2,242 mt in 1960 to 1,743 mt in 1961 as a result of engine breakdowns in the trawl fleet (Salmon, 1963: 58).

Changes occurred in the proportions of landings by both species group and ecological complex during this period (Figs. 11.5 and 11.6). Landings of fish and molluscs increased at the expense of crustaceans, and those from the estuarine-littoral complex increased in greater proportion than those from the other two complexes. It is likely that the two changes are related. Oyster landings, from the estuarine-littoral complex increased by about 400% and landings of fish species from the same complex increased by from one-and-a-half to four times. The increase in mollusc landings was a result, according to Buesa (1964: 27), of the removal or disregard of minimum size regulations in the oyster fishery. The same factor was identified as the cause of the decrease in landings in the fishery in 1963 and to the fact that the oyster banks of Isabela de Sagua, the richest in the country, were on the point of extinction. The growth in fish landings represented an expansion in the catch of formerly under-utilized species, such as sardines and mackerels, for local consumption. However, some of it came from increased exploitation of the grunts (Haemulon spp., roncos), species of the coral reef-seagrass complex, which increased by 28 times from 76.8 mt to 2,166.2 mt. The fish catch, like those of the other species groups, experienced fluctuations during this period. Buesa (1964: 32) noted that 80.3% of the scale fisheries were conducted in waters at depths of 0-10 m and that 81.6% of the fish caught were between zero and 3 years of age. These fisheries were, in other words, being conducted in nursery

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1 It will be noted that total landings by ecological complexes are not equal to total landings shown in Fig. 9.5. The explanation is that: a) landings for some categories of fish (eg. some of the billfishes) are not available for the entire 1959-1985 period and b) the category "Other Fish" has not been included because there is no indication from which ecological complex these landings came. In spite of these omissions, the relative proportions of landings from each complex should be accurate enough for comparative purposes.
Fig. 11.5. Shelf Landings by Species Group: 1959-1985
Fig. 11.6. Shelf Landings by Ecological Complex: 1959-1985
areas and growth overfishing may have been occurring.

11.1.6 Regional Distribution of the Catch

During this period, the proportion of landings from the northeast shelf remained fairly stable but that from the southeast shelf increased by more than 10% so that the other two shelves showed corresponding decreases. In 1968, 33% of landings came from the southeast shelf, 29% from the southwest, 11% from the northeast and 26% from the northeast (Fig. 11.7).  

11.1.6.1 Southeast shelf. Annual landings on the southeast shelf grew from 4,873.9 mt in 1959 to 12,485 mt in 1968 (Fig. 11.8a-c). This was a reflection of the growth in fish and mollusc landings, discussed above, from the estuarine-littoral zone. As a result the proportion of crustaceans fell, in spite of a four-fold growth in the shrimp landings during this period, a result of expansion in the trawl fleet and the export policy with respect to high value species. The proportion of landings (fish, molluscs, shrimp) from the estuarine-littoral zone grew from 33.5% in 1959 to 45% in 1968 at the expense of those from the coral reef-seagrass zone.

The increase in shrimp landings was not constant throughout this period but showed a great many fluctuations for several reasons. As mentioned above, there were mechanical problems in the trawl fleet; the same fleet tended to concentrate fishing operations in very restricted areas (Lestev and Obvintsev, 1969: 296); but, perhaps most importantly, the traditional fishery which comprised 71% of all vessels in the fleet (Pogodin, 1966) caught large numbers of juvenile shrimp and, in doing so, according to Buesa (1964: 27) "interrupted the biological cycle." It would also, of course,  

1 This conflict between the traditional inshore shrimp fishery and the offshore industrial trawl fishery was not unique to Cuba. See McGoodwin, 1989.
Fig. 11.8b. Landings from the Southeast Shelf: 1959-1985.
Fig. 11.8c. Landings from the Southeast Shelf: 1959-1985.
Ecological Complex
have resulted in growth overfishing. The conflict between the two fisheries was resolved in the late 1960s by the eradication of the traditional fishery.

11. 1. 6. 2 **Southwest shelf.** Since the southwest shelf was the most heavily exploited in the pre-revolutionary period, landings from it did not show as great an increase as those on the other shelves (Fig. 11.9a-c) growing only from 9 062.8 mt in 1959 to 11 081.9 mt in 1968. However, since this increase was made up mostly of export species such as lobster and lane snapper, this relatively small increase would have been important in terms of value. Landings from this shelf, unlike those for the insular shelf as a whole increased immediately after the Revolution but then, as a result of decreases in the lobster catch, dropped from 1962 through 1964. Buesa (1964: 27) attributes both the increase and subsequent drop in landings to the indiscriminate catching of under-sized lobsters.

The species composition of landings did not change fundamentally during this period (Fig. 11.9b), although the proportion of crustaceans increased somewhat. The drop in the fish proportion of landings was a result of a decrease in the tuna catch from 1 299.7 mt in 1959 to 728.7 mt in 1968, a decrease which is reflected in the composition of the catch by ecological complex which shows that the proportion from the oceanic waters complex fell by 12% to 9% in 1968. Landings from the coral reef-seagrass complex, mainly lobster and demersal fish, remained overwhelmingly in first place while an increase in oyster and sardine landings contributed to a relative increase in the importance of the estuarine-littoral complex (Fig. 11.9c).

11. 1. 6. 3 **Northwest shelf.** Landings on the northwest shelf, for unknown reasons, were the only ones which showed a decrease in 1960. Nor did they demonstrate the sustained growth of those on the the other shelves (Fig. 11.10a-c). However, overall growth occurred, from 2 840.3 mt in 1959 to
Fig. 11.9a. Landings from the Southwest Shelf: 1979-1985
Fig. 11.9b. Landings from the Southwest Shelf: 1959-1985. Species Group
Fig. 11.9c. Landings from the Southwest Shelf: 1959-1985. Ecological Complex
Fig. 11.10b. Landings from the Northwest Shelf: 1959-1985.
Species Group
4 192 mt in 1968. Fish landings remained by far the most important, although they suffered a relative decrease as a result of higher mollusc landings, a consequence of a growth in the oyster catch from almost nothing to nearly 900 mt. The rise of this new fishery was also reflected in an increase in the proportion of the catch taken from the estuarine-littoral zone on this shelf (Fig. 11.10c).

11.1.6.4 Northeast shelf. Landings on the northeast shelf, like those on the others, increased during this period, from 5 673.9 mt in 1959 to 9 845.9 mt in 1968 (Fig. 11.11a-c). Growth was not, however, sustained, but shows a similar plateau in the mid 1960s as that shown by landings from the northwest shelf. There was a major change in the species composition—the proportion of fish species increased from 45% to 77% of the total, and crustaceans decreased almost proportionately. The increase in fish landings was a reflection, in part, of a slightly more intensive exploitation of the mullets of the estuarine-littoral zone but, more importantly, of an expansion into the oceanic waters complex in pursuit of sharks, billfish and tuna. Mollusc landings, principally oysters, showed proportional growth for reasons mentioned above.

11.1.7 Productivity of the Co-operative Extractive Sector

The first attempts to measure productivity in the shelf fisheries date from this period. In 1963, the Fisheries Research Centre conducted a study of the shelf fishery based on a sample of co-operatives (Buesa, 1964). The foreign experts, in addition, attempted to estimate the productivity of the fishery. While these studies, especially Buesa (1964), provide a great deal of quantitative information, it must be remembered that no one, at this time, had any idea about the precise number of vessels and fishers nor of the types
Fig. 11.11a. Landings from the Northeast Shelf: 1959-1985
of gear operating in the shelf fisheries. The quantities provided may, therefore, lend an appearance of accuracy which is illusory.

In the absence of precise effort data (e.g. standard vessel days, standard pot lifts, etc.) estimates of the productivity in shelf fisheries during this period are based upon such indices as the average weight of fish caught per fisher, per day, per vessel, per area fished, and per type of gear. The following conclusions, presented by Buesa (1964) give a picture of the productivity of the fishery in 1963. Change must have taken place in the fisheries in the ensuing five years of this period but they have not been discussed in published material.

1. The average area exploited by each fisher was 1.7 nm² and the average production was 3.2 mt/fisher/year. (The average annual per capita output of Malayan fisheries in the late 1940s was 2 mt [Ooi, 1990: 2]).

2. The average catch per shelf fisher was 35.7 kg/fisher/day but varied according to the type of gear employed: 32.0 kg for hook and line; 44.1 kg for small traps; 42.6 kg for haul seine; 31.8 kg for gillnet).

3. Small traps had an average catch of 0.7-1.5 kg/lift, Antillean traps set in similar areas caught 3.2 kg/lift.

4. Large edge traps had an average catch of 5.9 kg/lift.

5. The catch per vessel per day depended on the type of gear employed and the size of the crew: 80.1 kg with hook and line; 315.6 kg with haul seine; 106.4 kg with small traps; 89.7 kg with edge traps; and 92.2 kg with gillnets.

6. Yields per fisher/day were highest on the southeast shelf.

7. Production in terms of kg/fisher/day in the lobster fishery, at 27.8 on average, was the lowest of any fishery.

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1 The lack of a reliable statistical base for the fishery was pointed out as a fundamental problem by observers of the fishery at the time (Salmon, 1963: 41).
In the absence of extensive comparative data, it is difficult to make any conclusive comments on the above. However, the foreign experts who visited at the time considered that the productivity of the shelf fisheries was low (e.g. Salnikov, 1966: 50) and could be improved. Among the problems noted were the following:

1. The average number of fishing days in the shelf fisheries, between 75 and 100 days per year, was low. The remainder of the time was spent on the way to and from the fishing grounds, in shelter, or in port (160 days). The average length of trip was only 3. 1 to 4. 2 days and some vessels travelled up to 12 hours each way, leaving very little time for fishing. Vessels from Cienfuegos (Lestev and Obvintsev, 1969: 294), for example, travelled as far as the Isle of Youth and some from La Coloma fished in the waters of the eastern Gulf of Batabanó. The amount of time in port was a result, at least partly, of the fact that, although each co-operative had a small boat yard, these were often poorly supplied with spare parts and with skilled labour.

2. Fishing gear was not exploited intensively. For example, typically no more than 3 sets of a haul seine were made in one day and only 15 to 20 large traps were checked in 2 to 3 days (Lestev and Obvintsev, 1969: 295). However, it should be noted that, with the exception of the shrimp trawl fishery, all pulling of gear was done by hand.

3. As noted previously, mechanical problems were common and there was a chronic lack of spare parts.

4. As a result of the existence of many private fishers who protected their fishing knowledge from others, there was not widespread diffusion of successful gear or method innovations throughout individual co-operatives, between co-operatives or between regions.

5. Socialist observers pointed to the conservatism of fishers as a problem but it may have acted in a beneficial manner by preventing the replacement of well-adapted gear by poorly-adapted technical innovations.

6. Some new vessels were not well-adapted to fishing in the
7. Organization within the co-operatives was frequently poor and they often lacked qualified personnel. Supplies of ice, fuel and provisions were often lacking.

In spite of these problems, the catch in the shelf fishery, as we have seen, increased during this period. There is no way to tell, however, the cost at which the increase was obtained.

11.2 THE SECONDARY SECTOR

As we saw before, all processing, storage and distribution of Cuban as well as imported marine products in the 1960s was done by ECOPEMAR, created in late 1963. There is not a great deal of published information dealing with this sector. Most foreign experts concentrated on the extractive sector of the industry and treated the processing sector only cursorily or not at all.

The available information (Achurra Larrain, 1967: 33-34) indicates that the total amount of marine products which were processed increased almost four-fold from 1962 (3 037.6 mt) to 1964 (12 846 mt), and then experienced a small decrease in 1965 (Fig. 11.12). Processing involved canning, freezing and salting but as can be seen from Fig. 11.12, the proportions of each one changed radically during this period. Seventy-three per cent of all products were canned in 1962, but difficulties in obtaining imported sheet steel, resulted in a shift in emphasis toward freezing so that in 1965, only 18% of all products were canned while 64% were frozen. Salted products also increased from negligible amounts in 1962 to 17% in 1965. According to Achurra Larrain (1967: 33), salting was restricted to green cod brought into the country by a cod vessel in very poor condition, probably the Bacaladero I mentioned previously. However, it seems unlikely that this vessel could have supplied the almost 2 000 mt which were salted in 1965 so this total may include cod
Fig. 11.12. Processing of Marine Resources: 1962-1965

- **a. Total Production**
  - Year: 1962-1965
  - Production: MT

- **b. Type of Processing**
  - Canned
  - Frozen
  - Salted

- **c. Canned Production**
  - Year: 1962-1965
  - MT

- **d. Frozen Production**
  - Year: 1962-1965
  - MT

- **Shrimp Tails**
  - MT

- **Lobster Tails**
  - MT

- **Tuna Steaks**
  - MT
imported from the Soviet distant-water fleet. Although sardines and shrimp were canned in the early part of this period, the most important canned products were lobster and tuna (Fig. 11.12).\(^1\) As a result of the lack of canning materials, the processing of tuna changed to frozen steaks which showed a dramatic increase in 1964. While the proportion of frozen lobster was not high, it was increasing in 1965 and would increase further in the ensuing years (Fig. 11.12).

Most of the marine products which were processed, in line with the fisheries policy articulated in 1964 and described in the last chapter, were destined for export. A severe decline in the quantity of exports was experienced after 1960 as a result of the loss of the United States’ market (Fig. 11.13). Lobster was by far the most important, making up 71% of the total value in 1965 but shrimp, shark fins, turtle shells and sponges were also exported. Exports began to recover in 1965 with the discovery of new markets for lobster, especially in France, but later in Spain, Japan and Canada and other capitalist countries. However, the total value of exports in 1965, at $3,385,000 had still not equalled the total in 1960 ($4,299,800). Most of these export earnings were in convertible currencies and were, therefore, very valuable to the country.

There is very little information about the distribution of processing plants during this period. According to a map of co-operatives in 1965 (Salnikov, 1966), the pre-revolutionary concentration of the industry in the western part of the country persisted, with plants in La Coloma, Batabanó, Nueva Gerona and Havana (the Fisheries Terminal in Regla).

\(^1\) The source for Figs. 11.12 and 11.13 was Achurra Larrain (1967).
Fig. 11.13. Exports of Marine Products: 1960-1965
11.3 THE TERTIARY SECTOR

Salmon (1963: 64) characterized the Cuban food regime as being closer to that of the countries of Western Europe in which, protein consumption consisted of a balance of meat, fish and poultry, and unlike that of its Antillean neighbours where less meat and more fish were eaten. However, per capita consumption of fish, which had been increasing in the 1950s, fell after the Revolution (Achurra Larrain, 1967: 40; Salmon, 1963: 63). This was partly a result of an attempt by the government to improve the trade balance, by cutting imports of fish by 15% in 1960, by 30% in 1961 and by 75% in 1962 compared to pre-revolutionary levels (Achurra Larrain, 1967: 40). As a result, per capita consumption in 1961 (5.2 kg [Salmon, 1963:63] was similar to that in 1956. However, it then increased to a high of 12.4 kg in 1964 before falling again to 8.9 kg in 1965 (Achurra Larrain, 1967: 41). The increase had multiple causes. Firstly, imports, still overwhelmingly the traditional dried cod supplied in large part by the Soviet distant water fleet, began to increase from 1963. Secondly, the government push to increase exports included meat and poultry products so that fish began to substitute, in some measure, for other forms of protein. Thirdly, a large proportion of the fish was distributed by the government and consumed by the population through institutional channels. Fourthly, government propaganda campaigns to increase the amount of fish consumed had a positive effect. Fifthly, fish was available in the markets at fixed, fairly low prices. Lastly, as a result of the improved distribution system, described in the last chapter, fresh fish was available in rural areas where it had not been in the past. During the first half of the 1960s, the value of fish imports, especially from the Soviet distant-water fleet, exceeded the value of fish exports, thereby continuing the historic pre-revolutionary pattern.
During the period from 1959 to 1968, government policy played an increasingly important role in Cuban fisheries development. In the shelf fisheries, the processing sector and most of the tertiary sector were nationalized. In the primary sector, nationalization was incomplete and cooperatives, the organizational focus, remained of mixed character with many private fishers. Modernization of the fleet and of fishing gear and methods was well underway, but incomplete, by 1968. Numerous organizational, statistical, political, personnel and other problems were experienced in the process of transformation undergone by the fishing industry. However, in spite of them, the shelf catch grew during this period and shelf fisheries began to concentrate explicitly on the exploitation of valuable species for export. The lives and work conditions of fishers and their families, in addition, improved. The next chapter will examine the final stage in the nationalization of shelf fisheries and the expansion in landings which resulted from it.
CHAPTER 12
NATIONALIZATION AND GROWTH: 1969-1976

Two major events with widespread impacts occurred in Cuba during the latter part of the 1960s. The first was the "Revolutionary Offensive," the culmination of the process of nationalization of the economy which had begun in the early part of the decade. It involved the nationalization of some 56,000 retail and small businesses. The second was the attempt to obtain a 10 million ton sugar harvest in 1970. While the harvest achieved, at 8.5 million tons, was the highest ever in Cuban history, it was 15% less than the target and represented a severe blow to morale. In addition, it was obtained only by the massive diversion of resources, including labour (e.g., 170,000 industrial workers) from other economic sectors, and caused severe disruption throughout the economy.

Economic problems began to appear in the late 1960s. A lack of coordination in planning caused shortages in inputs, bottlenecks in supply and shutdowns in industry. Education and health care were free, services were cheap, and consumer goods were scarce so that a large part of the labour force possessed surplus cash and could afford to stay home and not work. With the major disappointment of the failure of the 10 Million Ton Harvest, many did so, and absenteeism increased to an estimated 20%. Production per capita and other indicators of economic efficiency also declined.

The development strategy and economic organization of the late 1960s was criticized by Fidel Castro as having been idealistic, utopian and unreal and their failure was acknowledged by the political leadership. It was realized that socialism and communism could not be built at the same time and the
next five years were a transition period during which new forms of economic organization were developed. This was, fortunately, a time of a boom in sugar prices so that the early 1970s was a period of economic growth in Cuba. The country became a member of COMECON in 1972 and an increasing proportion of its trade was directed toward the socialist countries of eastern Europe.

12.1 NATIONALIZATION OF THE CO-OPERATIVE SECTOR

Both the push for a 10 million ton harvest and the Revolutionary Offensive had impacts on the fishing industry. The diversion of resources to the harvest may have been a contributory factor to a drop of 1 289 mt in the 1970 shelf catch, the first decrease in annual catches since 1963 (Baisre, 1993). The "Revolutionary Offensive" had a more fundamental impact. Private ownership of fishing vessels was completely eliminated so that the means of production in the industry finally came completely into state ownership. At the same time, co-operatives and sub-co-operatives were rationalized by mergers, and processing functions were added to them, thereby forming a base for the creation of a new type of vertically-integrated enterprise, the fishing combine (combinado pesquero). Combines were state enterprises under the control of the Shelf Fleet (Flota de Plataforma, FP), a new department of the INP (Fig. 12.1). At the same time, the Havana Bay Co-operative was absorbed by the Gulf Fleet and the shrimp sector of the latter separated to form the Caribbean Shrimp Fleet (Flota Camaronera del Caribe, FCC) with 90 vessels in 1969, to which 27 were added in 1970 and 3 more in 1971 for a total of 120.

There is almost no published information with respect to this very important organizational transformation of the shelf industry. It is

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1 The source for Fig. 12.1 was Appleyard and Saetersdal (1969).
FIG. 12.1. Organizational Chart of the National Fisheries Institute (INP), 1969
mentioned by Mena (1983: 61) but not at all by Baisre (1987) in his history of Cuban fisheries. However, García Ramón, who visited and studied the fishing industry in 1969, gives an idea of the type of consolidation involved: the combine of La Coloma would be made up of the former co-operative of the same name plus the sub-co-operatives of Cortés, Boca de Galafre, Punta de Cartas and La Furnia while Surgidero de Batabanó would incorporate the sub-co-operatives of Cajío, Guanímar, Tasajera, Caimito, Rosario and Cayo Largo. With respect to the creation of the combines in general, she noted that "this change is causing many problems since it implies better organization and a change of the fishermen's attitudes. For this reason there is no hurry in bringing this change about because it could be a failure." "Cubans," she continued, "believe that this system is fairer and truer to the ideological line and also more productive and easy to plan" (García Ramón, 1970: 69). Thus, at the end of the 1960s, the extractive sector of the fishing industry had been integrated with the processing sector by means of the creation of a new base unit, the fishing combine.

At the same time, the industry had been completely nationalized and the state had finally become the sole-owner of the means of production with the theoretical advantages for the ability to pursue rational use of resources that such ownership implies. Unfortunately, in the ensuing period, the government's attention was directed, not to the shelf fisheries, but to the distant-water fleet which received a large amount of capital investment. As noted in Chapter 10, 26 super-trawlers were added to the fleet between 1974 and 1978. The reason for this emphasis has not been articulated but it may be surmised that it involved, as well as ensuring the food supply, the possibilities of technological development and the prestige that would derive from possession of a distant-water fleet.
Capital investment, as we will see, also occurred in the shelf fisheries but, strangely, this sector seems to have been otherwise ignored by the higher levels of the government during this time. Scientific research seems to have decreased as a result, according to Baisre (1993), of "ignorance" and "underestimation of the role of science" by fishing sector directors. Compared to the periods before and after, there are relatively few published works on the shelf fishery by Cubans during this period. Neither are there any general evaluations of the type done by foreign experts during the 1960s, so that describing the industry in general during this period is quite difficult. In addition, and even more importantly, fishing regulations were not enforced (Baisre, 1993). The same informant attributed all of this to the fact that emphasis had been placed on the distant-water fishery. The impact of simultaneous scientific and regulatory neglect combined with a policy which emphasized growth in exports meant that, instead of employing the power of sole-owner to rationalize the fishery and to protect the shelf resources, the catching power of the shelf fleet was increased substantially and the catch grew at a greater rate than before.

12.2 THE SHELF FISHERY

The number of vessels in the shelf fishery decreased during this period but the catch continued to increase, as a result of a combination of factors. The first of these was the organizational change described above. Equally, if not more important, was the quite substantial technological change which occurred in both vessels and in fishing gear and lastly was the more complete utilization of the catch, especially by-caíches (morralla), which began to be recorded in landings statistics in 1969.
12. 2. 1 Vessels and Fishing Gear

It is not possible to trace the precise nature of the changes which occurred in the shelf fishing fleet during this period but some broad features may be discerned. Firstly, the number of vessels diminished substantially, from 3,348 in 1965 to 1,818 in 1974, 1,811 in 1975 and 1,764 in 1976 (Appleyard and Saetersdal, 1969: 5). On the face of it, this might appear like a rationalization of the fisheries in the direction of decrease in effort. It was not. All vessels in the 1970s were powered and were larger than their predecessors. Some very successful designs, such as the Cayo Largo, the Ro, Langoster, Camaronero and Escamero, were introduced (Appendix IV). As a result of the scarcity of local lumber, steel began to be used in the 1960s for vessel construction in the Campeche Bank shrimp fleet. However, the most important innovation was the use of ferrocement which began to be employed in 1970 and then diffused widely throughout the fleet. Given the fact that vessels were larger, powered and well-designed, the catching power of the fleet increased in spite of the decrease in the number of vessels. Thus, while the fleet of more than 3,300 vessels in 1965 had landings of 30,186.9mt, some 1,800 vessels landed 57,707mt in 1974. Even if the by-catch is discounted, the smaller fleet still landed a greater amount at 43,475mt.

Some of the most dramatic technological changes occurred in the fishing gear employed by the shelf fleet. Extensive trials of modern types of gear were conducted under the supervision of Soviet, East European and Japanese experts (Ichikawa, 1971; Lestev and Obvintsev, 1969; Obvintsev and Terejov, 1966; Okonski, 1964; República de Cuba, 1978a). Cuban fishers, however, seem to have successfully resisted both standardization of gear throughout the archipelago and, with the exception of the shrimp fishery, mechanization of fishing operations. We will examine gear changes in more
detail later in this chapter.

There is no record of the number of fishers during this period but, given the decrease in the number of vessels, even though most of them were larger, it is likely that it decreased. Given the increase in catches, productivity per fisher must have also increased. A possible explanation for this may be found in the system of payment to fishers. As noted earlier, with the elimination of the co-operatives, all fishers began to be paid a base salary. Bonuses for completion and over-completion of plans were also awarded but, in the late 1960s, these were in the form of moral rather than material incentives. Material incentives were re-introduced, but on a communal basis, in the early 1970s and may have helped to stimulate production.

12. 2. 2 The National Catch

Total landings from the shelf fishery increased by 80%, between 1968 (37,605.4 mt) and 1976 (68,201.2 mt) (Fig. 11.4). As noted above, a significant part of this increase was a result of the beginning of the utilization of by-catches for reduction and conversion into animal feed.1 The major source was the shrimp fishery by-catch which was made up of 91 species, 61 of them fish, many of them juveniles of commercially valuable species. Since the greatest proportion came from that fishery, the major source region was the southeast shelf.

While total landings increased between 1968 and 1976, the rise was not constant. As pointed out, the diversion of resources to the sugar harvest in 1970, has been blamed for the drop in landings experienced in that year.

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1 In a visit to a shrimp processing plant in Cienfuegos in 1989, the author observed commercially important species such as blue crab being extracted from the by-catch for processing and packaging for the Japanese market. Some of the fish in the by-catch was also processed in the form of frozen flaked meat (picadillo) for human consumption. It is not known when such utilization began.
(Baisre, 1993). However, a closer inspection of the statistics reveals a somewhat more complex situation. While total landings registered a slight decrease (1 288.9 mt or 3%) in that year, landings of molluscs, "other fish" and the by-catch actually increased (by 62%, 2% and 126% respectively). The most significant decreases occurred in fish (7%) and, especially, lobster landings which fell by 18%. Since, as will be seen later, such decreases in lobster landings recurred during the 1970s, it would appear that the search for the causes of the 1970 decrease may have to be widened beyond the sugar harvest to include biological factors relating to the species itself. Growth resumed in the following year to reach a peak of 68 201.2 mt in 1976.

The by-catch presents a problem when considering the species composition of landings and the ecological complex and shelf from which they came. From the statistics, it appears that it began to be taken only in 1969. This, of course, is not true. The shrimp trawl fishery, since its inception, was, in effect, a multi-species fishery in which the greater proportion of the catch was dumped, mostly dead, back into the sea. Thus, it is the pre-1969 statistics which, in not recording the by-catch, are inaccurate from a biological and ecological point of view. Keeping this in mind, it can be said that the proportion of fish in the catch in the pre-1969 statistics was under-represented to some unknown degree and that a larger biomass was being extracted from the shelf than was recorded in landings. By 1976, assuming that the largest proportion of the weight of by-catch landings was fish, it can be seen that this species group constituted more than 60% of the total shelf catch, with crustaceans in second place (25%) and molluscs third (Fig. 12.2a).1 Similarly, the proportion of the shelf biomass taken from the estuarine-littoral ecological complex since the beginning of the shrimp trawl fishery was also

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1 The source for Figs. 12.2-12.10 was García-Arteaga and Claro (1987).
Fig. 12.2. Total Landings from the Insular Shelf: 1976
undercounted. In 1976, landings from this complex made up over 50% of the total, with those from the coral reef-seagrass complex at 38% and those from the oceanic complex a poor third at 10% (Fig. 12.2b). As a result of the distinctive nature of each of the four shelves, the by-catch also had an impact in determining the proportion of landings from each of them (Fig. 12.2c). Since the estuarine-littoral zone is most extensive on the southeast shelf and since, therefore, the shrimp fishery is concentrated there, the proportion of national landings in 1976 (43%) was highest there, followed by the southwest (26%), the northeast (24%) and the northwest (7%).

12.2.3 Regional Distribution of the Catch

The biological and ecological distinctiveness of the four parts of the insular shelf is revealed very strongly in the landings for 1976, the end of the period under consideration.

12.2.3.1 Southeast shelf. The southeast shelf was the only one of the four which did not register any annual decreases in total landings, although growth from 1968 to 1970 was slow (Figs. 11.8 and 12.3). However, if the by-catch is removed, landings showed a general decrease from 1969 to 1973 before resuming growth to 1976. The importance of the shrimp fishery on this shelf in 1976 is revealed by the fact that 26% of landings were in the crustacean group (however, 25% of this group were lobsters), 50% was by-catch and fully 77% were taken from the estuarine-littoral complex. Landings from the coral reef-seagrass complex, made up of both fish and crustaceans, made up only 21% of the total.
Fig. 12.3. Landings from the Southeast Shelf: 1976
12. 2. 3. 2 Southwest shelf. Total landings on the southwest shelf increased overall during this period but were rather more variable (Fig. 11.9). As noted above, total lobster landings dropped significantly in 1970 and 81% of this decrease occurred on the southwest shelf. In 1976, crustaceans constituted about the same proportion (43%) of landings as they did on the southeast shelf (Fig. 12.4). In this case, however, this group was made up mostly of lobster and, as we have seen, this was a shelf region in which demersal fish landings, 79% of which came from the coral reef-seagrass complex (Fig. 12.4), were important. Landings of fish from the oceanic complex (12%) made up the second highest proportion and, unlike the southeast shelf, those from the estuarine-littoral complex were third at only 8%.

12. 2. 3. 3 Northwest shelf. Landings from the northwest shelf in 1976 were, as in the past, the smallest of the four. They exhibited a general, but small, increase during this period but like those of the other shelves showed some fluctuations (Fig. 11.10). On this shelf, they were overwhelmingly made up of fish species (83%) with small proportions of both crustaceans and molluscs (Fig. 12.5). It is distinguished from the other three shelves in that it is the only one in which landings from the oceanic complex were in the majority (56%) (Fig. 12.5). Those from the coral reef-seagrass and estuarine-littoral complexes made up 33% and 11% respectively.

12. 2. 3. 4 Northeast shelf. In the period under consideration, there was, as with the other shelves, a general increase in landings during this period. They did not, however, drop in 1970 but increased from 1968 to 1971 before experiencing decreases from 1971 to 1974 and then rising again to 1976 (Fig. 11.11). As with the northwest shelf, the fish species group made up the
Fig. 12.4. Landings from the Southwest Shelf: 1976
Fig. 12.5. Landings from the Northwest Shelf: 1976
largest proportion (63%, plus by-catch of 15%) of landings (Fig. 12.6). However, unlike that shelf, oceanic species made up a relatively small proportion (13%) while those from the coral reef-seagrass and estuarine-littoral complexes comprised 50 and 37% respectively. This was the only shelf where molluscs (12%) made up a larger proportion of the catch than did crustaceans (10%) (Fig. 12.6).

12.3 THE FISHERIES

As noted above the shelf fisheries were subject to substantial changes during this period. Organizational changes such as the creation of fishing combines, which affected all of the fisheries, have already been discussed. In the following section, the regulatory, technological and operational changes which occurred will be discussed in the context of each of the major fisheries.

12.3.1 The Lobster Fishery

12.3.1.1 Regulations. In the post-revolutionary period, all of the shelf fisheries still operated under the General Fisheries Law of 1936. With respect to the lobster fishery, this prescribed a permanent prohibition on the catching of "berried" females (females with eggs), a minimum legal size of 15cm measured from the eye to the fork in the tail and a reproductive closure of 84 days. In addition, the use of trawls, and other kinds of nets was prohibited within one mile from the coast in natural nursery areas. In 1966, because of the damage they caused to lobster, the use of spears (pincharri) was prohibited in the fishery.

As noted in Chapter 5, such regulations were criticized by later Cuban observers of the fishery as being too general and without a sound basis in the biological reality of the species. In fact, as a result of the isolation and different
Fig. 12.6. Landings from the Northeast Shelf: 1976
physical characteristics of each of the shelves, many marine species, including lobster, reached maturity at different times on different shelves so that a general closed period and minimum legal size applicable to the whole archipelago perhaps did not make sense. Buesa attempted to deal with this problem by programming closures for lobster (and lane snapper) according to shelf-specific criteria (Buesa 1992). In 1968, the lobster closed season was reduced in length and averaged only 58 days during the period to 1977 (Baisre, 1984: 386).\(^1\) It is unclear whether this drastic reduction in length was a result of Buesa's programming of the closure or whether it was simply a consequence of the drive to increase exports. During the same period, the enforcement of minimum size regulations was slack or ignored, and up to 18.5% of landings were, as a result, composed of under-sized lobster (Cruz et al. 1989: 12.3.1.2).\(^2\)

**12. 3. 1. 2 Vessels.** During this period there were substantial changes in numbers and types of vessels in the fishery. A large part of the lobster fleet was replaced with new, larger vessels of the Cayo Largo type, first introduced in 1965 (Appendix IV). This vessel was 20 m in length and built originally of wood but subsequently of ferrocement, steel and fibreglass. Many, but not all, had holes in the hull so that seawater could circulate through a live-well in which the lobster were kept. In 1970, the 121 vessels of this type made up almost 25% of the lobster fleet. The overall number of vessels in the fleet decreased concomitantly with the replacement of smaller with larger ones. A total of 1 024 lobster vessels, mostly 4 to 5 m in length, in 1961 (Baisre and Páez, 1981: 16) was reduced to 488 in 1970 (Buesa, 1972: 38) and to 355 in 1978 (Baisre and Páez, 1981: 16), 21% of the shelf fishing fleet (Anon., 1978). The

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1 Other authors report a closed season of only 45 days duration (Cruz et al., 1991: 247).
2 The authors do not state whether this figure is an average for the period or whether it refers to only a single year.
number of lobster fishers also dropped with the decrease in vessels: from 3,400 in 1961 (Baisre and Páez, 1981: 16) to 1,994 in 1970 (Buesa, 1972) and to 1,024 in 1978 (Baisre and Páez, 1981: 16).

12.3.1.3 Gear. Lobster fishing gear changed fundamentally during this period. Pesqueros (jaula, casita cubana in Mexico) and large traps with wings (jaulones)\(^1\) replaced the bully net and the Antillean trap as the principle types of gear (Cruz, Blanco and Baisre, 1981). As noted in the last chapter, pesqueros were built using the trunks of coastal palms and generally covered an area of about 4 m\(^2\) (Appendix V). After 1970, the difficulty and time involved in finding appropriate lumber led to the use firstly of zinc and then fibrecement plates on coastal palm trunks. This was a passive type of fishing gear which could attract up to 150-200 lobsters seeking refuge (Cruz et al., 1990: 75). The fishing operation consisted of surrounding the pesquero with a lobster net (chinchorro langostero)\(^2\) approximately 6 m in length with a 2 m cod-end (Appendix V), taking the direction of the current into account, then lifting it to disturb the lobster which were caught in the net as they fled. Fishers in Caibarién in the 1990s were observed using pesqueros in conjunction with bully nets, rather than haul seines, for fishing lobster. The method was essentially similar to that described in Chapter 7.

The other major change in lobster gear during this period was the introduction and widespread diffusion of the jaulones, an innovation which had been in use for some time by the fishers in La Furnia and Cayo Largo on the southwest shelf. It consisted of a metal frame (92 cm x 62 cm x 32 cm) covered with hexagonal galvanized wire and possessing a funnel-shaped entrance at one end (Appendix V). Attached to it at an angle were two wings

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\(^1\) There is no good translation for this word and, since "large trap with wings" is rather cumbersome, jaulón (plural: jaulones) will be used here.

\(^2\) This is the translation given by Cruz and Phillips (1994: 327).
(bandas) up to 50 m in length, constructed of metal frames covered with capron web designed to lead lobsters to the entrance of the trap. The traps could be set singly but were more commonly set in series, especially across routes of movement during the autumnal migration period described in Chapter 2.

*Pesqueros* and *jaulones* had two significant impacts on the fishery. Firstly, the latter were able to catch lobster in much larger numbers during migrations and secondly, lobster caught in the former, being free to enter and leave were generally in much better condition than those which had been confined to a trap without food for a period of time. In addition, both types of gear were also cheap to construct, required little maintenance and did not require the use of bait.

Other types of gear were also used in the fishery. The bully net still made up 60% of all lobster gear in 1970 (Buesa, 1972: 38) and, as we have seen, did not disappear completely. A type of liftable FAD (*goma levable*), constructed of one or several automobile tyres, sometimes covered with branches, was also in use (Appendix V). This was fished by simply being lifted from the water by means of an attached line, thereby catching lobsters which had entered seeking refuge. Traps of various types also continued to be utilized.

There is no information on the precise dates of introduction, nor of the rates of diffusion or quantities of the new types of gear in the fishery during this period but, as noted above, the bully net was still the principal type of gear in 1970 so that widespread adoption of newer gear must have occurred later in the decade.

As noted previously, the change in market demand consequent upon the US embargo beginning in the early 1960s, resulted in a change in lobster
processing from frozen tails to whole pre-cooked and live lobsters (Cruz et al. 1987: 107). This required the delivery of live lobsters to processing plants by live-well fishing vessels making daily trips but this increased costs especially in fuel, and decreased the radius of action of individual vessels. A solution was found by the introduction of storage centres (centros de acopio) on, or close to, the fishing grounds. Fishing vessels then went on 10 day fishing trips but, at the end of each day, delivered their catch to a storage centre where the lobsters were unloaded into holding pens while awaiting transport by packing vessel to the processing plant. The centres were usually built on stilts in shallow water and, along with their storage functions provided some services, such as ice, to the fleet and others, like television and medical services, to fishers. Lobsters were kept in web-walled tanks, through which seawater circulated freely, for 1-5 days. Tanks were floating, fixed or liftable and their extraction from the water was either mechanized or manual. By the end of this period, there were 30 such centres on the shelf. As well as improving the quality of lobsters delivered to the plant, they also introduced a degree of spatial rationality into the fishery in reducing the lengths of delivery trips by fishing vessels.

12. 3. 1. 4 The catch. Lobster landings averaged just over 9 000 mt (9 282. 5 mt) from 1968 to 1976, up from an average of 7 916. 1 mt in the previous nine-year period (Fig. 12.7). However, the shortening of the closed period (and, perhaps, the disregard of the minimum size) had an immediate impact on landings which reached a high of 11 131.6 mt in 1969, a level not surpassed again until 1982. In spite of a reported, but unquantifiable, increase in the fishing capacity of the fleet resulting from the innovations described above, landings fluctuated quite severely for the remainder of the period under consideration. The second highest catch, obtained in 1976 (10 624 mt)
Fig. 12.7. Lobster Landings: 1959-1985
was followed by the second highest decrease, and marked the end of this period of the fishery.

Although the 1970 catch was taken from 500 different locations in the archipelago (Buesa, 1972), the high proportion of increased landings from the southwest shelf reflected its traditional orientation to this fishery (Figs. 12.7). Landings from the southeast and northeast shelves were in second and third place.

12.3.2 The Shrimp Fishery

The shrimp fishery was subject to both spatial expansion and technological improvements. The former occurred with the introduction of the trawl fishery into Manzanillo in April of 1966 (Baisre and Zamora, 1983: 5) and with a movement toward the exterior of the shelf in La Vela Sound and the Gulf of Caballones to the south and west respectively of Santa Cruz, which was made possible by the acquisition of larger and more powerful vessels.

12.3.2.1 Regulations. The shrimp fishery was subject to only the minimal regulations of the General Law of 1936 which had been brought into force prior to the existence of the commercial trawl fishery. These included the general closed period for crustaceans of 84 days duration, and, in addition, a minimum legal size of 70 mm overall length.

12.3.2.2 Vessels and gear. The development of vessels and gear in the shrimp fishery were inter-connected in that more powerful vessels were required to employ more advanced gear. The foundation of fleet development, then, was an aggressive acquisition program which introduced larger vessels with greater power into the fishery. As we have seen, replacement of older smaller vessels using a single trawl net (single-rigging) had already begun in the early 1960s but the pace picked up with the
introduction of Cuban-built Ro vessels equipped with 150 hp Soviet motors in the Santa Cruz del Sur region in 1967 and 1968 (Appendix IV). These vessels allowed the adoption of double-rigging, the towing of one net from each side of the vessel (Appendix V), which had been common in the United States since the 1950s. Double-rigged vessels of the Lamda and Sondero type also began to fish on the shelf edge in the La Vela Sound and in the Gulf of Caballones at the same time (Baisre and Zamora, 1983: 7). In 1970, the first ferrocement boats and steel boats were introduced into the fishery. The former were entirely built in Cuba and began operating widely in the fishery in 1973 and 1974 (10 in Manzanillo, 21 in Santa Cruz del Sur). Some of the latter, which were equipped with freezers, were Cuban-built but many were also imported from Spain and Peru. Seventy-five were incorporated into the shrimp fleet in 1973 and 1974 but not all of them fished on the Cuban shelf.

The last major technological improvement in the trawl fleet was the introduction, beginning in Playa Florida in 1975, of the twin-trawl net which had been invented in the United States in 1972 (Baisre and Zamora, 1983: 8). Each vessel now towed one twin trawl from each lateral boom, for a total of four nets. In 1977, 152 vessels operated in the fishery (República de Cuba, CETC, 1978c). During this period, then, the catching power of the shrimp fleet increased substantially along with, no doubt, the experience of the fishers involved.

Another type of fishing gear was employed in the shrimp fishery in the lagoonal coast of the Tunas de Zaza area in the western Gulf of Ana María, albeit only for a short time. This set-net (copo camaronomer0) was introduced to Cuba by a Japanese technician in 1964 (Vázquez, 1981). It consisted of a long web tube (25 mm mesh) with wings attached (Appendix V). Set in channels

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1 CETC stands for "Comité Estatal de Ciencia y Técnica."
and lagoons to catch shrimp in their seaward migration, such nets had the
advantages of not causing damage to nursery areas, of allowing small shrimp
to pass through the mesh, and of being usable in areas inaccessible to trawling.

As a result, the catch in this zone increased by 40% (Vázquez, 1981). The use
of this type of net was, however, discontinued in 1975, because it was realized
that the shrimp would be more valuable if allowed to grow larger and then
caught offshore by the trawl fleet.

One additional innovation occurred in the shrimp fishery during this
period. Employing the advantage of being sole-owner of the means of
production, the state moved, in 1972, to improve operations by organizing
small fleets (flotillas) of five or six vessels under the control of an


12. 3. 2. 3 The catch. The increase in the catching power of the shrimp
fleet and the organizational changes described above had a significant impact
on landings which averaged 4,209.8 mt from 1968 to 1976, double those
(2,101.3 mt) of the previous nine-year period. Growth was sustained except
for a slight decrease in 1971 and a larger one (99 mt) in 1975 (Fig. 12.8). All of
the catch was taken from the southeast shelf.

12. 3. 3 Scale Fisheries

The scale fisheries of the archipelago, like those for lobsters and
shrimp, were subject to regulatory, technological and organizational changes
during the period 1968 to 1976. Regulations in many, if not all, of the fisheries
for the numerous fish species on the shelf, were either discontinued or
ignored. For example, in the lane snapper fishery, before 1965, there existed a
closed period in the summer which varied in length from year to year but appears to have averaged about 3 months. This was abolished completely in 1967 and so, it seems, were closed periods for other fish species. Such abolitions were particularly serious in the scale fisheries because, as we have seen, many of these species concentrated in restricted areas of the shelf during relatively short time periods on their spawning migrations. The removal of the closures made the fish available to the fishery for a longer time period but also at their time of greatest vulnerability, so that more than 40% of the catch was taken during the 3 month period from May to June (MIP, 1980: 4.3).\(^1\)

Regulations with respect to minimum legal sizes were also violated during this period (MIP, 1980: 4.3) and large quantities of juvenile fish were taken before they had an opportunity to spawn.

12. 3. 3. 1 Vessels and gear. The scale fisheries shared in the general improvement and mechanization of vessels which occurred in the shelf fleet as a whole. Since much of the fishery took place in shallow inshore waters, vessels tended to be relatively small and included the following types: *Criollos* A, B, C and D, all under 10 m in length; *Sigmases*; *Etases*; launches; and auxiliary vessels (García del Barco and Crespo León, 1981: 54). In addition, however, since the peak fishing time in the scale fisheries coincided with the closed season for lobsters, many vessels from that fleet also participated in these fisheries. As a result of this type of part-time fishing, there are no reliable statistics from this period for the total number of vessels involved, a fact lamented by later Cuban observers.\(^2\)

Of even greater significance to the scale fisheries was the introduction

\(^1\) This report has no page numbers, so section numbers are employed here as a substitute.

\(^2\) "There is no document that reviews and critically analyzes the development of scale fisheries from the Triumph of the revolution until the present. This document begins the process" (MIP, 1980: 1).
and wide diffusion of various types of large-scale fishing gear. During this period, hooks and lines and traps, which had been the most common gear until the mid-1960s, were replaced to a great degree by set nets, haul seines (chinchorros) and FADs. An important characteristic shared by each of these types of gear was that they were all suited to fishing in shallow waters. As a result, there was an increased emphasis on the utilization of fish stocks in such waters and a concomitant relative decrease in that of stocks in the deeper waters of the shelf edge (MIP, 1980: 4.4).

Set nets (tranques or corrales) as we have seen, were employed in the lobster fishery and in aboriginal mullet fisheries in Cuba but they only came into widespread use during this period. They were usually constructed in shallow water (1.9-2.8 m) in channels close to keys, or in lagoons. They exhibited a variety of shapes but generally consisted of a catching chamber (von Brandt, 1984: 171), called the piscina or sacadero, and some arrangement of barriers (bandas or aletas) which guided the fish into it (Appendix V). The basic shape of chamber and barriers was laid out by a number of mangrove stakes (2-300 in one observed by Ubeda, 1975, 117: 22) set vertically into the sea bottom. The chamber walls were then covered by galvanized hexagonal mesh 2.5-3.8 cm in diameter while the barriers were usually covered by capron mesh. Since this was passive gear, it fished 24 hours per day and was especially effective during spawning periods of the various fish species.

Fishers, operating from a mother vessel checked the amount of fish in the chamber either by diving or by using a glass-bottomed bucket. If there was a sufficient amount, a haul seine was introduced into the chamber from a small auxiliary boat and schools of fish were guided or frightened into the

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1 Their spread was aided by a FAO Fishery Development Project (CUB/71/54) (Mihara and González, 1974: 1).
cod-end. Ubeda (1975, 117: 22) observed the net then being taken to the mother-boat, in this case a lobster vessel, and emptied onto the deck. The catch, amounting to 8 550kg, was then transported to a storage centre where it was boxed and loaded onto packers for delivery to the processing plant. In areas without storage centres, the fish were transported directly to the plant.

In the mullet fishery, set nets were employed, throughout the year in some areas, across migration routes during the spawning season in others (Alvarez-Lajonchere, 1978a: 6). On the north coast, in Nipe Bay, installations were set perpendicular to the coast. They were constructed of tree branches set in the bottom and covered with 2 cm galvanized wire mesh shaped in such a way that fish could not escape. Once fish were in the net, they were caught with bully nets or other auxiliary gear. In Tunas de Zaza, nets of this type were set in the exit channels of lagoons or across estuarine channels. A stockade was constructed using mangrove trunks (R. mangle, Avicennia nitida) and within it, corrals were built of the same material. One of the corrals connected with the channel by means of two doors made of Castillian cane (Gynereum sagittatum). In this way, communication between the lagoon and the sea was completely cut off. During high tide, the fisher squatted on a plank and opened the doors to allow fish into the corrals from which they were removed at low tide. In newer installations, galvanized wire and free entry were used.1

As a result of their success in increasing catches, a great variety of such structures spread throughout the archipelago and 278 were reported in the early 1980s with the following distribution: 87 (31.2%) in Zone A; 41 (14.7%) in Zone B; none in Zone C; and 150 (53.9%) in Zone D, mostly in the combines of

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1 These structures sound very similar to stockades used to catch juvenile shrimp in lagoonal areas of the west coast of Mexico. (See McGoodwin, 1989).
Caibarién and Nuevitas (Ramos, Pérez Tain and Machado Montero, 1981: 2).

As we have seen, haul seines have a long history in the Cuban shelf fisheries. It is clear that their numbers increased substantially during this period but information about their diffusion in the scale fisheries is scarce. Observers speak only of their "massive employment" (Baisre, 1985b: 70). In the 1970s, they were made of capron mesh with dimensions that varied from place to place on the insular shelf. Generally, they varied in length from 180-900 m with a mesh of 10-14 mm in the cod-end, and 20-30 mm in the wings (Appendix V). Three types are described (MIP, 1982): the beach seine (chinchorro bolapié or chinchorro playero) and the boliche (no translation), both operated manually, and the trawl (chinchorro arrastre), normally operated by vessels (Ramos and Obregón, 1983: 3). Haul seines, of which 134 were in use in 1981 (Ramos, Pérez, Tain and Machado, 1981: Table 2), shared with set nets a lack of selectivity. The consequent catch of juvenile fish in both types of gear was later identified as a contributory factor in overfishing in the scale fisheries.

Haul seines were sometimes used in the scale fisheries in conjunction with FADs (pesqueros). While Silva Lee (1975) reported that 4 or 5 vessels on the southwest shelf were using such structures, it appears that their use was more widespread at that time and became even more so later. The same observer described the FADs as "complexes" made up of several different types of basic structures including automobile tyres, scrap metal and mangroves. The first of these consisted of 16-18 tyres tied together by galvanized chain. The second was made up of a truck bed, four 55 gallon tanks and other pieces of scrap metal and the last consisted of a triangle of mangrove branches through which smaller branches were inserted to form a structure about 3 m in height, 4.7 m in diameter, with a perimeter of 15.3 m.
Each complex consisted of one, two or more basic structures separated from each other by several metres. They were usually set in 4-5 m of water on seagrass bottoms, sometimes on sandy bottoms, but never on rocky bottoms. They were not marked by buoys but were located using landmarks.

Silva Lee (1975: 6) reported "enormous" quantities of fish in the FADs but, more importantly, four times as many around them. They were fished by passing a haul seine towed by three row-boats (chalanas) over the top, the operation being guided by a fisher using a glass-bottomed bucket for observation. The fish caught in order of importance were lane snapper, grey snapper, jack, porgy, guaguanchu (Sphyraena guaguanchot), and grunts. The maximum catch with a FAD consisting of 2 or 3 structures was 8 000-9 000 kg but the average was 450 kg with 2 000 kg being frequently caught.

As well as the innovations described above, gillnets continued in use. Traps, harpoons and castnets were also still utilized but the last two especially were employed decreasingly because of low productivity.

12.3.2 The catch. Landings in the scale fisheries, reflecting the abolition or neglect of regulations coupled with an increase in catching power consequent upon the introduction of the new types of fishing gear, increased by 45% from 1968 (15 487.7 mt) to 1976 (22 587.2 mt) before suffering decreases for several years (Fig. 12.9).

The regional distribution of landings (Fig. 12.9), when examined in relation to the area of the four shelves, shows an interesting pattern (MIP, CIP, 1980: 2.3). The northeast shelf, with only 18.8% of the total area of the insular shelf, supplied 34% of landings in 1968 and this increased to 37% in 1976. The northwest shelf, with only 7.3% also supplied a disproportionate quantity (14% in 1968; 13% in 1976). The southeast shelf, on the other hand, with 35% of the area, supplied only 29% of landings in 1968 and this decreased
Fig. 12.9. Scale Landings: 1959-1985
to 23% in 1976. Similarly, landings from the southwest shelf, with 38.8% of the area, made up only 24% of the total in 1968 and 27% in 1976. It has been suggested (MIP, 1980: 2.3) that the explanation for this apparent higher intensity of exploitation of fish stocks on the north coast lies in the fact that enterprises on the south coast had other, more valuable fisheries available to them (e.g. lobster on the southwest shelf, shrimp on the southeast) and that they, therefore, expended lesser amounts of effort on the less valuable scale fisheries.

12.3.4 The Tuna Fishery

The tuna fishery was the only one of the major shelf fisheries which did not undergo substantial changes in regulation, technology or organization during this period. Since the fishery did not exist in 1936, the General Fishery Law is silent on the subject. Even in the 1980s the only regulation was a minimum legal size of 30 cm which, it seems, was a result of industrial requirements rather than biological characteristics of the species (MIP, 1984: 11). It is not clear when this regulation was introduced.

According to Baisre (1981: 15), there had been no change in techniques in this fishery since 1945. Ritzhaupt, an expert from the DDR, who visited Cuba in the 1960s, proposed both technological and organizational changes to improve the fishery. He suggested the installation of pumps to circulate water in live-bait tanks and experiments were conducted that were successful in keeping bait alive for 3 days. He also suggested that the economic efficiency of the fishery could be increased by the introduction of co-operation by means of the organisation of "brigades" of vessels in place of individual vessel operations. An individual vessel could be assigned to catch bait which would be kept in storage tanks to supply the several vessels of a "brigade" (Ritzhaupt,
1965: 47). These suggestions seem to have fallen on deaf ears and the fishery continued into the 1970s with few changes except for vessel replacement.

12.3.4.1 The catch. Landings increased by about 80% between 1968 and 1976 (from 1,532.4 mt to 2,774.7 mt) before declining in 1977 and 1978. Small decreases were registered in 1969 and 1973 but growth was strong in the following years (Fig. 12.10). At least part of the increase in catches towards the end of the period came from expansion in the area exploited. Ritzhaupt (1965: 38) reported that an experimental fishery was underway on the northeast coast from Caibarién in the mid-1960s. According to Baisre (1981: 15) a commercial fishery operated from that port in 1968 but was discontinued for a time and then re-started in 1975. The fishery subsequently expanded eastward to Punta Alegre and Nuevitas. Forty vessels and about 300 fishers operated on the western shelves while an additional 29 vessels were involved from northeastern shelf ports.

The first scientific evaluation of the tuna fishery took place during this period. Carles (1972) compared the fishery during the periods 1954-1959 and 1965-1970.¹ and reached the following conclusions. Firstly, although there was an increase in the average annual catch during the late 1960s compared with the 1950s, the difference was not statistically significant. Secondly, this modest increase in average catches was obtained at a level of effort 97% higher, measured by fisher days fished than that of the 1950s (Carles, 1972: 93). This was a result of the incorporation of new vessels and more complete utilization of the fleet in that vessels no longer abandoned the fishery during the period of lobster migrations. Thirdly, while in the 1950s there seemed to be no relationship between the catch per unit effort (CPUE) and effort, in the late 1960s, this was no longer the case and increases in effort resulted in

¹ The intervening years were not treated because of lack of data.
Fig. 12.10. Small Tuna Landings: 1959-1985
decreases in CPUE. Fourthly, as a result of the foregoing increase in effort, there was a scarcity of bait in all fishing areas of the southwest shelf.

With respect to effort, no detailed information is given in the report for the number and type of vessels introduced to the fishery during this period. However, the number of vessels active in the fishery increased from a monthly average of 14.25 (low 4, high 20) in 1954-59 to 24.6 (low 12, 31) in 1967-70. Also, the number of days fished increased from a monthly average of 265.75 (low 86, high 479) to 404 (low 153, high 635). Both of these effort indices showed a distinctly seasonal pattern with peaks in the months of March to August or September. The third and fourth characteristics of the fishery, the relationship between CPUE and effort and the availability of bait are closely interconnected. As Carles noted (1972: 92), the less the amount of bait available, the greater is the amount of time needed to find it and the greater the resultant impact on the measure of effort. The increase in the number of vessels involved in the fishery had severe consequences for the availability of the various small bait fish, especially anchovies. After an exploratory fishery in 1969, it was reported that there was an almost complete absence of bait fish in the entire western part of the southwest shelf so that vessels from La Coloma and and Nueva Gerona had to go to the eastern part of the Gulf of Batabanó to find it. As a result, while a maximum of four or five hours were required to obtain bait at the beginning of the 1960s, this operation sometimes took two days at the end of the decade (Carles, 1972: 92). This had a further impact in that the fishing fleet was concentrated into smaller and smaller areas trying to find bait with further negative consequences for populations of those species.

The major limiting factor of tuna fishery in the latter 1960s, then, was the availability of bait in the traditional fishing zones, especially on the
southwest shelf but it was not the sole limiting factor. Also of importance was the "bite" (*la picada*) of tuna schools, which rarely lasted more than 20 minutes. It was hypothesized (Carles, 1972: 98) that this may also have been a consequence of bait scarcity. Thus, if only a small amount of bait were used for attraction, the tuna might have been easily distracted by alternative stimuli. The proposed solution for this problem was to increase the number of fishers per vessel so that the "bite" could be more completely exploited. A comparison with Japanese pole-and-line vessels of a similar size to the Cuban ones indicated that the number of fishers/ton of vessel displacement in the former (0.35) was double that of the latter (0.17) (Carles, 1972: 98). Such an increase, would, moreover, require no additional bait fishing and would, in fact, better utilize the bait available.¹ Carles (1972: 99) also recommended the adoption of technologically superior fishing methods, especially seine fishing.

Further developments in research into the fishery in the 1970s included the first attempt to estimate the population sizes and "potential catch" of the two major small tuna species, skipjack and blackfin. Using a yield/recruit model in the traditional fishing zone (southwest and northwest shelves), Carles (1975: 84) estimated a potential catch of 1 300 mt with a total biomass of 3 000 mt for blackfin tuna and a potential catch of 700 mt with a biomass of 2 300 mt for skipjack resulting in a total potential catch of 2 000-2 500 mt per annum for the southwest and northwest shelves or about 40% more than the average catch for the period 1965-1975. The total biomass of these species in Cuban waters was estimated at 8 000-10 000 mt. The optimum level of effort to obtain these catches was calculated at 85 000 fisher days for skipjack and 37 741 for blackfin. Available data indicates that effort continued

¹ There was usually dead bait left in the live-well at the end of the day.
to increase during the 1970s (Fig. 12.11). It increased by 116% between 1965 and 1977 (Carles and Hirtenfeld, 1978: 3). In a report published in 1978, the following information about the fishery was given: the fleet consisted of 40 vessels crewed by 300 fishers; the effort level was 70 800 men days fished, the highest in the previous 13 years but still less than that required to obtain the estimated MSY; average CPUE in the traditional fishing zone was 35 kg/fisher/day, rising to as high as 70 kg/fisher/day during the corrida (República de Cuba, CETC, 1978c).

The period from 1968 to 1976 was one of fundamental change in the overall organization of the fishing industry, with the abolition of the co-operatives and their replacement by the combines, fully-nationalized enterprises. It was also a period in which the shelf fisheries became explicitly important in fisheries policy as generators of exports, especially to countries which could supply convertible currency. As a result, there seems to have been no shortage of available capital and fishing fleets were renewed with larger and more powerful vessels. Innovation in fishing gear also occurred, but not in the direction of standardized mechanization as suggested by Soviet and Eastern European experts. With the exception of the shrimp trawl fishery, methods remained mostly manual and new gear was relatively inexpensive. At the same time, the shelf fisheries suffered a lack of regulation. Whether this was a deliberate policy to increase export income or whether it was a result of neglect, itself consequent upon a preference for the high technology and prestige associated with the distant water fleet, is a question with no clear answer.

1 The source for Fig. 12.11 was: Baisre and Páez (1981: 67)
Fig. 12.11. Effort in the Tuna Fishery: 1968-1977
Under the stimulus of all of these changes, landings from the shelf fisheries exhibited strong growth during the period and almost all of them reached levels in 1976 never before achieved. However, they subsequently experienced severe decreases in the late 1970s, a time that coincided with further national economic policy changes, and the introduction of 200 nm exclusive economic zones in the world ocean. Part V will examine how the transformed industry adapted to falling catches and the new world ocean legal regime.
PART V

FISHERIES MANAGEMENT: 1977-PRESENT
CHAPTER 13
A NEW REALITY

The second half of the 1970s brought fundamental changes to the political organization of the world ocean which had important impacts on all coastal states, including Cuba. The process of change was formally set in train by UNCLOS III (Third United Nations Conference on the Law of the Sea) which was convened in Caracas in 1973, as a result of a number of concerns of coastal states including the accelerating depletion of their fish resources by distant-water fishing fleets (Copes, 1981a: 217).

13.1 CUBA AND THE LAW OF THE SEA

Cuba, as a state with both a substantial distant-water fishing fleet and a large merchant fleet, was an active participant in the discussions leading to the Draft Convention on the Law of the Sea. An initial position in favour of a 3nm territorial sea was subsequently modified in support of the 12nm limit favoured by the Soviet Union (Coll, 1985: 900). However, the positions of both countries were rapidly overtaken by a groundswell of support for a 200nm limit which became widely diffused among coastal states by 1976 (Copes, 1981: 218). By the end of 1977 a significant number of these states had established 200 nm zones by unilateral declaration. Cuba was amongst them.

The widespread adoption of 200 nm zones in the world ocean was not to Cuba's advantage (Ballah, 1983: 81). The most serious consequence was the establishment of extended jurisdiction in waters of other states where the distant-water Cuban Fishing Fleet (FCP), the Gulf Fleet (FG) and the Cuban Shrimp Fleet (FCC) operated. Catches made by these fleets represented about
two-thirds of the total national catch in the mid-1970s and, while the Draft Convention required that coastal states give other states access to any surplus of the allowable catch for the various species in their fishing zones, they were effectively able to retain very tight control over such resources. Cuba was able to enter into fishing agreements with the United States, Canada and Mexico but with the election of Ronald Reagan to the presidency, the agreement with the United States was never implemented by that country. The agreement with Mexico, in addition, did not include access to the very valuable shrimp resources of the Campeche Bank. As a result, the Cuban Shrimp Fleet (FCC) based in the north coast port of Mariel, was excluded and returned to operate on the southeastern shelf from the port of Cienfuegos thereby adding a significant number of vessels to those already operating in that region. Distant water catches experienced a precipitous decline of almost 30% in 1979 from that of the previous year (Mena, 1985: 29) and the fundamentals of the Cuban fishing strategy were called into question.

On the 24th of February 1977 Cuba, following the Draft Convention, declared an Exclusive Economic Zone (EEZ) extending beyond a 12 nm territorial sea to a distance of 200nm from coastal baselines which were proclaimed on the same date.\(^1\) However, the location of the archipelago with respect to adjacent states meant that the Republic could not exercise its rights over a full 200 nm zone. Agreements on boundaries in the three very important strategic channels around the archipelago were reached very quickly: with Mexico in the Yucatan Channel (26 July, 1976); with the United States in the Florida Strait (16 December, 1977); and with Haiti in the

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\(^1\) Although the Republic consists of an archipelago, it does not satisfy the condition for drawing archipelagic baselines (i.e. a land to water ratio of greater than 1:1). As a result, straight baselines were employed. While the accuracy of these has been subject to some criticism (Prescott 1985, 337), they have not been legally challenged.

\(^2\) This date, preceding the declaration of Cuba's EEZ, is given by Prescott (1985: 340).
Windward Passage (6 January, 1978) (Geographer 1990, 38). While no record of agreements with other adjoining states such as Jamaica, the United Kingdom (Cayman Islands) and the Bahamas has been found, informal Cuban representations show boundaries that appear to follow the equidistance principle. The resulting very restricted Cuban EEZ, according to Ballah (1983: 73), included only about 8% of the Caribbean Sea. However, as we have seen, since such waters are of low fertility with limited resources, Cuba is fortunate amongst Caribbean insular states in possessing a relatively large insular shelf.

13.2 THE NEW FISHERIES STRATEGY

The widespread adoption of the fishing provisions in the Draft Convention, then, were not in Cuba's favour: its distant-water fleets no longer had free access to the coastal resources of other states; and its own EEZ, unlike those of some other coastal developing nations, was severely limited in area and contained few significant marine resources. As a result, a fundamental reconsideration of the country's fisheries development strategy was undertaken and a multi-pronged strategy was introduced in response to the new situation (Mena, 1985b: 41). In spite of the restricted size of the Cuban EEZ, new emphasis was to be placed upon maximum exploitation of the marine resources, both those of the shelf and those of oceanic waters, within it. While previous plans for expansion of the distant-water fleet had to be shelved, maintenance of its catch levels was to be achieved by fishing in international waters and by entering into bilateral agreements to gain access to other EEZs or fishing zones. In addition, processing of the catch was to be improved so as to increase value added, and foreign expenditures in ship-

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1 Some states, including Canada, declared only fishing zones of 200 nm in 1977.
building and repairing were to be minimized. Also, increased emphasis was to be placed on the long term development of aquaculture, involving both stocking of reservoirs with suitable fish species, and mariculture of shrimp. According to Mena (1985b, 41), the fundamental objectives of the fisheries strategy remained unchanged. The first priority was to feed the population. Exports to obtain convertible currency were secondary.

The increase in the relative importance of the marine resources of the insular shelf (those of oceanic waters within the EEZ were still relatively undeveloped) consequent upon the change in the fisheries strategy came at an unfortunate time for Cuba. As Mena (1985b: 28) noted:

> The changes introduced by the new Law of the Sea coincided with a time of acute world-wide economic slump which affected nearly all countries in the world. The Third World countries in particular, given their generally frail economies and the inequalities in international economic relations, were brutally and severely affected by these changes.

### 13.3 OVERFISHING

In addition, the year 1976 marked a peak in the growth of the total catch from the Cuban insular shelf. Landings in the following year (62,120.7 mt) were 9% lower. The decrease was experienced by all of the major species groups (landings of fish fell by 6%; those of crustaceans by 18.34%; and those of molluscs by 52.7%) in all three ecological complexes. An examination of the statistics for individual species reveals that decreases in landings of many fish (lane snapper, mutton snapper, mackerel, jack mackerel, mullets, mojarras), began in 1976. Landings for almost all other fish species (with the exception of sardines and Atlantic thread herring) fell in 1977 as did those of lobster, stone crab, oyster and the by-catch. Conch and sardine landings fell in 1978 and
shrimp landings, which fell only slightly between 1977 and 1978, experienced an abrupt decrease in 1979. In a four year period, therefore, the landings from the insular shelf of every important species of fish, crustaceans and molluscs experienced decreases.

This situation had important economic consequences because some of the largest one-year decreases were experienced by the more valuable species: lobster, 25.7%; shrimp, 16.8%; stone crab, 17%; oyster, 17.9%; conch, 96.8%; lane snapper, 13.6%; Nassau grouper, 25.9%; and small tunas, 14.6%. Such decreases obviously had serious implications for export earnings. They also had biological consequences. The decreases in catches, it appears, were a result of overfishing in the period of expansion described in the last chapter. At the precise time, therefore, when the relative importance of the shelf resources for the Cuban fisheries strategy was about to increase substantially, their biological and economic health was called into question.

13.4 ORGANIZATIONAL CHANGE

While the fisheries strategy of the country was subject to the twin stresses of the widespread adoption of 200 nm EEZs and crisis in the shelf fisheries, the industry itself was subject to a number of fundamental changes, some specific to this sector, others shared with all economic sectors. In December 1975 (Ley 1323)\(^1\), the Instituto Nacional de la Pesca was given formal ministerial status and renamed the Ministry of the Fishing Industry (Ministerio de la Industria Pesquera, MIP). At the same time, the wholesaling function was transferred to the fishing combines which thereby became vertically-integrated enterprises (Fernández Leal, 1989: 153).

In the same year, the first congress of the Cuban Communist Party

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\(^1\) Some sources give the date as 1976 (eg. Baisre and Benjamín Piloto, 1991: 95).
(Partido Comunista de Cuba, PCC) was held and it approved a new constitution and an administrative re-structuring of the country. Embodied in the new constitution was a de-centralized, popularly-elected government at the national (National Assembly of People's Power, Asamblea Nacional de Poder Popular, PP), provincial, and local levels which was introduced in 1976. The number of provinces in the country was also increased from six to fourteen and 169 municipalities (municipios) were created.

Many state administrative and economic activities were decentralized as part of the new administrative system. For example, responsibility for the activities of the Ministries of Education, Foreign Trade, Light Industry, Transportation and Agriculture within a single municipality were given to the Municipal Assembly while those which fell within more than one municipality were assigned to the Provincial Assembly (Rudolph, 1987: 171). The fishing industry seems to have been an exception. Although, as we will see, it was reorganized on a provincial basis, it remained strongly centralized under the central Ministry in Havana, and provincial governments did not participate in its operations (Instituto de Geografía, 1987: 2).

13.5 THE NEW ECONOMIC AND PLANNING SYSTEM

The same Party Congress announced the introduction of a new system of economic organization in the country as a whole. The System of Economic Management and Planning (Sistema de Dirección y Planificación de la Economía, SDPE) was modelled on Soviet economic reforms of the mid-1960s and, according to Fidel Castro, it had two major aims: the development of "economic consciousness" among planners and managers; and the achievement of maximum economic efficiency in state enterprises. Its introduction represented the end of the transition period of the first half of
the decade during which the economic errors of the late 1960s, including over-centralization and over-emphasis on moral incentives, were recognized and admitted, and a new development strategy and forms of economic organization were sought. All of these changes were introduced into the new system of political-administrative organization described above.

The SDPE was based on four general principles (Alvarez, 1990: 109). Firstly, each enterprise (the number of which increased from 300 in 1968 to 3,000 in 1979) was to be self-financing, with a profit objective which would enable its performance to be measured. Secondly, enterprises were to operate independently in the utilization of resources supplied by the state. Thirdly, worker participation was to be encouraged by a combination of individual and collective incentives both moral and material in kind. Lastly, costs were to be minimized by means of controls exercised by financial and banking institutions which would ensure that a relationship was established between the value of what was produced and the material and monetary resources used to produce it. The SDPE began to be introduced into the economy in 1976.

Central planning was basic to the SDPE. The central planning board (Junta Central de Planificación, JUCEPLAN) had the task of preparing long-term, 5-year and annual plans. The latter were to be prepared in consultation with the ministries of the various economic sectors. They were then sent to each individual ministry and to its enterprises and the departments within them for discussion of the feasibility of achieving plan targets and of resource requirements. The results of these discussions were then returned to JUCEPLAN through the ministries, adjustments were made, and a national plan was subsequently presented to the leadership of the Cuban Communist Party (PCC) and to the National Assembly for ratification.
13.6 SDPE AND THE FISHING INDUSTRY

The introduction of the SDPE into the fishing industry involved some fundamental changes. The new central organization (MIP) had total responsibility for all fisheries policy, planning, management, regulation and production. In addition to fisheries and aquaculture development, it was in charge of processing, internal wholesaling, export and import of marine products, construction and repair of vessels, education and training of technicians and specialists, and execution of research programs. It consisted of a central organization, based in Havana, and 19 new socialist enterprises built on the base of the former fishing combines. Three types of enterprise were created: Industrial Fishing Combines (*Combinados Pesqueros Industriales*, CPIs), of which there were eight; 10 Fishing Enterprises (*Empresas Pesqueras*, EPs); and one Wholesale Distribution Enterprise (*Empresa Mayorista de Distribución*). The CPIs and the EPs were involved in both fishing and processing and the latter also distributed fish to hospitals, kindergartens, fish stores and other outlets. The Wholesale Distribution Enterprise, in accordance with its name, had an overwhelmingly distributive function but also possessed a small fishing fleet. All of the enterprises received marine products from both shelf and distant-water fisheries. The industry incorporated a total of 63 establishments of which 43 were fishing ports, the remainder being workshops, shipyards, and other ancillary services.

The introduction of the SDPE involved a spatial re-organization of the fishing industry on the basis of the new provinces such that each would possess at least one enterprise and that all relations between the enterprise and its subordinate establishments would be contained within provincial boundaries. The resultant spatial arrangement can be seen in Fig. 13.1 which also shows the relations between enterprises and their subordinate
FIG. 13.1. Shelf Fishing Enterprises: 1980s
establishments. Spatial rationality with respect to provincial boundaries did not, unfortunately, reflect the reality of existing relationships within the industry. For example, Santa Cruz del Sur had been the headquarters and principal port of a combine that had subordinate establishments in Guayabal, Playa Florida and Júcaro, all on the coast of the Gulf of Ana María and all within the province of Camagüey. With the new administrative system, this province was dismembered and a new province of Ciego de Avila was created from its western part while the eastern part became the new province of Las Tunas. As a result, both Júcaro and Guayabal were separated from Santa Cruz del Sur and were included in the new enterprises of, respectively, the EP of Ciego de Avila and the EP of Las Tunas. As can be seen from the map, neither of these EPs included a major fishing port and they had no other reason for existence apart from the reorganization. Their creation, according to Baisre (1993), was a "grave error." The EM of Guantánamo also, according to the same commentator, "had no reason for its existence." However irrational their existence, these enterprises persisted into the 1990s, although a plan for their elimination was under study in the early 1990s (Baisre 1993).

13.6.1 Planning

A description of how the SDPE was supposed to operate in the fishing industry was given by Mena, López and Largo (1985). As noted above, planning was central to the new system. There were three basic levels in the process: JUCEPLAN which directed planning at the national level; MIP, in charge of all fishing activity and all economic activity related to the utilization of marine resources, except for retailing; and the basic units, the fishing

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1 The source for Fig. 13.1 was unpublished research conducted by Lic. Jorge Ibañez Zamora in preparing the map of fisheries in the Nuevo Atlas de Cuba (ACC, 1989).
combines, as well as ancillary services such as vessel building and repair and research centres. Fisheries planning was the responsibility of a department in JUCEPLAN which specialized in this sector and which had close connections with an economic department in MIP, and each basic unit had a specialized department or sub-department which dealt with planning.

Three types of plan were prepared: a long-term development strategy with a 15 to 20 year outlook; a medium-range, 5-year one consistent with the long-range strategy; and a one-year plan which outlined precise goals and the means of accomplishing them. As noted above, the annual plans were approved by the National Assembly and thereby became law. The long-range strategies, prepared by MIP in conjunction with JUCEPLAN, represented a first approximation to the outlining of the means for satisfying the general fisheries objectives of supplying protein to the population and generating foreign exchange. This involved, on the one hand, the preparation of a resource inventory by CIP (fisheries within the EEZ), the National Aquaculture Enterprise (inland waters) and the Office of International Relations (distant waters) and, on the other, estimates of internal and external demand. In the satisfaction of internal demand, there was no attempt to ensure that Cubans in all parts of the country ate the same amounts of fish. Rather, the objective was to provide a minimum level of animal protein throughout the country. Fish would, therefore, be directed to areas deficient in other sources of protein. Calculation of external demand was done by market studies conducted by MIP and by international agencies (e.g. Roblejo Falcón, 1979). The long-range plan prepared by MIP was subject to consideration by JUCEPLAN and approval by the higher levels of government.

The five-year plan, much more precise in nature, was structured in six
interrelated categories:

1. Scientific-technical progress involved evaluations of fishing techniques applicable to available species, processing technology, means of distribution, and the natural environment.

2. Production and services included estimates of total landings by groups of species and important single species, the proportions of the total destined for export and internal consumption, the proportions of production by quality categories and the efficiency of all productive processes.

3. Investments involved the prediction of capital required to achieve the production goals. It took into consideration, replacement, enlargement, and modernization of existing facilities as well as new installations.

4. The plan ensured the material supply with respect to the consumption of raw materials, consumables, spare parts, etc. In effect, requirements were organized at the base level of the enterprise, aggregated by the Fishing Supplies Enterprise (Empresa de Suministros Pesqueros, EMSUPES), a special MIP dependency, which then sent them to JUCEPLAN and the State Committee for Technical Material Supply (Comité Estatal de Abastecimiento Técnico Material, CEATM) which, in turn, coordinated them with the requirements of other sectors.

5. Work and wages. This aspect of the plan dealt with productivity, the required number of workers, salaries and the distribution of the work force.

6. Costs, revenues and profitability were summarized with the objective of decreasing costs, stimulating worker productivity and, thereby, increasing profits.

The annual plan contained exactly the same categories as the five-year plan but the various indicators described above were more precisely defined. Beginning one year in advance, each enterprise, with the help of various MIP dependencies, prepared a plan which included estimates of all its requirements--vessels, gear, spare parts, demands for research, freezers, ice, water, and transportation. Individual plans were then subject to scrutiny by
MIP and JUCEPLAN, sent back to the enterprises, and finally adjusted to bring them into balance with the National Economic Plan for the time period in question. Once adopted by the National Assembly, the plan was sent back to MIP and from there to each enterprise for its execution.

13. 6. 2 Fishers' Wages

The system of payment to fishers changed in the mid-1970s, providing financial bonuses to individual fishers in addition to the base wage. According to Mesa-Lago (1978: 46), the new wage system was introduced in 1976 in 9,680 enterprises employing 600,000 workers and it seems likely that the fishing combines were included at that time. In the previous period, fishers had been paid a fixed wage on the 8th and 23rd of every month regardless of the catch or whether or not the vessel, because of weather, breakdowns, lack of socialist consciousness or other reason, had achieved its assigned catch goal (Abascal, 1975: 25). In keeping with the re-introduction of material incentives and after consultation with unions, management and workers' assemblies, the system was changed. The monthly wage remained, but was fixed at a lower level. Each vessel was assigned a catch goal (norma) based on the previous five years experience, and on the type of gear, fishing zone, type of vessel, species caught (by quality group) and size of crew. Goals were given, by month, in total kilograms, by one of three quality groups. Fishers were awarded a production bonus for completing the goal and, if a vessel caught more than the goal, its crew members were awarded further financial bonuses.

An example given by Abascal (1975: 28) gives an explanation of the system and also gives some insight into fishers'salaries.
I, for example, an engineer on a scale fishing vessel earned a monthly wage of $150 before. Now, I'm going to receive for my work - that will be measured on the basis of twenty days fishing per month, with 10 days of rest per month - an assured wage of $90.78. And once my monthly goal is completed they will pay me my corresponding production wage, that is $64.22. If you sum the two quantities, you will see that the result is $155, that is $5 more than they always pay me because of a wage adjustment made by the new system. But suppose my boat over-achieves its monthly goal and instead of catching 1 000 kg, catches 1 500 kg; suppose also that these extra 500 kg are of (quality) Group I. Then, that month I get, on the 23rd, my $90.78 base wage, and on the 8th of the following month, I get the $64.22 production wage for completing the norm, plus $32.11 more as a bonus (incentivo) for the over-completion. In other words, the wage for that month would amount to $187.11, so that everyone wins (My translation).

There is little information with respect to wages in the fishing industry in the 1970s so there is no easy way to discover how the sample wage described above compares with those of workers in other sectors. However, a study of country-wide wages in the mid-1980s (Pérez-López, 1989) revealed some interesting characteristics of wages at that time.1 Firstly, bonuses in the fishing industry were an important component of wages: in the three years under consideration, hourly earnings (wages plus bonuses) were more than twice as high as hourly wages (1984: $1.95/0.77; 1985: $2.18/1.00; 1986: $2.28/1.00). Secondly, hourly earnings put fishers among the highest paid workers in Cuba (1984: only five out of 50 occupations reported higher hourly earnings; 1985: only 6 out of 88, five of them in air transport; 1986: none were higher but air transport was omitted). Unfortunately, there is no way to

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1 Pérez-López notes the paucity of information on wages in Cuban publications. The data for his article were obtained from the International Labour office (ILO) to which Cuba reported on wages 9 times out of a possible 36 between 1951 and 1986 (1989: 201).
discover from Pérez-López' data how many hours were worked by Cuban fishers in one month, nor how many months were worked per year. However, a crude monthly average wage may be obtained by multiplying average hourly earnings, by the average number of hours worked per week, by four. For 1984, 1985 and 1986 in the shelf fisheries this calculation gives a monthly average wage of of $304.05, about double that for the mid-1970s. Some interviewees (Pérez, 1991; Báez, 1991) stated, not without some envy, that "many" fishers earned more than $1 000 Cuban per month. (A fisheries biologist, by contrast, earned about $370). However, a recently-arrived, Cuban longline fisher interviewed in Key West in 1993 laughed at the suggestion of a $1 000 monthly wage and suggested that his average was closer to $300. The discrepancy could be a result of the type of politicized interpretation of events discussed in Chapter 9, or of variation in the value of different fish species, or both. With the available information it is not possible, to be more precise about fishers' total wages. However, it does seem clear from the ratio of hourly earnings to hourly wages that bonuses constituted a significant element in them.

13.7 TOWARDS A NEW STRATEGY FOR SHELF FISHERIES

A meeting between the government and MIP at which "some worries were expressed with respect to the management and exploitation of fish resources" occurred in late 1978 (Ramos and Obregón, 1983: 1). It is not entirely clear, but probable, that this was the meeting or series of meetings entitled the First National Scientific and Technical Plenum of the Fishing Sector (I Plenaria Nacional Científica-Técnica de la Rama Pesca.), during

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1 It is my impression that fishers continue to be paid a basic monthly wage during non-fishing periods.
which reports from several commissions were presented in an apparent attempt to evaluate the state of the industry (CETC, 1978a-f). The seven presentations covered the following topics: the fish resources and fisheries in national waters, fishing gear and techniques, vessel construction, processing of fish products, international fisheries and labour allocation. An examination of them provides a picture of the shelf fisheries at the beginning of this new stage in their development.

The introduction to the individual commission reports contained intimations of how Cuban fisheries strategy would develop in response to the new reality in the world ocean. Four lines of development were envisaged. Firstly, the limited nature of the resources of the shelf was recognized and their future exploitation was to be carried out in a more efficient manner than had previously been the case. Secondly, in response to the loss of free access to coastal resources in distant waters consequent upon the establishment of 200 nm exclusive economic zones, a search would be undertaken for new marine resources at greater depths and outside of these zones. Thirdly new catching and processing techniques would be investigated and fourthly, aquaculture would be developed. In fact, the last became an important aspect of Cuban fisheries development in the following decade, contributing 13% (some 24 000 mt) of landings in 1990 (Benjamín Piló o and Baisre, 1991: 106). In order to achieve these goals, it was recognized that a number of general problems would have to be overcome. Among them were: inadequate scientific and technical information, research and utilization of the labour force, as well as a lack of cooperation between the extractive and processing branches so that resources were not being directed to exploitation of the most desirable species. Special research groups, including one for each major fishery, were set up within MIP to attempt to grapple with these problems and
to find ways of achieving the new objectives. A number of very useful evaluations of the shelf fisheries date from this time.

Overall fisheries objectives remained similar to those articulated in 1961: to feed the population, to create employment, to improve the living conditions of fishers\(^1\) and to obtain convertible currency by means of exports. The social objectives according to Mena (1985: 30) were paramount: "We have to remember that in the development of the Cuban fishing industry the main objective has not been obtaining profits." However, with the introduction of "economic consciousness" by means of the SDPE, a change in emphasis began to occur. It was recognized that the revenues obtained from the catch were more important than was its quantity and that some consideration had to be given to the manner in which it was caught. For example, a 1980 report (MIP, CIP, 1980) contained the following motto in capital letters on its title page: "To extract more and better fish from our shelf in a more rational and efficient manner" (A extraer más y mejor pescado de nuestra plataforma de una manera más racional y eficiente). The fundamental objective continued to be refined in the next few years and, in the process, acquired an explicitly economic character. For the shrimp fishery this was elaborated as follows (Pérez, Puga and Rodríguez: 1983):

To manage the Cuban shelf shrimp fisheries to obtain the greatest sustained revenues in foreign exchange with the minimum investment possible, in accordance with the socio-economic structure of the country.

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\(^1\) No studies were found on the social and economic conditions of fishers after the immediate post-revolutionary period. Such studies have been done. See for example Méndez (1983), a survey of fishers and fishing ports conducted in the early 1980s. I spoke with the author of this report, a MIP psychologist, who told me that he would not allow me to see it because it contained classified economic and political information.
The Cuban fisheries literature does not include any account of how these objectives were arrived at. However, a closer examination of them may allow some deductions to be made about the degree of familiarity of fisheries scientists and policy makers with the theoretical ideas about management that were current in the capitalist world at the time.

According to the bioeconomic model described in Chapter 2, the greatest sustained revenues in a fishery are obtained with a level of effort which is consistent with MSY. The Cuban objectives therefore acknowledge, at least implicitly, the importance of avoiding biological overfishing and thereby obtaining sustainable catches. There is no question that Cuban fisheries biologists were familiar with the concept of MSY. As noted in the last chapter, Carles (1975) had attempted an estimate of MSY for the small tuna fisheries and Carles and Hirtenfeld (1976) explicitly estimated the MSY for lobster stocks on each of the four insular shelves as well as the optimum effort levels for achieving it. However, it is obvious from the dire situation of the shelf fisheries in the late 1970s that the question of sustainability had not been incorporated in any meaningful way into the practical management of fish stocks.

Returning to the new objectives for the shrimp fishery, it is clear that there was a realization among their drafters that sustained revenues should not be obtained without regard to costs but "with minimum investment possible." According to the bioeconomic model, these are contradictory objectives since obtaining the "maximum sustained revenues" requires an effort level consistent with MSY. What was being proposed, then, was a trade-off between maximum revenues and minimum costs without specifying in the statement of objectives at what point it should take place. However, since the report of the first National Shrimp Meeting in 1980 (CIP,
1980) contains a discussion of MEY, it seems clear that what was being proposed was a move towards the optimal trade-off between maximum revenues and minimum costs represented by it.¹ A straightforward move to MEY as an objective in the fisheries was prevented by the qualification, in the last part of the statement, that it had to be achieved "in accordance with the socio-economic structure of the country." This objective is consistent with that of OSY, as described in Chapter 2. Whether the theoretical concept of OSY was familiar to Cuban scientists at the time is not known. It does not appear explicitly in the available literature.

This exegesis on the objectives of the shrimp fishery leads to the conclusion that fisheries scientists in Cuba in the early 1980s were familiar with the bioeconomic analysis of fisheries. How deep and sophisticated was their understanding of the economic aspects of the model is impossible to ascertain but economists do not seem to have been involved routinely in the study of fish catching operations.²

The theoretical knowledge of fisheries scientists described above was obviously important to the management of the shelf fisheries. However, of equal or greater importance were the understanding and aims of policy makers in the Ministry and in the government. There is no published information with respect to either policy discussions within the Ministry or political ones within the government so that there is no way to gauge the depth of understanding of the peculiarities of the fishery at these levels. It should be noted, however, that the impulse toward cost reduction probably originated in the general SDPE objective of achieving economic efficiency in

¹ There may have been an ideological reason for the avoidance of an explicit statement in favour of MEY: in 1980, Fidel Castro stated that, "We must guard the ideological purity of our Revolution. We will use nothing that smells of capitalism" (Jeffries, 1990: 23).
² In an interview, Pérez (1991) told me that his requests that an economist be attached to shrimp research group went unanswered.
all economic enterprises.

The late 1970s and early 1980s was the period in which the revolutionary government finally began to utilize the theoretical advantages of being sole owner of the marine resources of the insular shelf and the adjacent waters of the Exclusive Economic Zone, and of the means of production in the fishing industry. As we have seen, it was a time of crisis in Cuban fisheries with the overall fisheries strategy being called into question and the fisheries of the shelf in a state of biological over-exploitation. The following chapters will examine the nature of the official response to the crisis and will attempt to evaluate its degree of success. Each major fishery will be examined in turn beginning with the shrimp fishery, the leader in innovation in management strategies and the fishery about which the most complete information was obtained.\(^1\) It should be pointed out that very little information was available in Cuba with respect to recent history of the processing industry. These chapters, as a result, concentrate on the harvesting sector of the industry.

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\(^1\) The following section will not deal with a number of fisheries classified as "specialized." They include fisheries for clams, crabs, sponges and turtles.
As we have seen, the shrimp fishery, with the exception of occasional exploitation of La Broa Bay by the CPI of Batabanó and of very minor fisheries in Isabela de Sagua and Nipe Bay on the northeast coast, was overwhelmingly conducted on the southeast shelf. In the early 1980s, the resource was fished by fleets from the ports of Cienfuegos and Júcaro, operating in the Gulf of Ana María, a fleet from Manzanillo operating in the Gulf of Guacanayabo and fleets from Playa Florida and Santa Cruz del Sur operating in both gulfs. In 1983, Júcaro (EP of Ciego de Avila) was removed from the fishery (MIP, 1984: 8). Between 1976 and 1980, 97.2% of the catch was obtained on the southeastern shelf, the bulk of the remainder in the La Broa Bay (García-Arteaga and Claro, 1987).

The fishing fleet was composed mainly of Cuban-built, ferro-cement trawlers (17.8 m in length), although a number of larger (22.9 m and 25.2 m length) steel vessels operated in deeper waters toward the outer edge of the shelf in the Caballones area. All of them were very similar in design to shrimpers in other parts of the Gulf of Mexico but were more simply outfitted in terms of electronic equipment. They had two-way radios but did not generally have radar, depth sounder (except for those operating in deeper waters), Loran or automatic pilot. Navigation was by dead reckoning and was, therefore, dependent on the skill of the vessel skipper. The fishing gear was the "standard western jib trawl" (Baisre, 1984: 366) rigged in two pairs (chinchorros gemelos) (Appendix V). Overall, the fleet was relatively homogeneous in terms of vessels, gear and fishing techniques.
Shrimp catches from the shelf fishery showed a strong increasing tendency, with some fluctuations, from 1959 until 1977 when a maximum of 5,863.7 mt was caught (Fig. 10.8). After that year, catches began to drop. Effort continued to increase, however, partly as a result of continued emphasis, at least for a few years, on "constant increase in catches" and partly because of the exclusion of the Mariel-based FCC from the newly-established Mexican EEZ. This fleet returned to operate on the southeast shelf from the port of Cienfuegos, adding a significant number of vessels to those already operating there. Effort in the fishery almost tripled from some 14,000 fishing days in 1973 to a peak of 38,000 fishing days in 1982 (Puga, Morenza and Pérez. 1986) (Fig. 14.1).

Decreases in landings, beginning in the late 1970s, along with continued increases in effort, raised concern in MIP that overfishing was occurring in the shrimp fishery and, in 1979, a new shrimp research group made up of biologists, headed by A. Pérez, was set up within the Fishery Research Centre (CIP) to study the situation.

14.1 PROBLEMS IN THE FISHERY

14.1.1 Overfishing

In the absence of detailed published statistics, it is not possible to carry out a comprehensive objective assessment of the situation in the fishery in the late 1970s and early 1980s. However, inspection of those reports which were available, along with information obtained from interviews, allows some deductions to be made with respect to the question of overfishing.

After some study, the Cuban shrimp research group came to the conclusion that the shrimp populations of the shelf had been subject to

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1 Fig. 14.1 is a reproduction of a graph in Puga, Morenza and Pérez (1986).
overfishing since about 1976. In an interview, Pérez (1991) stated that,

> We saw typical signs of overfishing--increasing effort levels and stabilized or diminishing catches. We also knew that there were no new areas for expansion. ... Besides, we made an assessment based on general production models and they also indicated that there was an overfishing state.

Neither the interviewee nor contemporary reports are particularly clear about what type of overfishing had been found in the fishery. The use of general production models, a dynamic variant of the surplus yield model (Baisre 1989: 48-50; Cunningham, Dunn and Whitmarsh, 1985: 59) in this context indicates that overfishing was being defined in its biological sense. Confirmation of this conclusion comes from the statement by Baisre that "it was about 1976 when the increase in efficiency of the gear and the number of vessels caused the exploitation level to exceed the one corresponding to MSY" (Baisre, 1984: 366). A closer inspection of the evidence may allow a more precise definition of the problem.

14.1.1.1 Recruitment overfishing. Recruitment overfishing has been defined by Pauly (1979a: 3) as: "what happens when the (parent) stock is reduced by fishing to the extent that not enough young fish are produced to ensure that the stock will maintain itself." With respect to this topic Garcia (1989: 286)\(^1\) has noted:

> This issue has been neglected for a long time in shrimp fisheries and the accepted paradigm was that because of the high fecundity of shrimp and the importance of inshore nurseries in determining cohort survival, shrimp stocks were unlikely to be

\(^1\) Garcia's review of coastal Penaeid shrimp fisheries was invaluable in this analysis of the Cuban fishery.
exploited intensively enough to cause recruitment problems and that economic factors probably would limit effort below the critical level for shrimp stock reproduction.

In other words, it was assumed that shrimp stocks were non-self-regulating and would produce a yield-effort curve similar to that shown in Fig. 2.2C in which continued increases in effort would result in a curve which would asymptotically approach MSY.\(^1\) Since the curve never reaches MSY such a stock, in theory, could not be subject to biological overfishing. However, as Copes (1986b: 56) has noted,

\[\text{even where a stock appears to be non-self-regulating over a wide range of fishing pressure, there may be some high rate of harvesting at which the adult stock will be reduced to a level where it becomes 'self-regulating'. At this point, recruitment will start to vary in relation to the size of the remaining parent stock, as well as environmental factors.}\]

According to Pérez (1992), application of various types of production model (e.g. Schaefer and Fox), to catch and effort data in the Cuban shrimp fishery did not exhibit an asymptotic yield curve approaching the level of MSY. Further, simulation studies carried out in the Gulf of Ana María (Pérez, et al., 1984) indicated that there were stock-recruitment relationships in the fishery, i.e. shrimp stocks there were self-regulating. The yield curve most applicable to the fishery, therefore, might be the modified Schaefer curve.

\(^1\) There is some question about the applicability of models like the Gordon-Schaefer model in the fisheries for short-lived, unstable stocks like those of tropical shrimps. Caddy (1985: 239) has considered the topic and concludes: "Clark (1985) referring to the Gulf of Carpinteria prawn fishery indicated that 'although the Schaefer model may be biologically unrealistic (for prawns) its cautious use as a basis for a general economic analysis seems justified, because its principles are in fact quite robust.'"
described in Chapter 2. The curve, as we saw, does not return to the axis because the stock will probably not be fished out completely as a result, for example, of fish protected in sanctuaries inaccessible to fishing. Thus, high levels of effort in the fishery may produce a catch less than MSY and the fishery, therefore, will be subject to biological overfishing.¹

14.1.1.2 Growth overfishing. Growth overfishing is a major problem in shrimp fisheries worldwide. Garcia (1989: 284) notes that "One of the key issues in present-day shrimp fishery management is to determine the most appropriate age at first capture and the fishing pattern to reach a specific economic objective or a given shrimp market." Penaeid shrimp are fast growing animals that, throughout the greater part of their range, may be available to the fishery for as little as one year.² Since, fishing may effectively be taking place on one cohort, decisions with respect to size (age) at first capture and the disposition of fishing fleets have to be made within the time frame of one fishing season.

A complication in the calculation of the optimal size at first capture arises from the fact that the price obtained per kilogram for large shrimp is greater than that for small shrimp. The issue, then, is to establish the "critical size" of shrimp from which the maximum revenues may be obtained from the fishery. This, "can be estimated by calculating and comparing the total value ('biovalue') of the catch that would result from different sizes at first capture" (Copes, 1986b: 54). Ideally, fishing would not begin until the individuals in the cohort had reached this critical size. Fishing before this would constitute growth overfishing. However, fishing to obtain maximum

¹ Caddy (1985: 288) shows a curve similar to the modified-Schaefer one for Penaeus schmitti in the Nicaraguan Caribbean.
² The western king prawn of South Australia, being toward the extreme range for tropical Penaeids, appear to have a life-span of four years (Copes, 1986c: 44). Similar long life spans may be characteristic of other stocks at the limit of the range.
biovalue is still quite a complex problem especially, for example, if the fishing fleet is otherwise unoccupied, or if there is competition for the same stock between inshore artisanal and offshore industrial fishereries. "The problem here is a trade-off between immediate loss of small shrimp catch and future gains in weight and value of the survivors" (Garcia, 1989: 284).

In the Cuban fishery of the 1970s, the proportion of small shrimp was relatively high as a result of the fact that, apparently, fishers' bonuses and enterprise catch plans were based upon the total weight of the catch rather than its size composition and, therefore, value (CIF, 1980). In the attempt to maximize the size of the catch, there was a tendency for operations to be concentrated during the recruitment period in the latter part of the year when large concentrations of small shrimp were available to the fishery (Rodríguez Montoro, 1988: 80). In addition, fleets were attracted to areas, close to the coast, which contained high concentrations of small shrimp in nursery zones. The attractiveness of such areas to the fleet was further increased by the fact that they tended to be more sheltered from inclement weather and, in addition, contained fewer patch reefs which could damage or destroy fishing gear. As a result, areas further from shore where both higher yields and more valuable, larger shrimp might have been obtained, were fished relatively little (Rodríguez Montoro, 1988: 81). Such temporal and spatial concentration of fishing effort may be viewed as a rational response by fishers and enterprises to the emphasis on maximizing the size, rather than the value, of the catch, but the consequent high proportion of small shrimp in the catch raises the possibility that growth overfishing was occurring in the fishery.

14. 1. 1. 3 Economic overfishing. The economic situation in worldwide shrimp fisheries closely approximates that described for the open-access fishery in Chapter 2. Garcia has noted (1989: 283):
Most shrimp fisheries around the world are common property resources, even when the coastal countries have claimed exclusive economic zones, for access is still open to nationals. The usual competition among participants for a greater share of the common resource has often led to an uncontrolled increase of effort to the point where the economic rent is dissipated and often the economic situation of the fishery is very critical, some fishermen no longer being able to cover their capital costs and even sometimes their operational costs. Governments intervene by providing subsidies, soft loans, tax reductions, and so on, which usually aggravate the problem, leading possibly to overall economic losses to the country.

The major means of correcting such economic overfishing in existing shrimp fisheries is rationalization of the fishery by means of reduction and limitation of effort. As we saw in Chapter 2, rationalization has been attempted in other world fisheries with varying degrees of success. Even in fisheries, such as the shrimp fisheries of South Australia, where limitation has been successfully introduced, problems may persist and constant refinement may be necessary (Copes, 1986, 1990).

Since the state in Cuba owns the means of production, it should have been able to avoid the excessive growth in effort that leads to economic overfishing. The available evidence suggests that it did not. The fishery of the late 1970s and early 1980s appears to have been subject to the type of externalities typical of an open-access fishery. As noted above, it was characterized by a generally decreasing trend in catches accompanied by a substantial increase in effort from about 14 000 days fished in 1973 to about 38 000 days fished in 1982 (Fig. 14.1). The term "economic overfishing" does not appear in any of the contemporary Cuban literature so that it seems likely
that, during this period, the fisheries objective of "constant increase in catches" was being pursued without any attention being paid to the cost of obtaining them. In the absence of an understanding of economic overfishing, it seems that the original stimulus toward remedial action in the fishery may have been based mainly on biological assessments. However, under the stimulus of "economic consciousness" introduced by the SDPE, described in the last chapter, the shrimp research group very quickly began to consider economic aspects of the fishery as well. In spite of this move toward the inclusion of economic considerations into analysis of the fishery, Pérez (1991) reports that it was not until 1989 that the shrimp group developed a "bioeconomic simulation model" which "was applied to the Manzanillo mixed fishery, and MEY and the corresponding effort was estimated for each species of shrimp." This report, unfortunately, was never published.

14.1.2 Other Problems

In addition to the biological and economic overfishing described above, Cuban managers had to deal with some other issues shared by shrimp fisheries in general.

14.1.2.1 Stock instability. As noted above, shrimp are short-lived species. As a consequence, Garcia noted (1989: 285):

The annual yield is therefore largely a function of the importance of the annual level of recruitment and the latter is widely influenced by environmental conditions. The consequence is that annual catches vary from year to year either randomly or, more probably, following long-term autocorrelated oscillations.
Such fluctuations make it difficult to estimate MSY or any other sustainable yield level (e.g. MEY). This in turn makes it difficult to establish an optimal effort level in the fishery in advance of the fishing season. Cuban research into this question occurred in the 1980s and will be discussed later.

14. 1. 2. 2 Conflicts. There are two important sources of conflict in shrimp fisheries: between industrial and small-scale fisheries; and between the fishery itself and aquaculture (Garcia, 1989: 284). McGoodwin (1989) has documented the first type of conflict on the west coast of Mexico where small-scale fishers caught small shrimp on their exit from coastal lagoons while an industrial fleet fished larger shrimp of the same stocks offshore. Gear conflicts may also occur when shrimp trawlers damage the fixed gear of small-scale fishers. "Conflicts between industrial and small-scale fisheries cannot be overstated" (Garcia, 1989: 284). Cuba, as we have seen in Chapter 11, dealt with conflicts within the fishery by completely eliminating the artisanal fishery for shrimp by 1972 and the set-net fishery in the lagoons of Tunas de Zaza in 1975 (Pérez, Puga, Rodríguez, 1983: 50). While this was indeed a "drastic measure" (Garcia, 1989: 284), it is likely that the displaced artisanal fishers were given alternative employment in the fisheries or other economic sectors.

However, the removal of the artisanal fishery did not completely remove conflict in the fishery. Although each enterprise had been in possession of an exclusive fishing zone since 1976, there was little or no management co-ordination between zones. For example, the FCC trawl fleet operated in the offshore area of Caballones in the Gulf of Ana María fishing adult shrimp, while the Júcaro trawl fleet operated in the inshore area of the same Gulf fishing young, less-valuable shrimp of the same population.

Conflicts with aquaculture, according to Garcia (1989: 284) derive from competition in markets, for space and for post-larval seed. Shrimp
aquaculture is dependent on the collection of wild post-larvae but projects are usually built in coastal areas and often involve the destruction of mangroves which play an important role in the production of such seed (Longhurst and Pauly, 1987: 26). The result has been that shortages of such seed have occurred (Garcia, 1989: 284). Although shrimp culture has been developed in Cuba, it has not yet come into such conflicts with the fishery.

14.1.2.3 By-catch. The shrimp trawl fishery is a multi-species fishery. As Garcia (1989: 287) has pointed out: "Shrimp are only one element (a major one in value but a minor one in weight) of the fish assemblage available for exploitation on tropical shelves and one of the important characteristics of shrimp fishing is the importance of by-catch and discards." It is easy for the observer of a shrimp fishing operation to be appalled at the apparent waste of the large amounts of fish which are discarded, usually dead, over the side.1 However, as Garcia noted, its utilization presents a number of problems: storage on board may be difficult, landings of "trash fish" may compete in markets with landings from small-scale fisheries; and the impact of removing large quantities of fish from the ecosystem may have an ultimate impact on shrimp production, although this has not been established. In addition, a large proportion of the by-catch may be composed of juveniles of fish species which would be commercially valuable if allowed to grow to adulthood. The by-catch in Cuba began to be utilized for the manufacture of meal for animal feed in the early 1970s (Baisre, 1985: 91). More complete utilization began in 1980 when CIP began to insist on the utilization of some of the by-catch for human consumption. In 1981, landings of 7.5 mt of blue crab (exported to Japan), 4.7 mt of clams and 16.7 mt of Atlantic thread herring were reported in

1 Although admitting that it is an oversimplification, Allsopp (1981: 29) suggests that a by-catch to shrimp ratio of 10:1 for tropical waters is a useful guide.
the Manzanillo area for the months of June and July (Pérez, 1991). Such culling of the catch was encouraged by paying different prices for fish suitable for human consumption and the system became integral to the shrimp fisheries in the 1980s.

Such utilization of the by-catch may be a much better alternative than simply discarding it, but it does not deal with the impacts of removing large numbers of fish, including juveniles of valuable species, from the ecosystem. Various attempts have been made to avoid or reduce the by-catch. Trawl nets have been constructed with large-mesh selective panels designed to separate shrimp from fish and to allow the fish to escape. However, shrimp losses as high as 50 or 60% in some situations, discouraged their use (Vendeville, 1990: 11). The trawling efficiency device (TED), which was originally designed to allow the escape of turtles from shrimp trawls, has been more successful (Watson, Mitchell and Shah, 1986). Vendeville (1990: 26) reports that some versions of this device, which separates fish from shrimp and directs them out of the net, may reduce the by-catch by up to 84% and may even improve the shrimp catch. It was introduced into the shrimp fishery in the southeast United States (Watson, Mitchell and Shah, 1986). A comparison of the social cost and benefits of utilization of the by-catch as against the introduction and use of such devices in the Cuban shrimp fishery might be a worthwhile exercise.

14.2 MANAGEMENT STRATEGIES AND TECHNIQUES IN SHRIMP FISHERIES

Shrimp fishery managers possess a set of tools which can be employed in the attempt to deal with the issues discussed above. According to Garcia (1989: 290) these may be divided into two groups: those which involve the
regulation of the age composition of the catch; and those that deal with the regulation of fishing effort. Each of these will be examined before considering the remedial measures taken in the Cuban shrimp fishery in the early 1980s.

14.2.1 Regulation of the Age Composition of the Catch

The objective of measures aimed at regulating the age-composition of the catch is to increase its biovalue by increasing the mean age-at-first-capture. The most straightforward method of doing so is by means of regulation of mesh size in trawl nets. "The principle is clear: the larger the mesh size, the larger will be the average size of fish retained in the net and the greater will be the number of smaller fish that escape through the mesh" (Copes, 1986: 99). In the shrimp fishery, as noted above, an increase in the average size of fish results in an increase in the value of the catch. The application of a minimum mesh size may be complicated if the fishery targets mixed stocks: "Adjusting the mesh size to the most profitable stock (usually the larger species) leads to the underexploitation of the smaller ones" (Garcia, 1989: 290). Larger mesh size could also reduce the by-catch and thereby avoid or at least reduce the problems of impacts on other fisheries and on the estuarine-littoral ecosystem in general. A supplementary measure that may reinforce mesh size regulations is the establishment of a minimum landing size for shrimp.

It was noted in Chapter 4 that, as a result of the offshore migration of maturing shrimp, the spatial distribution of stocks is to some extent stratified by size. As a result, selectivity in harvesting, with the aim of increasing the age at first capture, may be accomplished by the establishment of temporary
closures of different areas.¹ (Such closures may also be introduced to protect nursery areas). Garcia (1989: 292) proposes two steps in this process: determination of an average optimal closed season; and fine-tuning of precise opening and closing dates to take account of annual variations in recruitment. Copes (1986: 99) has described a more flexible variation which he called "stock component targetting" which "involves monitoring stock movements and stock composition and giving rapid directions to the fleet so that they will target stock components having the most appropriate size distribution." This is a form of "real-time management" which has been employed generally in the shrimp fisheries of South Australia and has been especially successful in the Spencer Gulf fishery. Such a flexible system is particularly appropriate where stocks are mixed and where there may be several recruitment peaks or even continuous recruitment to the fishery.

14.2.2 Regulation of Total Fishing Effort

As noted previously, many, if not most, shrimp fisheries in the world are characterized by excessive effort. Possible solutions to this problem may involve what was referred to in Chapter 2 as "handicapping" i.e. reducing the catching power of individual vessels, or reducing the aggregate fishing time for the fleet. The former, which can be achieved by placing limitations on engine power or vessel length, or by limiting the number of trawls employed per vessel, may protect stocks but "such an imposed decrease in efficiency adds ... to the cost of fishing and is hardly acceptable from an economic point of view" (Garcia, 1989: 296). Economically acceptable or not, such limitations are common in fisheries where entry limitation has not been possible, or has not

¹ See, for example, the Gulf of Carpinteria shrimp fishery in Australia's Northern Territory (Copes, 1977).
been successful. Reducing fleet fishing times by closures of various kinds (weekend, moon closures) has also been tried in shrimp fisheries. However, such measures may stimulate even greater competition and a more intense "race for fish" amongst fishers during the shortened fishing season, leading to investment in more efficient gear and equipment (capital stuffing) which further decreases the efficiency of the fleet.

Potentially, the most suitable method of regulating effort in shrimp fisheries is to limit the entry of vessels into the fishery in the first place or to reduce their number if the fishery is already in a state of economic overfishing.\textsuperscript{1} The aim here is to operate the fishery at some level of effort lower than that which results in the open-access equilibrium in order to restore resource rents to the fishery. Whether the level aimed at is the one consistent with MEY, or with MEY modified by social or other considerations (OSY), depends on the objectives set for the fishery by the central authority involved. Such limited entry existed in the South Australian shrimp fisheries from their inception. However, as Copes (1986: 6) has noted, limiting the number of vessels does not necessarily control effort in the fishery. Technological change and improvement in fishers' skill with experience can increase the fishing power of the fleet to the extent that means must be found to remove additional vessels from the fishery in a process of fine-tuning. Copes (1986: 1990) has documented the difficulties of implementing such fine-tuning in the South Australian shrimp fisheries.

\textsuperscript{1} Individual quota systems, which require the setting of an total allowable catch (TAC) are not suitable for shrimp fisheries where it is often important to fish the stock hard to catch all the fish before they succumb to natural mortality. In such a case it would be inefficient to make vessels stop fishing when a pre-set quota had been taken.
14.2.3 Habitat Protection

According to Garcia (1989: 299), "It has been shown that the potential of a shrimp resource is proportional to the amount of habitat available in the nursery." The mangrove habitats of estuarine and lagoonal coasts are especially important but these have been subject worldwide to pollution, deforestation (often for aquaculture), land reclamation and housing and tourist development. Their protection or restoration is crucial to shrimp fisheries.

With these general comments about management of shrimp fisheries in mind, we can now begin a consideration and evaluation of the remedial measures taken in the Cuban shrimp fishery in the early 1980s.

14.3 THE NEW MANAGEMENT REGIME

According to those involved, one of the most fundamental problems in the fishery was the lack of clear management objectives (Pérez, 1991). The objective of 1961, calling for a constant growth in catches, was no longer tenable in the face of the over-exploited condition of shrimp stocks. It was replaced, as we have seen in Chapter 13, by a new "economically-conscious" statement:

To manage the Cuban shelf shrimp fisheries to obtain the greatest sustained revenues in foreign exchange with the minimum investment possible, in accordance with the socio-economic structure of the country (Pérez, Puga and Rodríguez: 1983).

As we saw in the evaluation of this statement in Chapter 13, it contains some contradictory elements. However, it is clear that the fisheries scientists involved in the shrimp fishery fully realized that achieving it would involve
a move toward MEY, tempered, however, by the "socio-economic structure of the country".

With these objectives in mind, the research group set about to re-organize the shrimp fishery, "by means of a management based on the application of science and technology" (CIP, 1980). In practice, this involved two types of action. The first was the introduction of a series of fisheries regulations aimed at: effort and, therefore, cost reduction; increasing the value of the catch; and protection of stocks. The second involved the creation of a strategic management system for the fishery.

14.3.1 Regulations

The introduction of regulations into the shrimp fishery was carried out in the context of a new legal framework for fisheries. On February 12, 1981, the National Assembly approved Law No. 33, Protection of the Environment and Rational Use of Natural Resources (Protección del medio ambiente y uso racional de los recursos naturales) (República de Cuba, 1981). The law established that all marine resources within the EEZ were public property and, as such, were subject to regulation for their better conservation and more effective utilization. Exploitation of marine resources was to be undertaken on a scientific-technical basis to guarantee their preservation and optimal use. The competent state organization (MIP) would regulate conservation, optimal utilization, processing and sale of all marine products. Unauthorized pollution of any kind, and civil engineering works as well dumping garbage in coastal waters and removal of coastal mangroves were all prohibited. A subsequent part of the law (Decree No. 103, Regulation for Non-Commercial Fishing) regulated sport and scientific fishing. In 1984, a Fisheries Management Committee (Comité de Administración Pesquera) consisting of
scientists, specialists and executives, was created within MIP with the task of harmonizing fishing regulations and catch plans within the EEZ. Regulations approved by this committee were implemented by Ministerial Resolutions to which compliance was obligatory (Pérez Puentes, 1986: 33).

Several regulatory measures were introduced to deal with the critical situation in the shrimp fishery. Permanent area closures of nursery areas along parts of the coast were implemented in 1981 to protect juveniles and to cut down the percentage of low-value small shrimp in the catch. In La Broa Bay, a coastal strip 3 nm deep was closed to fishing for three months to allow white shrimp stocks to re-build.

In the late 1970s the shrimp fleet used trawl nets with 20 mm mesh. A series of selectivity experiments were undertaken which showed that, with the use of 25 mm mesh nets, small shrimp escaped through the mesh with a 95% survival rate and, as a result, nets of this mesh size were introduced nationwide in 1980 and 1981. Theoretically, the introduction of nets with a larger mesh size should result in an initial drop in the catch as a result of the escapement of smaller shrimp. However, a compensation should occur later in the year when the escaped shrimp have grown large enough to be caught. A review of the first year of operation of the Cuban fishery with the new nets revealed that such compensation did not occur and there was an overall drop of 4.6% in the weight of the catch (Pérez, Puga and Hondares, 1981). This was attributed to poor temporal disposition of the fleet. The review, unfortunately, does not comment upon the change in the value of the catch but the improvement in the size composition of the catch consequent upon the introduction of new nets may have increased the value of the catch.

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1 In his review of shrimp fishery management, Garcia (1989: 287) states that the usual mesh size in shrimp trawls was 40-50 mm stretched. Cuban nets, therefore, apparently have a quite small mesh size.
sufficiently to compensate for the relatively small loss in overall weight. The change in mesh size, therefore, had potential for beneficial impacts both on stock rebuilding (eliminating recruitment overfishing) and on the value of the catch by increasing its overall weight and by improving its size composition (eliminating growth overfishing).

A further measure to improve the size composition of the catch and to ensure recruitment was taken in 1983 when a closed season of 3.5 months (15 July to 31 October) was imposed on parts of the coastal zone. Every year thereafter, joint consultation between MIP, CIP and the appropriate enterprises, determined which statistical squares were to be closed. However, since the zones of recruitment did not vary a great deal, there was not much annual variation in the closed areas. Simulation studies carried out by the researchers of the shrimp group indicated that such a closure would be effective and it was continued in 1984 and 1985. Subsequently, in 1990, a total ban on shrimp fishing of one month duration was imposed and in 1991, this was increased to 3.5 months.

14.3.2 Cost Reduction and Conflict

Cost reduction in the fishery in this early period was effected by the removal from it of old vessels and those requiring extensive repairs. The problem of competition between fleets of different enterprises fishing close inshore on the one hand and farther out on the shelf on the other, was solved by removing the Júcaro establishment of the EP of Ciego de Avila from the fishery. Since its fleet had operated mainly in close inshore areas and had catches which showed a high proportion of small shrimp, this measure would have improved the size composition of the catch. At the same time,
catch plans were reduced in the establishment of Playa Florida, the fleet of which also fished inshore, but on shrimp of more varied size.

14. 3. 3 Management

The regulations described above were not designed and implemented in isolation. They were integral to a new management system. Such a system in a shrimp fishery has to cope with a highly fertile species with a short life-cycle and large annual variations in population. It must, therefore, be extremely flexible. The proposed new management system for the fishery was presented in 1980 to a national meeting involving all those (researchers, enterprise managers and ministry representatives) involved in the fishery (CIP, 1980). Subsequent meetings were held and an education programme, including radio speeches, was implemented to persuade enterprise managers and fishers of the utility of the new system. The system was introduced first in Manzanillo at the end of 1980 and subsequently extended to Santa Cruz and the other enterprises involved in the shrimp fishery.

14. 3. 3. 1 The catch bureau. The centrepiece of the system devised to manage the fishery was an administrative structure called the catch bureau (Buro de Captura) which would serve as a link between the scientific branch of the industry, CIP, and the productive branch, the enterprises (CIP, 1980). A similar structure had first been employed in managing the operations of the FCC on the Campeche Bank.¹

It was proposed that each catch bureau would be staffed by one biologist and three technicians.² They would work closely with the managers and

¹ A similar organization was employed in Soviet fisheries at the time and the suggestion for its use in Cuba came from a Soviet advisor, Boris Averin (Pérez 1991).
² By the mid-1980’s, 80% of the employees in the bureaus were biologists, 10% were specialists in fishing gear and techniques and the remainder had been trained in specialties such as
fishers of each enterprise but would be subordinate to CIP and would have monthly meetings with CIP personnel to assess the progress of their work. Fig. 14.2 shows the proposed relationships between the various bodies.¹

The original proposal by the shrimp research group outlined the objectives of the catch bureaus as follows: to plan and organize the shrimp fishery so that it would operate rationally and efficiently; to direct fishing units to areas with the greatest abundance and quality of shrimp; and to obtain the necessary information for making and refining predictions about the behaviour of the resource (CIP, 1980). A later statement of objectives added that of conservation of the resource (CIP, 1986). In the shrimp catch bureaus of the 1980s, these objectives were achieved through the performance of a number of tasks which can be grouped into two types: data collection; and fleet guidance or tactical management.

There are several sources of fisheries data in Cuba. A single national system for fishery statistics has existed from the beginning of the 1960s. It was improved considerably in 1966. Statistics on catch and effort by vessel have been collected since 1974 and on catch and effort by "statistical squares" 25 nm² in size (9 nm² in La Broa Bay) from 1976. Also since 1976, the percentage by weight, of 5 shrimp size-groups by statistical square for each day and month have been recorded but this data is only reliable since 1980 (Pérez, Puga and Rodríguez, 1983: 52). Size-composition information from shrimp processing plants and a good chronology of events, such as introductions of new vessels and gear are also available within MIP.²

¹ The source for Fig. 14.2 was C.I.P (1980).
² This information is not published on a systematic basis.
FIG. 14.2. Catch Bureau Relationships
Each shrimp catch bureau also had a shrimp trawler and crew at its disposal.¹ This vessel conducted monthly prospecting cruises over the fishing zone and made sample test trawls of one hour duration at a series of fixed points with the aim of obtaining a picture of the abundance and distribution of the resource. Information on such topics as water temperature and salinity, species-composition and size of the shrimp catch and weight and species-composition of the by-catch was recorded.² The vessel also made exploratory cruises during which it examined areas in which the fishing fleet was not operating to find potential fishing zones. The size-composition of the shrimp catch and the species-composition of the by-catch were further checked by inspection of landings in port. CIP researchers regarded the statistical information available to them as being of good quality by international standards (Pérez, 1991). On the basis of this information and by means of monthly meetings between the catch bureau and the personnel of the shrimp working group of CIP, trimestral and annual predictions about the behaviour of the fishery were constructed.

The catch bureau also had responsibility for the guidance and control of the shrimp fishing fleet under a system of real-time management which met the flexibility requirement for shrimp fisheries previously mentioned. The size of the flotillas was reduced from 15 to 5 to allow for more flexible spatial and temporal distribution. In the past, fishers had tended to search and fish in relatively restricted, favourite areas and times.³ There was a tendency

¹ Usually a vessel that had been retired from the fishery.
² For a complete list of data collected, see CIP, 1980.
³ A study estimated that in the late 1970's a better spatial distribution of the fleet could have obtained up to 64.5% greater value from the catch and that between January 1978 and May 1980 a better temporal distribution could have resulted in 38.6% greater production by value with 4.2% less effort (CIP, 1980).
towards fishing in inshore areas which were more sheltered and also towards fishing during periods of better weather.1

One of the major tasks of the catch bureau was to provide a daily fishing guide to the fleet with recommendations on where they should fish.2 As mentioned previously the southeast shelf and the La Broa Bay had been divided according to a system of statistical squares since the late 1970s. In addition, each enterprise was given an exclusive fishing zone, divided into sub-zones, within which its fleet operated. Before beginning a 10 day fishing trip, fishers met with the personnel of the catch bureau who gave them recommendations as to which statistical square should be fished. Results were reported to the catch bureau each morning when vessels gathered to transfer the catch to packers. New recommendations for the next night were given to the fleet captains at the same time. Since catches and, therefore, bonuses, varied amongst sub-areas, sub-fleets were rotated through them to equalize, as far as possible, fishers' earning opportunities. Such a rotation, it should be noted, would also have removed the tendency for the fleet to concentrate in the areas of highest biovalue and would, thereby, reduce congestion on the fishing grounds. It was relatively easily achieved in Cuba precisely because of the nature of the command economy. 3

14.3.3.2 The profit index. The methodology for the preparation of the daily guide was based upon calculation of the "profit index" (Indice de Ganancia) for each statistical square in the fishing area. It was designed by shrimp biologist A. Pérez to direct the shrimp fleet to the areas where they

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1 The shrimp research group found that only 19% of the areas with high yields were fished during 1979-80 (CIP, 1980).
2 Statistical squares are quite large at 9 sq nm and 25 sq nm so there is still ample scope for fishers' skills to come into play in deciding where to fish within the recommended square.
3 Reducing congestion in areas of high biovalue is more complex in capitalist countries. Copes (1977: 278) proposed a system of differential licence fees for the Gulf of Carpinteria shrimp fishery in Australia's Northern Territory in order to deal with this problem.
might obtain the "best economic results" (Pérez, 1982: 34). Use of the index, then, reflects a realization of the importance of biovalue in the shrimp fishery. It was first used in 1979 in response to a request for help from the FCC in obtaining a better distribution of effort when it began to fish in the Caballones area (CIP, 1980).

The profit index is defined as, "the value of the final product obtained by one unit of fishing effort" (Pérez, 1982). In the case of the shrimp fishery, three aspects are considered: the volume of total catch; the size composition of the catch; and fishing effort. The size composition of the catch is important because, as we have seen, the price of shrimp increases with increase in the size of individuals. This variable is calculated by examining the mean value of various size groups in the markets of countries to which Cuba exports shrimp. Cost is incorporated indirectly by the use of fishing effort measured in standard vessel fishing days.¹

The profit index may be calculated using three different sources of data: statistics from processing plants; sample statistics from payments to fishers; and statistics from prospecting cruises. Using the first of these sources of information, the Index may be calculated as follows:

\[
I_g = \sum_{x=1}^{n} \frac{P_x(C_x)}{f}
\]

where

- \(I_g\) = Profit Index
- \(P_x\) = value of a group of size \(x\)
- \(C_x\) = processed weight of group \(x\)
- \(f\) = fishing effort

¹ Effort was standardized to ferrocement vessels 18m in length with two twin trawl nets.
The methodology for the calculation of the index using other sources of information is described in Appendix VI.

According to Pérez (1991), the profit index possesses several advantages which make it useful in the management of the shrimp fisheries. It unifies four fishery characteristics, those of abundance, size-composition, export-value and cost (fishing effort) into one index. It can easily be calculated from statistics obtained from landings, processing plants and prospecting cruises. It is immediately comprehensible to resource managers and can be easily incorporated by means of charts of profit index and size composition into daily fishing guides for the fleet.¹

In addition to their responsibilities related to tactical management of the fishery, the catch bureaus also conducted more basic and long-range research such as selectivity and tagging experiments and studies of nursery zones.

14.4 EVALUATION OF THE NEW MANAGEMENT REGIME

The success of the measures introduced into the fishery in the early 1980s will be evaluated on the basis of the goals for the scientific management of the fishery described previously. A review of the work of the first five years of operation of the new management regime conducted by CIP in 1986 listed the following achievements: a better understanding of shrimp population dynamics and behaviour; the development of recommendations on annual catch levels and effort by species, zone and enterprise; the development of monthly plans for catch and effort taking seasonal variations of the profit index into account; and better information about the by-catch

¹ Statistical squares with high PIs and small sizes were avoided in preference for those with high PIs and large sizes (Pérez, 1991).
In addition, important measures for the management of the fishery were introduced at the enterprise level. These included: a major reduction in the number of vessels and fishing effort; decreases in annual catch plans; introduction of a larger net mesh size (25 mm); rotation of sub-fleets through fishing sub-zones; a partial closure to fishing of a coastal strip 1 nm in depth to protect nursery areas; a seasonal closure of the fishery in the most important areas of recruitment from July to October, the major growth period. In summary, according to the report, the new management regime implemented in 1981 resulted in protection for shrimp populations and in a more efficient temporal and spatial distribution of fishing effort. In addition, the cost per weight of production in the shrimp enterprises was reduced, and the tendency for decreasing catches was reversed.

To those involved, then, the new Cuban shrimp management regime has had some notable successes. There follows an attempt to present an evaluation in terms of fisheries economics and related management concepts.

14.4.1 Stocks

It appears that the new management regime succeeded in halting the decline in shrimp stocks. During the first half of the 1980s annual catches seemed to have stabilized, at a new, albeit lower, level at around 4 500 mt (compared to an annual average of 5 430.9 mt for the period 1976-1980). Further evidence of success in stabilization may be adduced from data on the catch-per-unit-effort (CPUE) in the fishery. Theoretically, in a well-distributed stock, and with a stable level of effort, CPUE may be taken as a proxy for stock abundance. It began to rise in the shrimp fishery after the introduction of the new management regime. From a low of just over 100 kg/fishing day in 1981, it began to increase and reached a level of 208.8 kg/fishing day in 1988 (Fig.
14.1). This may indicate rebuilding of the shrimp stocks in the early 1980s but, it should be noted, such a rise in CPUE can also result from improved education and skill levels in the crews of fishing vessels.

However, Garcia (1989: 285) has pointed to the peculiarity of shrimp fisheries in, essentially, exploiting one year class. The result is that the annual yield is dependent on annual recruitment which, in turn, is influenced by environmental conditions. Pérez (1992) has made a similar point with respect to the Cuban fishery. The improvement in the size distribution of the catch which CIP noted from about the 1970s may be a result, he contended, not of regulatory success but of changes in environmental conditions which caused reduced recruitment and so a higher proportion of larger shrimp in the catch.\(^1\)

As Garcia (1989: 285) has noted, the importance of environmental factors means that shrimp catches vary annually "either randomly or, more probably, following long-term autocorrelated oscillations." In 1992, Pérez was working on two hypotheses with respect to this problem. The first was that winds and, consequently, wind-driven currents, in La Broa Bay are very variable so that, in some years, they may not have been appropriate to distribute shrimp larvae to nursery areas. This may have affected recruitment and may, he thought, explain the great variability in stocks in that area since the 1950s.

The second hypothesis dealt with predator-prey relationships in both La Broa Bay and the Gulf of Guacanayabo. In these areas, shrimp mortality in the early 1980s was estimated at 0.2 but recent studies have found it to be 0.9. The hypothesis is that when shrimp nursery areas were closed to fisheries in the early 1980s, juvenile lane snapper which occupy the same areas, were also protected. In addition, the reduction in effort in the shrimp fishery had, as a

\(^1\) This behaviour of the size composition of the catch is a feature of shrimp that is almost the opposite to what would be expected from a longer-lived species where a reduction in mean size in the catch is an indication of growth overfishing.
consequence, a reduction in the size of the by-catch which included lane snapper juveniles. As a result, lane snapper, which prey on shrimp, lived longer and may have eaten more shrimp and, therefore, affected natural mortality rates. The lack of increases in catches in the 1980s, then, may have resulted from a combination of these factors.1

In an interview with the author in 1993, Pérez pointed to the supply of fresh water to coastal lagoons as an additional, non-fishery-related, factor which might possibly have affected shrimp stocks. Cuba had recently suffered a drought which resulted in reduced water flow to these nursery areas. Another impact on fresh water supply to nursery areas has been the aggressive dam and reservoir construction programme undertaken since the Revolution. As a result, then, of environmental conditions and human impact, fresh water flow to lagoons has been reduced and there have been increases in water temperature, in evaporation, and in salinity, all of which may have affected shrimp stocks. In the early 1990s, MIP was considering remedial action including the artificial introduction of larvae into nursery areas, introduction of fresh water and dredging of lagoons.

14.4.2 Profit Index

As noted above, the spatial and temporal deployment of the shrimp fishing fleet was achieved by the use of daily guides based on charts of profit index and shrimp size composition. Such charts of variations in the index would reflect the differences in the profitability of one statistical square from another and their use represents a distinct improvement over simply allowing the fleet to fish as it had done before. It may be questioned, however, whether the profit index takes costs realistically into account. By

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1 Unfortunately, Pérez lost his job at CIP in 1992 and was not able to finish this work.
way of illustration, two sources of variations in costs may be mentioned. The first is distance. Running costs to a remote statistical square with a high profit index may be such as to make it less profitable than exploiting a nearby square with a lower index. The incorporation of such variations in cost into the index would make it more accurately reflect profitability. The second source of variation derives from differences in the capabilities of vessels to access squares with different characteristics (weather, currents etc.). Thus, small vessels may best be employed away from the more exposed outer edge of the shelf. However, since the shrimp fleet is the most standardized one in technological terms in the shelf fisheries, this may not, be of such great importance.

While it appears to measure revenue adequately, then, the index would more accurately reflect profit if it incorporated an estimate of the variable costs described above. Both revenues and costs, in addition, would have to be measured in constant, rather than current, monetary values in order to deal with inflation. It is not clear whether this was done in the calculation of the index.

14.4.3 Externalities

In fisheries in countries with market economies, experience has shown that the most efficient small boat operations are individually owned and operated (Copes, 1991). This is because in such situations individual owner-operators have a strong incentive to maintain their vessels in good condition and to perform as well as they possibly can. However, such individual vessel efficiency does not necessarily result in the fleet as a whole being efficient. As we have seen, following their individual search for profit, fishers compete with, and impose externalities upon, one another with results that have led
to overexploitation of fish stocks in many parts of the world. Being part of the command economy, the Cuban shrimp fishery is part of a collective enterprise which, theoretically, should be able to avoid such externalities by directing fishing vessels in such a way as to maximize returns from fleet and from individual operations. The result should be a more rational and optimal utilization of shrimp stocks.

It is obvious from the description of the new management regime that such a rational allocation of harvesting resources was indeed being attempted in Cuba. However, some characteristics of the fishery indicate that not all of the externalities had been removed from it. Three important potential sources of such externalities are the continuing presence of small shrimp in the catch, catch plans, and fishers' bonuses. With respect to the first of these, if there are small shrimp in the catch, the fleet as a whole is denied the larger, more valuable shrimp at a later time. An attempt was made in 1990 to deal with the problem of small shrimp by establishing closures for zones containing more than a recommended percentage of them (Pérez, 1992). The regulations given for 1990 were as follows: in the Cienfuegos zone, if 20% of the shrimp in samples were 8.4 cm or less in length, the zone (presumably the statistical square) would be closed to fishing, and for Santa Cruz, the equivalents were 30% and 8.2 cm (MIP, Dirección de Regulaciones Pesqueras, 1990: 12). It is not clear from the description of the regulations whether these sizes refer to whole shrimp. If they do, they seem small. In addition, while it is difficult to generalize across all shrimp fisheries, the mesh size of Cuban trawl nets seems to be rather small. Vendeville (1990: 8), referring to tropical shrimp fisheries states that "Mesh size (stretched mesh) rarely exceeds 50 mm. It is often between 30 and 50 mm," and lists mesh sizes in six different countries none of which is less than 30 mm. Further research into increasing
the mesh size in Cuban trawls might help to find ways to improve the size composition of the catch.

With respect to catch plans, the danger is that enterprises and fishers will attempt to complete them without regard to the condition of shrimp stocks. Thus, to complete catch plans, large volumes of smaller shrimp may be taken and this may contribute to growth overfishing. This has occurred in the past (CIP, 1980) but the regulations described above and the real-time management strategy should prevent it from happening in the future. In addition, interviewees (Pérez, 1991; Báez, 1991) have indicated that the catch bureaus have frequently been successful in supporting enterprise appeals to MIP for revised, more realistic plans.

Since a proportion of fisher's wages is made up of bonuses based on the volume and size-composition of the catch, there may be an incentive for individual vessels to fish as hard as possible in a fishing zone since any shrimp left in the water would only add to the bonuses of other fishers in sub-fleets which will later be rotated through it. There is some indication that, in fact, this was a problem in the period before the introduction of the new management regime when effort tended to concentrate in the months immediately after the main recruitment period. This resulted in large catches and bonuses but a high proportion of the shrimp caught were very small so that, in all likelihood, growth overfishing was occurring (C.I.P., 1980).

Under the new regime, an attempt was made to deal with such externalities by organizing smaller, more flexible flotillas which were directed by the catch bureaus to more nearly optimal spatial and temporal distribution in their fishing operations. Flotillas were rotated through the various sub-areas of each enterprise fishing zone in order to equalize fishing opportunities and, therefore, bonuses. However, bonuses were paid on the basis of
individual vessel performance so that the same competitive situation among vessels described above might persist. Pérez (1992) conceded that such competition may indeed occur but contended that, because of the overall reduction in the number of vessels in the shrimp fleet, it was not possible for them to cause fast and uncontrolled over-exploitation. Further, since the fishery was managed on a daily basis, corrective closing of zones was always available as a measure for redistributing effort. The remaining inter-vessel competition, being embedded in a closely-regulated fishery, might, then, promote efficient operations rather than the damaging competition typical of the open-access fishery. On the other hand, it may be questioned whether such state-employed fishers, in a country where food and housing were inexpensive, if not always abundant, where health care and education were free and where consumer goods were in relatively short supply, had an incentive for maximizing bonuses. However, in the last chapter it was shown that not only were salaries high in the fishing industry in general, but so was the proportion of them derived from bonuses. This would argue for the existence in the fishery of something similar to the type of healthy competition found in fisheries in which owner-operators are predominant.

14.4.4 Profitability

In order to evaluate the economic impact of the new management regime, information on catch, revenue, effort and cost would be required (Copes, 1978). Ideally, using this information, revenue and cost curves for the fishery could be constructed and the magnitude, if any, of the resource rent being generated could be ascertained. However, such a task is not easily accomplished with respect to the Cuban shrimp fishery.
MIP does not publish detailed statistical information with respect to Cuban fisheries. Statistics of catches by weight and value as well as those for fish production, imports and exports, for Cuba as a whole, are published by the FAO. In them, no distinction is made between the shelf fisheries and distant water fisheries but catches for each may be distinguished, to some extent, by examining statistics by species. However, before the introduction of the Mexican EEZ in the late 1970s, shrimp caught on the Campeche Bank and those caught on the shelf are grouped together. Further, Cuba does not appear in the table of countries which export shrimp and, as a result, no information on revenues from the shrimp fishery is available. Unofficial catch statistics by species, or group of species, zone and enterprise, are available in an unpublished report compiled by two Cuban researchers (García-Arteaga and Claro, 1987). However, no detailed information on effort, cost or revenues is publicly available. Pérez (1992) reported that an economic study, estimating MEY and optimum effort levels for the different shrimp species, was conducted in the Manzanillo enterprise but the resulting report was an internal MIP document that was not published. The following evaluation of the economic situation of the fishery, then, is based on fragmentary information obtained from various reports on the fishery and from interviews with MIP scientists. It is, in consequence, a tentative evaluation.

14.4.4 Catch and revenue. From Fig. 14.1, it can be seen that catches decreased from a maximum of almost 6 000 mt in 1977 and from 1980 on, fluctuated around 4 500 mt per annum.1 This is a far cry from the optimistic estimate of a 7 000 mt potential catch envisaged in 1978. If prices in the

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1 This situation could have caused problems for the enterprises. However, revised, lower catch plans were accepted by the Ministry which was convinced by scientists that, as a result of damage to nursery areas from industrial pollution and shoreline development, it was not possible to achieve higher catch levels again without restoring damaged shoreline, re-stocking and other measures.
international market had remained constant, this lower level of exploitation would have represented a substantial decrease in revenue in the fishery.

However, the value of the catch is dependent not only on quantity but also on its size-composition, because, as we have seen, prices for shrimp increase with size. All other things being equal, an improvement in the size-composition of the catch would lead to an increase in revenues. One of the aims of the new management regime, by means, for example, of the introduction of a larger mesh size, had been to improve the size composition of the catch. The proportion of larger shrimp (13-58/kg) increased through the 1970s to a maximum of about 58% in 1981 (Baisre et al., 1984: 372), just after the introduction of the new mesh size and the new management regime. However, Pérez et al. (1989) reported lower levels in the 1980s with an average of about 48% from 1984 to 1988. One possible source of this decrease in the proportion of large shrimp in the catch is the fact that the fishery in the La Broa Bay was closed down in the early 1980s as a result of over-fishing. A large part of the catch in this area consisted of white shrimp which are larger, on average, than the pink variety.\(^1\) However, efforts continue to improve the size composition of the catch. The Calendar of Regulatory Measures (Calendario de medidas regulatorias para la protección de los recursos pesqueros marinos y de la acuicultura) for 1990 (MIP, Dirección de Regulaciones Pesqueras, 1990: 12) specifies a minimum size and maximum percentage of small shrimp in the catch for a fishery to continue in a zone.

From the foregoing discussion it can be seen that the question of whether the Cuban shrimp fishery was obtaining the greatest sustainable

\(^1\) A criticism might be advanced here with respect to the inclusion of shrimp of a size which averages 58/kg in the desirable 'large' category but is not clear from the reports at hand whether this refers to whole- or head-off shrimp.
revenues during the 1980s is not answerable with the information presently available. It is possible that the decrease in value consequent upon lower catches was offset by an increase resulting from improvement in catch quality but to what extent this might have occurred is not known. The question is further complicated by the fact that revenue is also dependent on shrimp prices in international markets as well as foreign exchange values.

14.4.2 Effort and cost. Effort in the fishery was substantially reduced as a result of vessel removals and also of closed seasons. In 1977, 152 vessels operated in the shrimp fishery (República de Cuba, CETC, 1978c). As a result of effort reduction measures, 60 vessels had been retired from the fishery by 1986 (CIP, 1986). Fig. 14.1 shows that effort reached a maximum of almost 38 000 fishing days in 1982 and then showed a strong decline to about 25 000 in 1985. It continued to decline in subsequent years, reaching 21 262 fishing days in 1988 (Pérez et al., 1989). These data seem to substantiate the statement by Pérez (1991) that effort in the fishery had been reduced by about 50% but it should be noted that fishing days is a rather crude measure of effort that does not take into account technological improvements in vessels and gear and improvements in fishers' knowledge and skills.2 There is no question that effort was reduced but, whether the corresponding real reduction in costs was as much as 50% is doubtful. Some important costs such as those for management (eg. the catch bureaus) were not considered and may not have declined very much, if at all.

The new, lower level of effort seems to have recently been formalized. The Calendar of Regulatory Measures for 1990 includes, for the first time, a

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1 During this period there was a shortage of engines and spare parts which made removal of vessels from the fleet less inconvenient.

2 There were no fundamental technological changes in the shrimp fishery during this period. However, Baisre and Piloto (1991: 99) have noted the importance of improvement in fishers' knowledge and skills in the shelf fisheries in general.
regulation on maximum fishing effort. The national level of effort in the
shrimp fishery is set at 21,290 fishing days distributed among enterprises as
follows: 7,740 dp (dp-\textit{día pesca} or fishing days) for Cienfuegos; 7,750 dp for Sta.
Cruz del Sur; and 5,800 dp for Manzanillo (MIP, Dirección de Regulaciones
Pesqueras, 1990: 11). CPUE in the fishery also began to rise after the
introduction of the new management regime. From a low of just over 100
kg/fishing day in 1981, it began to increase and reached a level of 208.8
kg/fishing day in 1988 (Fig. 14.1). It is possible that some proportion of this
improvement derived from increased fisher skills. The overall catch,
however, dropped by about 25\%. If the yield curve for the fishery was that of a
typical NSR stock, such a large drop in the catch would not have been
expected. On the other hand, if the yield curve was of the modified Schaefer
type, and if the fishery were operating on the right hand side of the curve
(beyond MSY), a decrease in effort would have led initially to no change or an
increase in the catch. It seems likely, therefore, that a large part of the drop in
the catch, must have been due to environmental factors.

The 50\% decrease in fishing effort in terms of standardized days fished
is impressive when compared with the experience in capitalist countries
where effort limitation has proved to be much more difficult. The experience
of rationalization schemes in other countries, such as that of the Davis Plan of
1969 in British Columbia, has shown that this is one of the most difficult
objectives to achieve in world fisheries. It was possible in Cuba precisely
because of the socioeconomic structure of the country. Since the Cuban state
owned the means of production, there was no need for the type of costly and
often unsuccessful buy-back program which would have been necessary to
remove vessels from the fishery in countries with free-market economies. In
addition, there was, officially, no unemployment in Cuba and the
government took responsibility for displaced workers. Fishers, then, could be said to have high opportunity costs. Those whose vessels were retired were given jobs on other vessels, in processing plants of the same enterprise, elsewhere in the fishing industry or in other sectors of the economy.¹

The question of costs in the fishery is a much more difficult one with which to deal. There is absolutely no published information on costs in the shrimp, or any other, fishery. Such studies have recently been carried out in some enterprises, especially in the scale fisheries, in the form of "cost per peso produced" but they remain internal documents.² When the topic was put to Pérez, in an interview in 1991, the former leader of the shrimp research group, replied that "since we were reducing effort and obtaining increased increments in catch, we could be sure we were reducing costs." Pérez later confirmed that "increased increments in catch" meant that the CPUE in the fishery increased.

Certainly, the removal of large numbers of vessels from the fishery would have reduced costs in the fleet compared to what they would have been without such a reduction. This, however, must have been offset to some unknown extent by such factors as increases in fuel costs in the early 1980s; and by more complete temporal utilization of the existing fleet which would increase overall running and maintenance costs. However, since the remaining vessels were more heavily utilized, annual repair and maintenance costs would be spread across a larger number of days and

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¹ It is not clear whether fishers truly have high opportunity costs. It is doubtful whether every job is equally rewarding economically and psychologically. Fishers were amongst the highest paid workers in the country and it is not known, but it is doubtful, whether alternative employment would be as high-paying. When asked if there was any resistance by fishers to alternate placement, the typical reaction from informants was a surprised look and a denial. Perhaps the existence of a degree of collective consciousness among fishers should be taken into account.

² I was able to briefly examine some of the cost data for the scale fisheries and these will be discussed later.
economies would have been achieved in the costs per vessel per day. As is the case for revenues, then, it is not possible at present to determine precisely the level of costs at which the Cuban shrimp fishery is being operated.\textsuperscript{1} However, it is clear that they must be less than they would have been if the actions towards effort reduction described above had not been taken.

The Cuban shrimp fishery experienced strong expansion in catches and effort during the 1960s and early 1970s. However, decreasing catches in the late-1970s prompted the introduction of a new management regime with the goals of managing the fishery on a rational and scientific basis. Protection of nursery areas, implementation of closed periods and other regulatory measures in combination with a substantial decrease in effort seem to have been successful in restoring and protecting recruitment, although natural and human-induced environmental change remain a concern for the future. In addition, the introduction of a real time management system centred on the catch bureau improved the utilization of the fleet both spatially and temporally and, along with the use of the profit index to direct fishing operations, the growth overfishing that was characteristic of the 1970s was ameliorated, if not corrected. The small mesh size of trawl nets and the large percentages of what appears to be quite small shrimp required for closure of a fishing zone remain causes for concern. In the absence of financial information, the economic situation of the fishery is unknowable. Improvement in the size-composition of the catch may have offset the loss in revenues resulting from the decrease in the total volume. In addition, without the cut in effort which took place, the costs in the fishery would have

\textsuperscript{1} It is certain that costs have risen recently, especially as a result of the substantial decrease in imports of oil from the former Soviet Union.
been much higher and the fishery would have been in much poorer financial shape. It must be said, however, that there is no way to know whether the fishery is operating in a state of economic overexploitation and the lack of a realistic appraisal of costs in the fishery must be considered a serious flaw in the management regime. In concluding this chapter, the following description of the American shrimp fishery in the Gulf of Mexico is offered as a comparison (Klima, 1989: 105):

The economic condition of the shrimp fishery has changed since the late 1970s. Vessel numbers have increased slightly, fishing power has doubled, access to Mexican fishing grounds has been stopped, insurance premiums have increased 300%, and the ex-vessel price paid for shrimp is lower than indexes of other food products. The overcapacity and excess fishing power of the fleet in the Gulf of Mexico, the increased landings of small shrimp by inshore fisheries in the northern Gulf, and the changing economic condition of the fishery are major problems and appear to be the main factors causing economic hardship on U.S. fishermen.
15.1 THE LOBSTER FISHERY IN THE LATE 1970s AND EARLY 1980s

As we have seen, the fishery for lobster was much more widely dispersed than was that for shrimp. In 1978, lobster stocks on all four shelves were exploited by 355 vessels crewed by some 1,500 fishers and using some 250,000 pieces of gear including fixed and liftable pesqueros, lobster nets, jaulones, traps and bully nets.

Landings in the fishery increased by about 63% between 1959 (6,535.4 mt) and 1976 (10,624 mt). However, as noted previously, they showed fluctuations which were sometimes quite substantial, as for example, in 1970, 1972 and 1975 (Fig. 12.7). The catch in 1977 (7,892.6 mt) was the lowest since 1964 and about 3,000 mt (about 6 million lobsters) less than that of the previous year. Although the number of vessels and fishers had decreased during the 1970s, effort in the fishery had increased. In 1978, it was reported as averaging 380,000 fisher/days/fished (f/d/f) (CETC, 1978), compared with 256,200 f/d/f in the period 1959-1964 (Baisre, 1969: 64).

The severe drop in landings in 1977, coincided, as we have seen, with the introduction of 200 nm EEZs in the world ocean and with problems in the other shelf fisheries and, as a result, the lobster fishery, the most valuable in the country, was subject to a similar type of scrutiny as that which was applied to the fishery for shrimp.

1 Establishing the value of the fishery with any precision was not possible with the available data. Baisre (1991) told me that the lobster fishery was "worth US $100M". Baisre and Cruz, (1994: 119) reported that the lobster fishery accounted for 60-65% of the country's gross income from fisheries products. According to FAO statistics, the mean value for exports of "crustaceans and molluscs" for the years 1980-1991 was $112,248,000 (FAO, 1989; 1991).
15. 1. 1 Problems in the Fishery

No more comprehensive official statistics on catch, effort, revenues and costs are available for the lobster than for the shrimp fishery. This evaluation, then, is based upon similarly fragmentary evidence. Starting in the late 1970s, annual reports of meetings of a lobster specialty group began to be published but, unfortunately, the earliest to be found was that from the third meeting in 1981 (Cruz, Blanco and Baisre, 1981). We do not, therefore, have access to the same type of contemporary assessment of the fishery in the late 1970s as we do for the shrimp fishery.1

15. 1. 1. 1 Overfishing. The maximum sustainable yield for the lobster fishery was calculated in 1980 to be from 8 400-9 500 mt (Villegas, Charlier and Arosemena, 1982: 45)2 and, as can be seen in Fig. 12.7, the catch for the fishery in the 1970s oscillated about this level. The fishery was considered, therefore, to be in a state of "maximum exploitation" and the drop in 1977 was substantial enough to raise concern.

15. 1. 1. 2 Stock-recruitment relationship. Of crucial importance to the management of a lobster stock is whether, within the customary range of fishing effort, it is self-regulating or non-self-regulating. As we saw in Chapter 2, renewal of fish stocks of the former type is dependent on the proportion of the population left unharvested. The amount of a non-self-regulating stock available for harvest, on the other hand, is determined by natural phenomena other than the size of the adult population.

Opinion as to whether Cuban lobster stocks are self-regulating3 has

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1 The information with respect to the lobster fishery is even less comprehensive than for the shrimp. I did not have an informant for the recent lobster fishery similar to that for the shrimp fishery.
2 The figure was given in a table in this publication. It was taken from a report by R. Cruz (1980) which I was not able to find. In the same table, the Cuban lobster fishery is characterized as being in a state of "maximum exploitation".
3 The term used in Cuba is "auto sostenida" or self-sustaining.
undergone some change. In the 1960s, prevailing opinion was that stocks were non-self-regulating. Genetic mixing occurred throughout the range of \( P. \text{argus} \) in Florida, the Caribbean and as far south as Brazil as a result of dispersion of the larvae by ocean currents during this pelagic phase of the life cycle (Morgan, 1980). Overfishing in any one area, then, would not result in a decrease in recruitment because of the supply of larvae from other areas in the Caribbean. However, recent research has found genetic differences between, for example, populations of \( P. \text{argus} \) in Florida and Central America (Morgan, 1980), and Buesa (1992) estimated, on the basis of experiments with floating bottles conducted in the 1970s, that only about 15% of the phyllosoma on the shelf, mainly on the outer edges, were from elsewhere. Later researchers (Baisre, 1984; Baisre and Cruz, 1994; Chubb, 1994: 204; Cruz et al. 1989; Cruz et al., 1991) leaned toward the opinion that the isolation of the four parts of the insular shelf has produced four distinct self-regulating lobster stocks which are not dependent on external recruitment. A possible explanation of the apparent resilience of stocks in the face of heavy fishing pressure points to the existence of unexploited lobster stocks in deeper water on the Cuban shelf slope which may be contributing to recruitment on the shelf (Buesa 1992). In addition, it has been suggested that reproduction and rates of growth in spiny lobsters are limited by the availability of food and/or shelter.\(^1\) Years of intense fishing, it is hypothesized, have lowered stock density and, therefore, increased the food supply which, in turn has increased the egg production and rates of growth (Baisre and Cruz et al., 1994: 130) in the type of compensatory process described in Chapter 2. It has also been suggested that the gyre circulation found on the southwest coast, described in

\(^1\) Recent research involving field experiments in the Florida Keys suggests that shelter rather than food is the important limiting factor for juvenile \( P. \text{argus} \) in seagrass beds (Lipcius and Cobb, 1994: 18).
Chapter 3, retains phyllolem larvae in the local area and thereby accounts for "probably ... the densest population of P. argus in the Caribbean" (Lipcius and Cobb, 1994: 15). The lobster stocks on each of the four shelves, therefore, appear to be self-regulating but the existence of the unexploited mature stocks in deeper waters seems to have ensured a supply of eggs sufficient in quantity to result in the type of open-ended yield curve shown in Fig. 2.2B. As a result of the existence of stocks protected in such sanctuaries, recruitment overfishing was not identified as a problem in the fishery in the reviews that took place in the early 1980s.

Variations in the catch during the 1970s may have resulted from several factors other than fishing mortality. It is well known that lobster populations are subject to fluctuations that result "from diverse biological and physical forces acting on all life stages and in habitats ranging from shallow-water nurseries to the open ocean" (Lipcius and Cobb, 1994: 21). For example, Phillips et al. (1994: 255) reported a negative correlation between the Southern Oscillation/El Niño events and the Cuban catch of P. argus two years later. In addition, recent decreases in Cuban catches during autumnal migrations has been attributed to a reduction in the intensity of cold fronts since 1987/1988 (Phillips et al., 1994: 295). However, although research is ongoing, the influence of factors such as meteorological and oceanographic processes on populations are not well understood.

15. 1. 1. 3 Growth overfishing. In the lobster fishery, as Baisre (1985b: 136) and others (e.g. Copes, 1978: 106) have noted, smaller sizes are more in demand in international markets and there is, therefore, a temptation for fishers to take and keep undersized animals. From 1970-1977, as a result of lax or no enforcement of regulations, 19.5% of the Cuban catch was made up of
lobsters below the legal minimum size of 210 cm TL\(^1\) (Cruz et al., 1991: 249) and 69.4% were recent recruits to the fishery, smaller than 240 mm TL (Cruz et al., 1991: 247). As a result, growth overfishing was identified as the major problem in the fishery and, according to Baisre and Cruz (1994: 121), it was the cause of the severe drops experienced in the catch in 1970 and 1977, after the high catches in 1969 and 1976.\(^2\)

15. 1. 1. 4 Economic overfishing. The available data are insufficient to allow a determination of the economic condition of the fishery in the early 1980s. As we saw in Chapter 10, although the fleet was reduced in size during the 1970s, small, older vessels were replaced by new, larger Cayo Largos with, presumably, a greater radius of action, higher capacity and, overall, greater fishing power. In addition, the widespread adoption of new fishing gear, the pesqueros and jaulones as well as the introduction of the system of storage centres and packing vessels would also have increased the efficiency of catching operations. As a result of such technological improvements, effort in the fishery increased by 48% between the early 1960s and the late 1970s. However, catches grew concomitantly, by 46%, between 1960 and 1978. While the fishery appears to have shared the expansion experienced by other spiny lobster fisheries (Copes, 1978: 8; Bowen, 1980: 243), it appears to have avoided another characteristic of them, namely a "drastic fall in fishing productivity as measured by catch per unit effort" (Copes, 1978: 8). What Copes meant by "drastic" in this context was a 29-fold expansion of fishing effort in the South Australian rock lobster fishery in the eighteen years between 1949/50 and 1966/67, accompanied by a growth in catch of only a factor of 2.5.

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\(^1\) Two measures are employed in lobster research and management: TL, total length, is measured from the middle of the antennae base to the tip of the telson; CL, carapace length, is the length of the carapace covering the cephalothorax.

\(^2\) Landings in the fishery in 1970 may also have been affected by the diversion of resources to the 10 Million Ton sugar harvest.
As with the other fisheries at this time, there is no information on costs in the lobster fishery. Decreases in costs consequent upon the improvement in efficiency of the fleet as well as the introduction of spatial rationality by the use of storage centres and packing vessels would to some unknown extent have been offset by the increase in effective effort, the necessity to buy motors, spare parts and gear components abroad and increases in bonus payments to fishers. However, the demand for lobsters was such that it is likely that the fishery was profitable. Whether it was operating optimally, at or near MEY, is not discoverable with the available information.

15. 1. 1. 5 Other problems. As mentioned above, the reports of the first two National Lobster Meetings could not be found so that contemporary Cuban perceptions of problems in the fishery were not available for study. However, the report of the third meeting, held at the end of March, 1981 (Cruz, Blanco and Baisre, 1981), supplies an account of the fishery which outlines some problems which were probably of long standing. The report presented an analysis of the relative efficiency of the fishery based upon examination of a number of factors: the relative abundance of stocks; the type and number of vessels; the level of operation of the fleet; the type and amount of gear used, and its level of operation. Quite substantial variations were found in the efficiency of the operations of the various enterprises involved in the fishery (Cruz, Blanco, Baisre, 1981: 28) and those enterprises with the greatest resource abundance did not necessarily have the greatest productivity. The extreme case was the CPI of Isla de La Juventud (Nueva Gerona) which had densities of the resource,\(^1\) vessels and gear above the national averages but catches below the average. Batabanó with a resource abundance, density of vessels and gear all below the national average but the

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\(^1\) Calculated per unit area.
highest catches in the country, was at the opposite extreme as the most efficient lobster enterprise in the country. The enterprises of the northeast shelf (Caibarién, Matanzas and Niquero) had gear densities above the average but below average catches while Santa Cruz del Sur, with good resource abundance and high densities of vessels and gear, had catches below the national average. Variations in standards between storage centres were also found (Fernández and Blanco, 1978) and damaging effects of distillery effluents on lobsters began to be noted (Basu et al., 1975).

15.1.2 The New Management Regime

15.1.2.1 Objectives. In the absence of a statement similar to that offered by the shrimp group, it might be assumed that the objectives of this fishery must have been altered to fit the new reality of the SDPE by introducing "economic consciousness" to the lobster enterprises. However, the only statement found (Baisre, 1985b: 136), indicating that the strategic objective of the fishery was to maximize hard currency earnings, does not seem much different from the former "constant increase in catches". According to the model described in Chapter 2, maximum revenues in a fishery are obtained at a level of effort consistent with MSY. The fact that, as we saw above, the MSY had been calculated for the fishery suggests that sustainability in the fishery, the maximization of revenues in the long run, was considered to be important by policy makers.

It is not at all clear, from reading available reports, whether the costs of such a maximization in revenues were taken into account. Given that in the 1980s the country had both trade deficits with capitalist countries and a large hard-currency foreign debt which could be serviced only by improving exports (White, 1987: 153), it does not seem unreasonable to assume that the lobster
fishery, the greatest earner of hard-currency in the fisheries sector, was indeed pushed to maximize revenues, albeit in the long run, without much consideration being given to costs. Ideally, the costs of motors, spare parts, net mesh and any other materials obtained from hard currency countries should have been deducted from the gross revenues from exports but since, as noted in the last chapter, the first detailed economic studies in the fisheries sector were not conducted until the late 1980s, it is safe to assume that such calculations were not undertaken.

15.1.2.2 Regulation. In general outline, the regulation of the Cuban lobster fishery is similar to that in other countries. It rests upon two main bases: the closed season and minimum legal size. The closed season has three main objectives: to ensure reproduction during the peak spawning period of the population; to protect the moulting period and to allow the growth of new recruits; and to allow growth and, therefore increase in weight, of a major part of the population (Cruz, 1981: 1). In response to the situation in the fishery, the length of the closed season was restored and expanded in 1978 to an average of about 97 days in the spring of each year (Baisre et al., 1984: 386). In addition, by means of sampling of the population for the presence of berried females and for the state of moulting, the closing and re-opening date of the fishery was adjusted to take account of differing conditions on each of the four shelves (Cruz, 1981).

If such a closure is constructed and implemented properly, it should have several impacts on the fishery (Cruz, Blanco and Baisre, 1981: 4). Firstly, because the population has not been exploited for approximately three

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1 Baisre and Cruz, (1994: 119) report that the lobster fishery accounted for 60-65% of the country’s gross income from fisheries products.
2 Recent accounts of the major spiny lobster fisheries in the world can be found in Phillips, Cobb and Kittaka (1994).
3 This was a method first introduced by Buesa in the 1970s.
months, the abundance of lobsters will have increased, bringing the possibility of large catches with smaller fishing effort in the period immediately after the fishery is opened. Secondly, the proportion of moulting lobster should be decreased. No explicit explanation for the undesirability of moulting lobsters could be found and such lobsters, called "whites", were retained in the Western Australian fishery (Bowen, 1980: 246). The significance of the Japanese market for Cuban exports may be important here.1 To Japanese consumers, not only is the general appearance of the lobster important but, "because of their attractive red colour, appearance and excellent taste, lobsters are considered lucky" (Oshikata, 1994: 517). Moulting lobsters would not, therefore, be desirable. Thirdly, there should be an increase in the total catch because a proportion of the population will have increased in weight during the closure. Lastly, the closure would have the effect of reducing effort in the fishery and providing an opportunity for vessel and gear repairs to be carried out.

The minimum size of 210 mm TL or 69 mm CL was not changed in 1978 but, from that year, it was enforced more strictly by means of inspections of landings. According to Baisre (1984: 386), the use of a minimum legal size in the lobster fishery was intended to allow the fish to achieve sexual maturity and to have the opportunity to spawn at least once so as to preserve the stock's reproductive capacity. In the early 1980s, no consideration appears to have been given to adjustment of the minimum legal size in order to optimize the financial returns to the fishery but strict enforcement of the minimum legal size would have allowed an increase in the growth of each lobster cohort and, thereby, would have had an impact on the growth overfishing from which the fishery suffered in the 1970s. As will be seen

1 Cuba was second to Australia as a supplier of lobsters to Japan in 1991 (Oshikata, 1994: 518).
later, the importance of the biovalue of the catch ("fishing for dollars") came to be recognized in the latter part of the decade.

Supplementary regulations in the lobster fishery including a prohibition on the capture of oviparous ("berried") females and permanent closures on areas identified as nurseries for juveniles had been specified by the General Fishery Law of 1936. A total prohibition on fishing by private individuals was also enforced but it is not known when it was introduced (MIP, Dirección de Regulaciones, 1988: 2-3). As we saw previously, the prohibition on the catch of berried females is one of the most longstanding regulations in the Cuban lobster fishery. It is designed to protect spawning but, if the limiting factors on lobster stocks are, as has been suggested, either the food supply or the availability of shelter or some combination of both rather than an insufficiency of larvae, then such a prohibition is unnecessary. However, in spite of the fact that the non-self-regulating nature of lobster stocks in South Australia had been established, Copes (1978: 110) found a strong prejudice against taking such females amongst fishers and some biologists in the region. A similar prejudice may well be in operation in Cuba but since stocks there are less clearly non-self-regulating, the regulation may well be worth keeping if only as a safeguard.

15. 1. 2. 3 Management. Since lobsters are much longer-lived than shrimp, there was no requirement in this fishery for the type of real-time management used in fishing the latter. The fishery, then, did not suffer the same type of radical change in management. Catch bureaus were introduced into the fishery but seemed to have functioned more in support and research roles than as mechanisms of strategic management. One catch bureau was set

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1 The question of prohibition on catching berried females is also discussed by Hancock (1982: 184-185).
up simultaneously with their introduction into the shrimp fishery but most began to function at later dates.

The nature and tasks of the lobster catch bureaus were described in 1986 (Cruz and Blanco, 1986). Prospecting cruises were made to sample the lobster population at a network of fixed stations located in storage centres. At each station, 200 lobsters were examined with respect to morphometric measurements, state of reproduction, moult condition and sex, and water temperature readings were taken. Analysis of the results by the personnel of the catch bureau would allow them to make recommendations about the timing of the lifting of the closed season in each zone. The catch bureau also inspected landings with the aim of controlling the size composition of the catch (i.e. to check for under-sized lobsters).

In the first half of the 1980s, catch bureaus also began to study the possibility of increasing recruitment by supplying artificial refuges, consisting of structures of concrete blocks, for juveniles in nursery areas. Subsequent studies of them were undertaken to determine lobster size and abundance and the nature of accompanying fauna.

As in the shrimp catch bureaus, statistics were collected to establish the quantity, types and distribution of gear in use in the fishery with the ultimate aim of implementing control on fishing effort, analysing yields and determining causes of losses in the industrial chain.

One of the most important management measures to be taken at this time was to increase spatial rationality in the fishery by allocating exclusive fishing zones to each enterprise involved in the fishery (Fig. 15.1). Each zone was further divided into sub-zones within which a specified number of vessels, organized in fleets, fished and delivered their catch to a storage
FIG. 15.1. Major Lobster Fishing Areas and Enterprise Fishing Zones, Lobster Fishery
centre.\(^1\) The zones were in the charge of chiefs who supervised the organization of fishing operations as well as technical and administrative matters.

15.1.3 Evaluation of the New Management Regime

15.1.3.1 Growth overfishing. As was the case with the shrimp fishery, the regulations and management measures introduced in the late 1970s had a positive effect on the lobster fishery. The expansion of the closed season and strict enforcement of minimum legal size regulation had an immediate impact. The proportion of sub-legal lobsters in landings decreased from 18.5% in the period 1965-1977 to 8% in the period 1978-1983 and to 7% in 1984-1988. The average size (TL) of lobsters increased from 227 mm in the period 1965-1977 to 245 mm in 1978-1983 and further to 250 mm in 1984-1988. Changes in the size composition of the catch toward larger sizes occurred and are shown in Table 15.1 (Cruz et al., 1991: 249). Whether this increased the value of the catch is not reported in the available literature.

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<tr>
<td>170-200mm</td>
<td>19.5</td>
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<td>210-240</td>
<td>49.9</td>
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<td>250-280</td>
<td>26.8</td>
<td>31.4</td>
<td>32.4</td>
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<td>290-320</td>
<td>4.5</td>
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<td>370-400</td>
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The annual catch recovered very quickly, reaching 10,530.5mt in 1978 and maintaining an annual average of 10,885.7 mt for the next six years, including

\(^1\) Five vessels delivered lobsters to the storage centre I visited near Caibarién. The source for Fig. 15.1 was: Cruz et al. (1987: 43).
1983. In addition, CPUE increased in the first two months after the lifting of the closure from just over 20 mt/ fishing day nationally in the period from 1967-1977 to 30 mt/ fishing day from 1978 to 1983 (Baisre, 1984: 387). Baisre summarized the impact of the new management measures: "Although a concomitant effort increase might also be responsible for the higher yields of later years, there is no doubt that the higher CPUE after the closed season, the increase in the average size and in the larger size groups support the idea that regulatory measures were the main factors involved" (Baisre, 1984: 386). The major problem in the fishery, that of growth overfishing, had apparently been overcome and did not recur during the 1980s (Cruz et al. 1989: 4).

15. 1. 3. 2 Externalities. As we have seen, two mechanisms for optimizing spatial allocation were introduced into the fishery at this time. The first, exclusive enterprise fishing areas, would have the effect of reducing costs in the fishery by preventing long-distance running by fishers to "favourite" fishing areas and would have prevented over-concentration of vessels in areas of relative abundance. The second, fleet organization, would have improved the spatial allocation of vessels within the exclusive enterprise areas and would have brought with it the possibility of cost reduction in operating costs and better correlation between the distribution of vessels and of the resource. There is no objective evidence upon which to evaluate the success of these measures. As in the shrimp fishery, incentives to work were provided by bonuses and there was still enough flexibility in the system to reward the fisher with superior knowledge and skills.

15. 1. 4 Summary

As in the shrimp fishery, the new management regime seems to have been able to deal with the immediate problems in the fishery. New
regulations lengthening the closed season and enforcing minimum legal size resulted in an improved size-composition and seem to have solved the problem of growth overfishing to which the fishery had been subject. The introduction of exclusive enterprise fishing zones and organization of fleets to operate within them resulted in an improvement in spatial rationality and reduction of damaging competition in the fishery. The work of the catch bureaus, in addition, helped in accurate determination of the dates of the closed season and ensured an acceptable size composition in landings. The subsequent development of the fishery in the 1980s will be examined in the second part of this chapter.

15.2 THE LOBSTER FISHERY IN THE LATE 1980S

15.2.1 Fishing Area

The area in which the lobster fishery was conducted in the late 1980s occupied 64% (53,713 km²) of the total area of the Cuban shelf (Fig. 15.1). It encompassed, therefore, an area slightly larger than that estimated for the coral reef-seagrass ecological complex (45,000 km²). The largest lobster fishing area in the archipelago was on the southwest shelf where it occupied the entire shelf (94%; 20,850 km²) with the exception of shrimp fishing and nursery grounds in the northern half of La Broa Bay. Fishing occurred in 30% of the southeast shelf (18,800 km²) in a zone located at some distance from fluvial influence and almost coincident with the area of patch reefs in the central part (Gran Esperanza Bank) and the seaward edge of the shelf in the Gulf of Guacanayabo, the area of reefs and keys (Pingües Keys) separating that gulf from the Gulf of Ana María, and along the barrier reef and keys on the outer edge of the latter. The fishing area on the northeast shelf occupied 56% of its area (10,118 km²) and is located away from fluvial influence along the
landward and seaward edges of the archipelagos of Sabana and Camagüey. Fishing on the northwest shelf, with its extensive patch reefs and barrier reef, occurred on 92% (3 945 km²) of its area. The fishery was carried out by nine enterprises operating from 12 fishing ports: Batabanó, La Coloma and Nueva Gerona on the southwest shelf; Santa Cruz del Sur, Casilda and Niquero on the southeast; Caibarién, Cárdenas and Nuevitas on the northeast and Arroyos de Mantua, Puerto Esperanza and Morrillo on the northwest.¹

15.2.2 Vessels

In 1988, there was a total of 292 lobster fishing vessels operated by some 1 200 fishers for an average of about four fishers per crew. The majority (some 80%), were ferrocement Cayo Largos but a small number of Criollos, from 6-11.3 m in length, were also in use and some small Sigmas and Jarucos were employed in Caibarién because of the very shallow waters in some areas of the northeast shelf (Appendix IV). Fibreglass versions of the Cayo Largo were also introduced in recent years. All were live-well vessels and were distributed as follows: 53.8% (157) fished on the southwest shelf; 21.6% (63) on the southeast shelf; 18.5% (54) on the northeast shelf; and 6.2% (18) on the northwest shelf.

While the number of vessels had decreased by 17.7% since 1978,² the average size of vessels must have increased with the incorporation of additional Cayo Largos (at least 18 m in length) into the fleet. Since Cruz, Blanco and Baisre (1981: 19) found that this type of vessel caught proportionately more fish than did other types, it is not clear how much, if any, decrease in effort occurred as a consequence of the reduction in vessel

¹ Morrillo may have been phased out of the fishery toward the end of the 1980s.
² A vessel reduction of 40% had been achieved in the shrimp fishery between 1977 and 1986.
numbers.

15. 2. 3 Gear

As noted previously, there were about 250 000 pieces of gear in the fishery in 1978. By 1988, this had increased to 333 262 pieces made up of 220 942 *pesqueros* (66% of the total), 41, 210 *jaulones* (12%), 62 509 traps (19%) and 8 601 liftable tyres (3%) (Fig. 15.2). By 1991, the number of *pesqueros* had increased to at least 250 000 (Cruz and Phillips, 1994: 324) and in that year they took 50% of the total national catch while *jaulones* took 30%.

Concern for the coastal vegetation led to a prohibition on the use of palms in the construction of *pesqueros* and they began to be built on a standardized pattern of fibrecement and ferrocement plates (Appendix V). In 1984 and 1985, 60% of *pesqueros* were constructed of fibrecement plates and coastal palm trunks, 14% of palm, 13% of fibre or ferrocement, 12% of automobile tyres and mangrove sticks and 1% of other material (Cruz and Phillips, 1994: 325). Fibrecement pesqueros cost US $ 25.00 to build and, at 1.60 m by 1.10 m, were smaller than traditional ones to facilitate transportation and handling.

During fishing operations, *pesqueros* were generally located by landmark or compass rather than by buoys. However, technique varied from shelf to shelf. On the southwest shelf, the lobster net, described in Chapter 10, was set from an auxiliary boat to surround the *pesquero*. Lobsters were driven from it either by lifting it using a hook fixed to a pole or by introducing a *tarentín* (Chapter 5) into it. A similar net was used on the southeast shelf but was set by free-swimming divers who chased the lobster into it by lifting

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1 The source for Figs. 15. 2 and 15. 3 was: Cruz et al. (1989).
2 Cruz and Phillips (1994: 327) have translated this as "prickle".
Fig. 15.2. Principal Types of Lobster Fishing Gear: 1988
the *pesquero*. Fishers on the northeast shelf set galvanized wire traps around the *pesqueros*. These were retrieved from the clear shallow water by a single fisher in an auxiliary boat (*chapín*) using a hook attached to a pole. The traps were emptied into the small boat and the lobsters were then delivered to a mother vessel. On the same shelf, once the traps were emptied, fishers used the traditional equipment of glass-bottomed bucket, *tarentín*, and bully net to catch the lobsters still in the *pesquero*.

*Jaulones*, as noted in Chapter 10, were employed in the fishery especially during the autumnal-winter migrations of adult lobsters when 30-40% of the total annual catch was obtained using this type of gear. As a result of the movement of larger lobsters towards deeper, cooler waters, catches in the *pesqueros* decrease in the summer months beginning in July and reaching a minimum in September.

15. 2. 3. 1 **Regional distribution of gear.** Gear, as might be expected from the spatial variations in lobster populations among the shelves, was not evenly distributed (Fig. 15.3). The largest quantity was found on the southern shelves: 45% on the southwest shelf, 23% on the southeast shelf. Only 6% was found on the northwest shelf but, surprisingly, the northeast shelf with a fishing area only 54% the size of that of the southeast shelf, had a marginally greater proportion of all types of fishing gear.

As we have seen, a variety of gear was in use. The mix on the various shelves was a function not solely of efficiency, as might be expected in a centrally planned fishery, but also of ecological characteristics and the fishing culture. On the southwest shelf (Fig. 15.3), *pesqueros*, which were fished all year, were the major type of gear (86%) and *jaulones*, fished mainly during

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1 These traps were used without bait. However, juveniles or sub-adult lobsters were also used in Cuba as attractants in traps. This practice is also common in Florida.
Fig. 15.3. Lobster Fishing Gear by Shelf: 1988
the autumnal migration period, made up only 14% of gear. Minor amounts of other types of gear were also in use in the late 1980s in the establishments of Boca de Galafre and Cortés (CPI Pinar del Río) (Cruz et al., 1987: 75). Between 1984 and 1988, 52% of the catch was obtained from **pesqueros**, 46% from **jaulones**, an indication of the importance of fishing during autumnal migrations. However, in the same period, the proportion of the catch from **jaulones** increased from 43% to 51% (Cruz et al., 1989: 10). This may be a result of an absolute increase in the numbers of this type of gear, about which there is no information, but may also derive from its use during the lifting of the closed period, mentioned above.

A greater array of gear was in use on the southeast shelf, although the **pesquero** (63%) was still the commonest, followed by the **jaulón** (18%), the tyre and trap (9%). In contrast to the situation on the southwest shelf, catches with the pesquero were consistently higher and increased faster than those with the jaulón (Fig. 15.3) (Cruz et al., 1989: 10).

The northeast shelf presents a very different picture from the southern shelves. In 1988, the trap (66%) was the commonest type of gear and accounted for 78% of the catch. Next in importance was the **pesquero** (32%) with 15% of the catch and the **jaulón** with only 5% (Fig. 15.3). However, the situation was slightly more complex than appears from the figure since, as noted above, traps were often used in combination with **pesqueros** on this shelf. Gear types on the northwest shelf were similar to those on the southwest with **pesqueros** (78%) accounting for 62% of the catch and **jaulones** (22%) for 38% (Fig. 15.3).

Cuban observers, as noted above, attribute the variety and distribution of gear to adaptations to varying ecological conditions and to custom. None, however, have investigated the matter in more detail. Cruz et al. (1989: 3), for
example, who noted that the best catches per gear type on the southwest shelf were obtained with *jaulones*, while the best on the southeast came from *pesqueros*, attributed the difference simply to "the particular characteristics of each shelf" (*las características propias de cada plataforma*).

15.2.4 Landings and Effort

While the shrimp fishery experienced stable or declining catches and decreases in effort in the 1980s, lobster catches and effort grew during the decade until the fishery experienced a "collapse" in 1990 (Baisre and Cruz, 1994: 121). Landings, as noted above, increased after the introduction of the new management regime. Cruz et al. (1989: 1) identified two periods: 1978-1983 when the annual average catch was 10 800 mt (compared to an average of 9 000 mt between 1965 and 1977); and 1984 to 1988 when the annual average reached 12 500 mt. However, the average, as is often the case, conceals a great deal of variation. After reaching a peak of 13 584 mt in 1985, landings, with the exception of 1987, experienced a progressive decline to somewhat less than 8 000 mt in 1990, a very considerable drop in quantity and revenues.\(^1\)

The initial increase in landings at the end of the 1970s may well have resulted from the regulatory measures described above. However, it is clear that subsequent increases were due to a substantial addition to effort in the fishery. In a fishery with such varied gear as this one, precise effort measurement is quite difficult. Cruz et al. (1989: 21) used the quantity of gear pieces which grew by one-third between 1978 and 1989, but this does not provide an accurate count of effective effort. Cruz and Phillips (1994: 334) used the number of *pesqueros* checked per annum, and found that this had

\(^1\) This figure was taken from Graph 8.2 in Baisre and Cruz, 1994: 121) which explains its lack of precision.
increased from 400,000 in 1975 to 856,000 in 1983 and reached a peak of 1,230,600 in 1987. While this type of gear accounted for only about 50% of the catch in 1991, these figures are indicative of the growth in effective effort which occurred in the fishery.

While it may not be possible to precisely quantify the increase in effective effort which occurred, there is no doubt that it was substantial. According to Cruz et al. (1989: 3), it was a result of four factors. Firstly, as we have seen, the total quantity of fishing gear grew so that by 1989, there was a national average of 1,141 per vessel1 (Cruz et al., 1989: 4). Secondly, jaulones, formerly used mainly during autumnal migrations, began to be used in the fishery in the period immediately after the lifting of the closure, especially on the southwest shelf. Thirdly, gear began to be set in the water 7 to 10 days before the end of the closure (a practice that, as we saw in Chapter 5, was common in the pre-revolutionary period). Fourthly, a fishery for the live-lobster export market began to take place during the closed period. To these may be added the additional factors of an increase in the average size of vessels and improvement in fishers' knowledge and skills as a result of experience in the fishery.2

15. 2. 5 Evaluation

Between 1985 and 1988 (with the exception of 1987), therefore, catches dropped in spite of growth in effort, so that it is possible that the economic situation in the fishery may have deteriorated. Further, in 1990, the fishery, "collapsed owing to very poor recruitment probably associated with a

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1 It must be remembered that the largest majority of these pieces of gear were passive pesqueros.

2 The master of the lobster vessel I visited in Caibarién in 1993 had 50 years of experience fishing in the area.
dramatic mortality of juveniles caused by Hurricane Gilbert in September 1988, which caused considerable damage to the fishing grounds" (Baisre and Cruz, 1994: 121). In spite of the new management regime introduced in the late 1970s, then, fishing pressure on stocks appears to have been sufficiently intense that the fishery, like the lobster fishery in West Australia, was heavily dependent on newly-recruited lobsters with the result that catches varied substantially with variations in recruitment (Brown and Phillips (1994: 57). What may have saved the fishery from recruitment overfishing was the existence of the unexploited stocks in the deeper waters of the shelf slope described previously. There is also a possibility that pesqueros, in providing additional shelter, increase survival among lobsters (Cruz and Phillips, 1994: 334). However, whether such enhancement has a significant impact on stocks is not known at present.1

Whether the fishery was operating at a level of effort greater than that required for MSY is difficult to establish. Early attempts in the 1960s and 1970s (Buesa, 1972: Carles and Hirtenfeld, 1976a) to calculate the "potential catch" for Cuban lobster stocks arrived at a value of somewhere between 8 000 and 9 500 mt but, based upon the longer closed period and closer vigilance with respect to the catch of sublegal lobsters, this was revised upwards in the 1980s to, for example, 10 940 mt (MIP, Comité de Administración Pesquera, 1984) and 12 790 mt (Cruz et al., 1989). Catches, as we have seen, have often surpassed the value estimated for MSY but have rarely done so for any substantial period of time. However, observers agree that the Cuban lobster fishery is being fully exploited at present.

Given the move to limit, or even reduce, effort in the fishery, it should

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1 Cobb and Phillips (1994: 530) have noted that "the ecological consequences of large numbers of ferrocement slabs lying on the bottom of shallow bays is unknown."
theoretically be possible, if not particularly desirable, to operate the fishery at
MSY in the long run. However, a decrease in recruitment has taken place in
the last few years (Baisre and Cruz, 1994: 127). This has been attributed to the
impact of Hurricane Gilbert and other environmental changes but the effects
of intense fishing pressure must also surely be considered:

given a minimum legal size of 69 mm and a size at
first maturity of 81 mm (Cruz and de León, 1991), it
is possible that extreme fishing pressure on the
juvenile population may severely curtail
recruitment to the breeding stock. This has
potential to cause a future serious decline in egg
production and should be a priority area for
research and management (Chubb, 1994: 204).

Whether economic overfishing also occurred is unknowable with the
available information. Lobster prices in international markets may well have
been sufficient to counteract additional costs consequent upon the growth in
effort. No explanation is given in the Cuban literature for the apparently
unrestrained growth in effort during the 1980s, a growth which continued in
the face of declining catches after 1985. It seems likely, however, that it was a
result of the drive to "maximize hard currency earnings" noted earlier.

The short-term response to the situation in the fishery was to stop the
growth in effort by increasing the length of the closed season to four months
from three and to prevent further increases in the number of *pesqueros* and
*jaulones* (Cruz and Phillips, 1994: 335; Cruz et al. 1989: 12). A suggestion was
also made in 1989 (Cruz et al., 1989: 9) that an increase in the minimum legal
size from 210 mm to 230 mm would help to increase the reproductive power
of the stock and also increase the national catch to around 13 500 mt. Such a
change, it was calculated, would also improve the biovalue of the fishery by
producing an additional US $4.5 million in revenues.\(^1\) Longer range research was also being undertaken to better measure fishing effort by determining differences in the catching capacity of the various types of gear, and to find a measure of annual recruitment that would allow better prediction of stock size (Baisre and Cruz, 1994: 128). Rationalization of gear types, eliminating traps and introducing a new, more efficient type of liftable *pesquero* were also being considered. According to an interviewee (León, 1993), limiting costs in the fishery had also become an explicit priority.

15.2.6 The Lobster Fisheries of Florida and West Australia: a Comparison

Baisre and Cruz (1994: 129) stated that:

Strict enforcement of fisheries regulations, the limited entry of new boats into the fishery, the regulation of the number of fishing gears, the assignment of exclusive fishing zones and the data gathering system all point to the Cuban fishery being one of the best-managed spiny lobster fisheries in the world.

As we saw in the preceding section, there is little hard evidence with which to make a definitive evaluation as to whether the Cuban lobster fishery was operating at an optimal sustainable level. However, a brief examination of the adjacent fishery in Florida may be illuminating in describing a probable alternative history as well as a possible future for the Cuban fishery.

The lobster fishery in Florida is overwhelmingly a trap fishery.\(^2\) Traps are constructed of wooden slats and salted cowhide is used as bait. The

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\(^1\) The Cuban minimum legal size of 210 mm Lt/ 69 mm Lc is quite small in comparison with other countries with spiny lobster fisheries—17 th out of a total of 21 countries listed in Cruz et al., 1989: 13). However, it is maintained (Cruz et al., 1989: 7) that strict enforcement in Cuba counteracts this.

\(^2\) This account is taken from Labisky, Gregory and Conti, 1980 and Hunt, 1994.
fishery, like that in Cuba, experienced strong growth in the 1960s when catches averaged about 800 to 1,300 mt using from 75,000 to 100,000 traps. The number of traps in use in the fishery grew to 250,000 by the early 1970s and, with the expulsion of U.S. fishers from Bahamian waters, to over 500,000 in 1975. Landings, however, did not increase and fluctuated around 2,700 mt in the late 1970s. Other problems in the fishery in the 1970s, which have persisted, included a large illegal market for "shorts" (sublegal-sized lobsters) and trap robbing to the extent that some fishers rented airplanes to protect their traps. Effort continued to grow and, in 1992, the Florida Department of Environmental Protection issued licences for an incredible 986,000 traps to 1,870 individuals. With the cost of traps (some fishers worked as many as 2,000), larger, faster vessels, and equipment such as hydraulic trap lifters, it is no surprise that the commercial fishery was characterized as overcapitalized (Hunt, 1994: 161). Further, the commercial lobster fishery is not the only user of the resource in Florida. Shrimp fishers are also licenced to keep lobster in the by-catch for a total harvest of some 450 mt. In addition, 120,000 recreational lobster licences were issued between August 1991 and March 1992. The recreational fishery landed 22% of the total harvest in the 1991/92 season.¹

The Cuban catch in 1988 of almost 12,000 mt with just over 300,000 pieces of gear seems impressive by comparison. When it is considered that more than 60% of lobster fishing gear on the Cuban shelf is made up of passive pesqueros within which, unlike traps, lobsters do not become trapped and die thereby adding to mortality in the fishery, the situation in the Cuban fishery seems to justify the statement by Baisre and Cruz, above. As an

¹ Private fishing for lobsters is permanently prohibited throughout the Cuban national territory (MIP, 1990).
addendum, it is probable that gear like *pesqueros* could only be used in a fishery as highly structured and regulated as the Cuban one with its exclusive fishing zones and sub-zones. It is difficult to conceive of such gear being employed in the Florida fishery with its 120 000 recreational divers.

Given the generally poor record of fisheries management in the United States, it might be argued that to choose the Florida lobster fishery for comparative purposes is to set up a straw man. There follows, therefore a brief examination of the lobster fishery in West Australia which is, "arguably the best-managed rock lobster fishery in the world" (Phillips and Brown, 1989: 179). The fishery was based on the exploitation of *Panulirus cygnus*, catches of which averaged 10 000 mt per annum between 1970 and 1990. In response to rapid expansion in the fishery during the 1950s, entry into it was closed in 1963 and strict regulations on the amount of gear (traps) were introduced in 1965. However, these actions were not able to prevent substantial growth in effective effort as a result of "fishers working more days per month, gaining experience and improving their boats, gear and fish-finding technology" (Brown and Phillips, 1994: 55). These attempts by fishers to gain advantage over their competitors within the limited-entry fishery, a process discussed in Chapter 2, have led to heavy exploitation of the resource by a highly capitalized fishery. In 1991-92, 649 vessels employing 69 307 traps shared a gross income of $250 million (Brown and Phillips, 1994: 52). The catch in the West Australian fishery, then, was more than three times larger than that of the Florida fishery but was caught with approximately one fourteenth the number of traps, a clear demonstration, I think, of the efficacy and necessity of strict regulation and rationalization in fisheries of this type.

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1 The resource is also exploited by recreational fishers.
2 Technological developments and their impact on fishing power are described in detail in Brown, Caputi and Hall (1994).
The Cuban and West Australian fisheries are similar in that, in both, lobster stocks are subject to a high exploitation rate but not yet to the extent of inducing recruitment overfishing. However, Australian fishers, using colour sounders and Global Positioning Systems have had great success in exploiting breeding grounds in deeper waters and this has led to some concern being expressed about recruitment in the future. In Cuba, as we have seen, the fishery occurs in the shallow waters of the shelf and stocks in the deeper waters of the shelf slope are presently unexploited. Fishing such stocks would require rather fundamental changes in fishing gear and techniques, all of which would increase costs in the fishery. An additional argument against their exploitation is their possible importance, as described previously, for maintenance of stocks on the shelves.

By all accounts, the West Australian fishery is a profitable one. As noted above, gross revenues in 1992 were US $250 million. This was about two-and-a-half times greater than the approximately US $100 million figure given for the Cuban fishery for approximately the same size of catch. The discrepancy stems, apparently, from the fact that the Australian fishery produces high quality products for export to Japan, Taiwan and the United States. As a result of the U.S. embargo, Cuba cannot export to that country and "While the Cubans are slowly breaking into the lucrative Japanese market ... their products command a lower price" (Chubb, 1995).¹

With respect to costs, it is likely that they are substantially lower in the Cuban fishery which involves less than half as many vessels operating within exclusive enterprise fishing zones. The "race for fish" is not, therefore, as intense as it appears to be in West Australia, so that there is no necessity for

¹ Dr. C. F. Chubb is a senior research scientist in the Rock Lobster Research Unit of the Fisheries Dept. of Western Australia.
high speed vessels, hydraulic trap winches, colour sounders, Global Positioning Systems equipment or any type of navigational equipment with the exception of a compass.\textsuperscript{1} As we have seen, competition, stimulated by bonuses, exists but it is not allowed to result in the type of escalation of costs seen in the Florida and West Australian fisheries. The only aspect of the regulation of the fishery in which the Cubans seem to have been lax is in the deployment of fishing gear. The apparently uncontrolled escalation in the amount of gear in the 1980s could have resulted in very serious problems if it were not for the fact that most of it was in the form of the passive pesqueros which do not add to mortality in the stock and, in fact, may enhance its survival.\textsuperscript{2} In addition, at an average cost of US$ 25.00, the quantity of pesqueros deployed would have had a high total value. Costs in the Cuban fishery, then, would have been much lower than those in West Australia.

15. 2. 7 Conclusion

The Cuban lobster fishery, the most valuable in the country, experienced a very different history from the time of the introduction of the new management regime in 1978. Under the stimulus, apparently, of a need to generate hard currency earnings for the national economy, catches increased but did so, not as a result of greater efficiency, but of a substantial increase in fishing effort, especially in the amount of fishing gear deployed. A "collapse" in the catch in 1990 resulting from the ecological impact of Hurrican Gilbert two years earlier, raised the possibility of recruitment overfishing in the fishery. The economic situation of the fishery is

\textsuperscript{1} Simplicity extends throughout fishing operations. On the lobster vessel, I visited in Caibarién, cooking was done on a charcoal stove and fishers prepared and repaired their own fishing equipment.

\textsuperscript{2} Abandoned or lost traps, on the other hand, continue to catch lobsters in a process known as "ghost fishing".
unascertainable from published information. Cuban informants (e.g. Baisre, 1991) maintain that it is profitable but this gives no indication of how much resource rent is being generated. In fact, given the difficulty of establishing costs in the Cuban economy and the complexity of measuring effort in the fishery, it may be impossible to precisely define where, in relation to MEY, the fishery is operating. However, the high value of lobster exports and the low cost structure in the fishery, indicate that it probably generated substantial resource rents.

A comparison with other spiny lobster fisheries reveals that in spite of the lack of sophistication in economic evaluation, the Cuban fishery seems to have caught a similar quantity of lobsters as that of the tightly regulated fishery in West Australia, but did so at lower cost. It thereby demonstrated an advantage of state ownership of the means of production. Whether this was enough to offset the much higher revenues in the Australian fishery is doubtful, but this is beyond Cuba's control. Compared to the Florida lobster fishery, the Cuban one is a model of good management and restraint and, together with the West Australian fishery, demonstrates the necessity for, and the efficacy of tight regulation of spiny lobster fisheries.
CHAPTER 16
THE SCALE AND TUNA FISHERIES

16.1 THE SCALE FISHERIES

The various scale fisheries on the shelf, as we have seen, exploit a large number of species in all three ecological complexes. In spite of their great variety, they form a distinct management-regulation unit within the shelf fisheries and possess characteristics in common which will be examined in this chapter. As we saw in Chapter 12, the scale fisheries are geographically widespread, occurring on all four shelves, with the highest catches coming from the eastern part of the archipelago. In the early 1980s, thirty-seven establishments, with 623 vessels, crewed by 2,091 fishers and employing over 400 pieces of massive gear types (set nets and haul-seines) as well as gillnets, traps and hook and line, were involved (Ramos, Pérez Tain and Machado, 1981: Table 4).1

16.1.1 Problems in the Fisheries

16.1.1.1 Overfishing. Landings in the scale fisheries, after reaching a peak of 26,839.3 mt in 1976, suffered from collective declines which persisted for several years. The phenomenon affected all shelves except the southeast, and 14 of 17 species groups. The drop of 53.4% in landings of the valuable lane snapper, between 1975 and 1978, was especially serious.2 As we have seen, the scale fisheries had experienced a massive increase in effort during

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1 These data do not include vessels and fishers involved in the fishery for small tunas.
2 Baisre (1985b: 70) called the collapse in this fishery in the Gulf of Batabanó the most dramatic experienced by a Cuban fishery with the exception of that of sponge fishery in the 1940s.
the 1970s when there was a radical re-orientation of fishing gear away from hooks-and-lines and traps, towards set nets and haul-seines. They showed evidence of satisfying Pérez' definition of overfishing (Chapter 14): "increasing effort levels and stabilized or diminishing catches." Another troubling sign was the high proportion in catches of juveniles, especially of slow-growing demersal species (CIP, 1980), an indication, as we have seen, of growth overfishing.

The abrupt drop in catches after 1976 coupled with the high proportion of juveniles in the catch suggested that recruitment overfishing was also occurring in the scale fisheries. Stocks, it appears, were being "fished down" rather than harvested on a sustainable basis. In addition, the size-composition of the landings, with high proportions of juveniles of lower value, would have led to a decrease in revenues, and an increase in costs because more ice was required to preserve them. The economic situation in the fishery, then, must also have deteriorated in the late 1970s.

As was the case with shrimp and lobster, the critical situation in the scale fisheries coupled with changes in policy consequent upon the introduction of 200 nm EEZs in the world ocean, resulted in their being subjected to detailed scientific scrutiny for the first time in their history. A summary of the results of the first few years of research was presented in the report of the National Scale Meeting in 1980 (MIP, 1980) and a number of problems, described below, were identified.

16. 1. 1. 2 Statistics. The collection of statistics in the fisheries was inadequate in several respects. Whereas they had been collected for 42 different species or species groups before 1959, the number had subsequently been reduced to only 20, making it difficult or impossible to accurately assess stocks of individual species. In addition, landings statistics were aggregated by
enterprise and, since some of them (e.g. Pinar del Río) had establishments on more than one shelf, it was difficult for researchers to establish exactly where catches had been made.\(^1\) Since, as we have seen, many populations of marine species were isolated by shelf, this compounded the difficulty of making stock assessments.

16. 1. 3 Gear selectivity and location. The widespread use of set nets and haul-seines had a serious negative impact on fish populations partly because of their lack of selectivity and partly because of the location of fishing operations. Both types of gear employed a mesh-size that was too small to allow the escape of juveniles. This lack of selectivity had especially severe impacts on the many species of slow-growing demersal fish, such as the snappers and groupers, many of which do not reproduce until 3 years of age.\(^2\) The proportion of juveniles in the catch also resulted from the fact that, in these fisheries, there had been a general movement away from deeper waters of the shelf edge toward inner, shallower areas. Most fishing, then, took place close to the mangroves of the coast and keys in areas which functioned as nurseries for many of the species being caught. This was true, not only of set-nets and haul-seine fisheries but also of the trap fishery for Nassau grouper which showed a high percentage of juveniles in the catch. The spatial distribution of fishing effort, then, as was the case in the shrimp fishery, was less than optimal.

16. 1. 4 Disregard of fishing regulations. An additional factor acting to increase the proportion of juveniles in the catch was the fact that, as we have seen, fishing regulations, if not abolished, were certainly ignored during

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1 Claro and Giménez (1989:150) noted that five different enterprises fished in the Gulf of Batabanó and some of them also fished in other areas.

2 According to Claro (1981) referred to in Baisre (1985b: 70), 50% of the lane snapper catch in the Gulf of Batabanó taken during the reproductive migration were smaller than the minimum legal size.
the 1970s. In the scale fisheries, closed periods, which had existed up until the late 1960s, were suppressed and minimum size regulations were ignored. The first of these, in conjunction with the widespread use of set-nets and haul-seines, resulted in a substantial increase in effort in these fisheries. The second compounded the problem of the high proportion of juveniles in the catch.

16. 1. 1. 5 Temporal and spatial misallocation of effort. Fishing pressure intensified during the spring and early summer when many of the valuable fish stocks concentrated in relatively restricted areas of the shelf during their reproductive migrations. This was the time of the lobster closed season and many enterprises diverted vessels to the scale fisheries. Copes (1986: 284) has pointed out that a race for fish is a necessity in some "flash fisheries" in which there is only a small window of opportunity for fishing. In such fisheries, however, strict limits on entry and tight regulation of fishing operations are an absolute necessity (see for example the roe herring fishery on Canada's west coast [Stocker, 1993]). As we have seen, there was little regulation of scale fisheries in the 1970s and, according to an interviewee (Obregón, 1993), up to 1 000 vessels fished in the restricted area of the Diego Pérez Key in the southeast Gulf of Batabanó during the spawning migration so that congestion and overcrowding were common on the fishing grounds during this part of the year. An associated problem was that vessels often travelled long distances to fish in what they considered to be their traditional fishing grounds (Obregón, 1991; Ramos, Pérez Tain and Machado Montero, 1981:3). For example, three enterprises operated in the southeast corner of the Gulf of Batabanó and, according to the report (MIP, 1980: 4.4), the closest ones had the smallest amount of effort in the fishing area. This must have added to aggregate fleet costs.
16.1.6 Other problems. The report also noted that gillnets and traps were often not checked with sufficient frequency, reducing their efficiency and adding to fishing mortality without any gain in revenue. In addition, pollution of coastal waters by industrial waste, fertilizers and pesticides was recognized as a potential problem for the fisheries. At this time, there was no explicit discussion of the economic situation of the scale fisheries.

16.1.2 Remedies

The 1980 report made a number of recommendations which focussed on improving statistics, increasing the selectivity of gear, reducing congestion and introducing or enforcing minimum size regulations and catch quotas. With respect to statistics, it recommended that landings be recorded by establishment and on the basis of a new listing of 13 groups and 30 species. Selectivity was to be improved firstly by encouraging diversification toward types of gear, such as longlines and gillnets, with higher selectivity, and secondly by conducting experiments on the biological and economic impacts of introducing mechanisms into set nets and haul-seines to increase their selectivity. The allocation of exclusive fishing zones to individual enterprises was suggested as a method for reducing congestion on the fishing grounds during spawning migrations and the concentration of fishing activity in close inshore waters was to be decreased by changing the bonus system to induce fishers to expand their areas of operation onto patch reefs further from the coast and into the deeper waters of the shelf edge. In addition, a system of minimum legal sizes and catch quotas was to be developed for each of the more valuable scale species. As we will see, some, but not all, of these recommendations were later incorporated into a new management regime for the scale fisheries.
16. 1. 3 The New Management Regime

16. 1. 3. 1 Objectives. The objective of the new management regime took economic considerations into account, at least implicitly: "To extract more and better fish from our shelf in a more rational and efficient manner" (MIP, 1980). While this statement cannot be interpreted as a re-orientation of the scale fisheries to a catch level consistent with MEY, it seems to indicate some movement in that direction. As in the other fisheries, the new objectives were to be achieved in the short term by the application of new regulations and in the long term by the introduction of a comprehensive management.

16. 1. 3. 2 Management structure. Changes in the management structure of the scale fisheries were not as fundamental or wide-reaching as in the shrimp fishery. Catch bureaus, introduced into the scale fisheries in 1981, operated rather like those in the lobster fishery. Basic tasks involved collection of catch and effort statistics by species and establishment¹, control of the closed periods for the most valuable species, size sampling on board vessels and in ports, and undertaking experiments to deal with problems in the fishery (Obregón, 1986). Longer range tasks involved the preparation, in conjunction with managers, of fishing plans for each enterprise.

16. 1. 3. 3 Management actions. As Panayotou (1982: 43) has pointed out, "Unless social considerations dictate a temporary sacrifice of some efficiency to maintain employment or to improve the incomes of fishermen," the most direct means of improving the biological and economic situation in scale fisheries is to decrease excessive effort. This could have been accomplished in Cuba by removing a number of set-nets and by limiting the

¹ A recommendation (CIP, 1980) to introduce a grid system similar to that in the shrimp fishery does not appear to have been acted upon.
number of vessels in the haul-seine fishery. Such limitation does not appear to have been considered in the early 1980s as a result, perhaps, of a desire to maintain employment in remote areas of the country.

Effort may be limited in scale and other fisheries by means of seasonal or area closures but, as Panayotou (1982: 42) has pointed out, these are rarely effective by themselves because they encourage "wasteful expansion of effort as the fishermen attempt to make the best of the open areas and seasons." Such measures are often introduced, however, in an attempt to rebuild over-exploited stocks. The reimposition of seasonal closures during spawning periods could have helped to improve the productivity of the Cuban shelf scale stocks. However, as Baisre et al. (1984: 380) noted with respect to the lane snapper fishery, such an action "would represent stopping the fishing activity when catches and the CPUE are at their highest" and it was rejected. Instead, juvenile fish were protected by establishing closures in nursery areas close to the coast.

Total allowable catches (TACs) were also introduced into some of the scale fisheries. These are designed to control mortality in the stock but, as Panayotou (1982: 42) has pointed out, they may have some serious drawbacks, including the race for fish as fishermen attempt to increase their share of the TAC. In addition, "in multispecies fisheries, a TAC can be more harmful as the ensuing competition is likely to result in the catch being concentrated on the most valuable species with the risk of their progressive extinction" (Panayotou, 1982: 42). Discards of unwanted species would also occur in such fisheries. When asked about such problems in Cuba, Obregón (1991) replied that the fishery was very visual. When a vessel arrived at one of its usual fishing places (an artificial or patch reef, for example), the skipper would use a glass-bottomed bucket to establish the species composition of the fish
concentrated there. Experienced skippers could do so very accurately and could, therefore, avoid fishing in areas where there were concentrations of species for which fishing was closed or for which the TAC was already achieved.

In spite of such regulatory measures, the situation of lane snapper stocks on the southwest shelf was so serious (the catch of 393.1 mt in 1980 was only 15% of the highest catch of 1974) that closures of varying lengths and catch quotas were applied in that area during the reproductive period in April, May and June. These were followed in 1985 by a complete closure during the reproductive period. In addition, minimum legal sizes were introduced, or re-introduced for lane snapper (18 cm) and grey snapper (24 cm). Such new regulations did not, however, apply to all species. In 1984, there were no regulations for the fisheries of other species such as yellowtail snapper, blackfin snapper, mackerels, shark and Atlantic thread herring (MIP, 1984).

Minimum legal size regulations may result in waste as fish caught in gear are discarded as being too small. The best way to avoid this is to use gear which is selective. Following the recommendation in the 1980 report, CIP undertook a survey of fishing gear and began experiments to study the problem of the lack of selectivity of set nets and haul-seines (Ramos and Obregón, 1983; Ramos, Pérez Tain and Machado Montero, 1981). As a result, two mechanisms were introduced into the fishery from January 1983. The first, a boat-shaped selective device (*vivero selector*, see Fig. 16.1) was designed for use with haul-seines in the set-nets. Once the fish were in the net, it was emptied into the device which was constructed of wooden slats with spaces between them to allow the escape of juveniles. Tests in Matanzas and Caibarién showed that use of the device increased the average size of
FIG. 16.1. *Vivero Selector*

FIG. 16.2. *Corona Selector*
individuals in the catch. It was also calculated that, although the weight of the catch would fall in the short-run, it would increase in the long term and, if prices were scaled according to weight, the value of the catch would improve substantially. In addition, the juveniles which escaped would have an improved chance of growing old enough to spawn, with beneficial impacts on stocks.

The second device, the corona selector (Fig. 16.2) was employed in the haul-seine fishery. It was constructed by making the mesh in the cod-end of the net larger, to allow smaller fish to escape, and of thicker thread, to further reduce entangling. Experiments indicated that a mesh size of 30mm allowed the escape of more than 90% of fish 16-18 cm in length (MIP, 1982). A study of enterprises on the south coast suggested that the use of this device would have beneficial effects on stocks and the size composition of the catch but that an incentive would have to be provided to persuade fishers to use it. This could be done by taking the size composition of the catch into account in setting fish prices.

In the early 1980s, therefore, the scale fisheries were subject to some regulatory and management changes but these were not so fundamental nor so widespread as those that occurred in the shrimp and lobster fisheries. Catch quotas and minimum legal sizes were introduced for some, but not all, of the more valuable species. Experiments on gear selectivity were successfully conducted and two new mechanisms, the vivero selector and the corona selector were introduced into set nets and haul-seines.

The recommendations in the 1980 report that required more fundamental changes to fishing operations and management do not seem to have been so readily accepted. Inadequacies in the collection and publication of catch statistics persisted during the 1980s. This problem prompted García-
Arteaga and Claro (1987) to undertake an attempt to systematize landings statistics from 1959 to 1985 on annual and monthly bases for both shelf regions and establishments. It also appears that no new listing of groups and species was introduced at this time.

Similarly, there does not seem to have been any movement towards reducing the emphasis on non-selective gears such as set nets and haul-seines nor upon decreasing the concentration of effort in inshore waters. Further, reduction of congestion and excessive competition by means of exclusive enterprise fishing zones did not occur and a price list which reflected species and size composition of the catch was not introduced until the early 1990s.

16.1.4 Impact of the New Management Regime

The multi-species nature and variety of the scale fisheries makes an evaluation of the impact of the new management regime upon them rather difficult. Total fish catches from shelf waters did begin to increase after 1979 but it is difficult to ascertain whether this recovery resulted from the new regulations or from an increase in effort in the fisheries in the early 1980s. With respect to lane snapper, Baisre et al. (1984: 380) considered the former to be the case.

The overall increase in scale landings, however, concealed a rather more complex situation. An inspection of landings statistics for the more valuable shelf species during the first half of the 1980s (See Fig. 16.3), reveals that growth was not experienced in all of them. Some registered decreases

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1 The resultant report (Garcia-Arteaga and Claro, 1987) contained 915 pages of statistics and was not published. I found a copy at the library of the Institute of Oceanography in Havana. In spite of employing every entreaty I could think of, I was not allowed to borrow the report so that it could be micro-filmed at the National Library. As a consequence, many long days were spent copying statistics by hand. These form the basis of the statistical analysis of the post-revolutionary fishery presented here.
Fig. 16.3. Selected Scale Landings: 1959-1985
(Cuban and Grey snappers, Nassau grouper), others showed some stability with annual increases and decreases (mutton snapper, mackerels, mullets), while still others showed increases (lane snapper). Further, with the exception of mutton snapper and Nassau grouper, all of these species registered decreases in landings in 1985. Also, the increase in total landings of lane snapper concealed decreased catches on the southwest shelf, its traditional fishing area.

The drop in catches of the more valuable species could have several possible explanations. Firstly, effort in these fisheries may have decreased. However, as far as can be ascertained, the number of vessels and pieces of gear in the fisheries were not reduced during this period, nor was a closed season introduced. Secondly, minimum size regulations in some species and the use of selection devices in both set nets and haul-seines, in reducing the quantity of juveniles in the catch, could have reduced the overall catch quantity in these relatively slow growing species, at least in the first few years. However, in time, as escaped juveniles grew, the size of the catch would be expected to increase again. Thirdly, stocks of these valuable species may have been subject to strong fishing pressure as a result of continued high effort levels and excessive competition between large numbers of vessels driven by the desire for bonuses. This could have been ameliorated by reducing effort in the fishery and by assigning exclusive fishing zones to enterprises. Biological overfishing, then, may have continued. Decreases in the catches of some of these species would also have brought decreases in revenues and, if effort

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1 The landings inspected were for species which were included in Groups 1 and 2 of the schedule of prices of October 1992 (MIP, 1992). The source for Fig. 16.3 was: García-Arteaga and Claro (1987).
levels, excessive competition and spatial irrationality had persisted would have maintained or increased costs so that the economic situation of some, at least, of the scale fisheries would have deteriorated.

16.1.5 The Scale Fisheries in the Late-1980s

Change took place much more slowly in the scale fisheries than was the case in those for shrimp and lobster, partly because, as a scale biologist pointed out, "We are the Cinderella Cuban fisheries because our catches are not destined for the international market. They are all consumed within Cuba" (Obregón, 1991).1 Continuing problems finally resulted in these fisheries being subject to the same type of scrutiny as had those for shrimp and lobster. A comprehensive evaluation by CIP began in 1988 (CIP, 1991).2 During that year and the next two, a thorough investigation of catches and effort was carried out in all establishments and enterprises involved in these fisheries. Total and monthly catches were examined by species, by quality group, by the type of gear employed, and by zones. The sizes of fleets, types of vessels and motors and year of construction as well as types of gear and yields were also studied, as were the fishing zones of each establishment. The study was notable in being the first of any Cuban fishery to attempt to document costs and revenues in a systematic way. In addition, a cluster of papers dealing with human impact on fish stocks was published in the late-1980s and early 1990s (Claro, 1988 and 1990; Claro et al., 1990; Claro and Giménez, 1989).

16.1.5.1 Vessels and gear. In the late-1980s, there were, apparently, 811 vessels involved in the fishery.3 If accurate, this datum means that the size of

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1 These fish were destined for the domestic market and the tourist industry.
2 The resulting report was huge and was not published. I was allowed to examine parts of it briefly in the CIP. The summary presented here is taken from my hand-written notes.
3 The term "apparently" is used here because the report summary does not supply the number directly. This figure is derived from other data: the total number of days at sea (131 542)
the fleet increased by some 23% during the decade, a rather substantial increase given the somewhat fragile state of the most valuable species. It is possible that the fishery was being used to absorb surplus labour and vessels from the rationalizing shrimp and lobster fisheries but it is not possible to verify this with the available information. The fleet showed a great deal of variety: 26 different types of vessels with an average age of 13 years; and 15 different brands of motors with 31 distinct models. Variety extended to fishing gear of which there were 16 different types: four haul-seines; two set nets; three traps, three longlines; three entangling nets; and hook and line. While large numbers of set nets were still in use, stricter controls were applied to them. Before a new one could be constructed a study of the proposed location by the enterprise catch bureau was required and if it was to be located in a channel, it was required to leave 30% of the width open so that some fish could pass (MIP, Dirección de Regulaciones Pesqueras, 1990: 45; Obregón, 1991).

16.1.5.2 The catch. Total landings increased to a peak of 25 169 mt in 1987 (plus some 2 500 mt from by-catches) before experiencing another downturn (CIP, 1991). Some part, if not all, of this increase must be attributed to the growth in effort represented by the addition to vessel numbers described above. However, as noted previously, total landing statistics conceal a more complex situation. The species composition of the catch changed during this period. In the early 1980s, the "most commonly caught species" (Ramos, Pérez Tain and Machado Montero, 1981: 2) were Cuban, mutton and lane snappers along with mullets, grunts and mojarras. By the end of the decade, the "principal species caught" (CIP, 1991) were sharks, skates and rays, grunts, lane, mutton and yellowtail snappers. The proportion of less valuable divided by the average number of days at sea per vessel (162) gives a total of 811 vessels.
species had, therefore, increased at the expense of more valuable ones. Of particular note were skates and rays (Batioid fam.) which had not previously appeared in statistics but which accounted for 11% of the total scale landings in the late 1980s (CIP, 1991: Fig. 6). In fact, landings of grunts, skates and rays, sharks and Atlantic thread herring, in combination with species classed as "other fish", none of which were classified as valuable species, accounted for 80% of all landings (Fig. 16.4). The proportion of valuable demersal species in catches experienced relative decreases in the same period.

Scale fisheries occurred on all four shelves (Fig. 16.5) but the majority of landings (72%) came from the two eastern ones. Of particular importance here is the fact that the northeast shelf, as noted in Chapter 12, continued to contribute to scale landings out of proportion to its area. On all four shelves, the category "other fish" constituted the largest proportion of landings but the species composition of the remainder of the catch varied somewhat by shelf (Figs. 16.6). Sharks, skates and rays and Atlantic thread herring made up 28% and 36% of total landings on the northeast and northwest shelves respectively, grunts and rays together constituted 35% on the southwest shelf and the northwest shelf was the only one where landings of demersal species remained in the majority. Even on that shelf, however, the largest single contribution to landings came from sharks.

16.1.6 Evaluation of the Scale Fisheries

16.1.6.1 Stocks. As mentioned previously, the multispecies nature of the fishery made the precise determination of the size of the sustainable catch difficult, if not impossible. Estimates for MSY of some of the more valuable species had been made in the past but, as we have seen, some of them were in

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1 The source for Fig. 16.4-16.8 was: Source CIP (1991).
Fig. 16.4. Species Composition of Landings: Late 1980s
Fig. 16.5. Scale Landings by Shelf: 1983-1989
Fig. 16.6. Landings by Species Composition
a state of biological overfishing without catches coming close to those estimates. Therefore, given the relative stability of catches which, although they fluctuated somewhat, did so only by about 10% about an average of some 26 000 mt, during the period 1983 to 1989, researchers employed a conservative first approximation of MSY for the scale fisheries as a whole at 24 000 mt.

As noted above, a cluster of papers by researchers at the Institute of Oceanography of the Academy of Sciences of Cuba examined the impact of fishing and other types of human activity on fish stocks on the northeast and southwest shelves. Claro and his colleagues found some disturbing changes in both fish populations and in their habitats. With respect to the former, heavy fishing pressure on lane snapper on the southwest shelf, led, as we have seen, to a collapse in stocks of that fish. In spite of the remedial measures taken in the 1980s, the researchers concluded that the haul-seine fisheries in this area were overexploiting fish populations and that the situation could become critical if effort levels were maintained (Claro and Giménez, 1989: 159).

As a result of the decrease in lane snapper populations, effort was directed towards other demersal species such as grey snapper, mutton snapper and yellowtail snapper. The researchers found that snappers, especially lane snappers, were being replaced in fish assemblages by several species of grunts. For example, in 1974, near the Tablones Keys close to the southern edge of the Gulf of Batabanó, the snappers constituted more than 60% of all fish whereas in 1984, they made up only 17%. The grunts, on the other hand, had increased in abundance on the southwest shelf in general and, especially on patch reefs and artificial reefs, came to constitute more than 70% of all fish. "A comparison of fish assemblage composition from different years and sub-
regions showed a gradual subsitution of lane snapper in the ecosystem by three species of grunts with which they competed for space and food, evidently as a result of overexploitation of the former" (Claro, 1988: 5). This presented a problem in that the grunts were less well accepted by Cuban consumers and were, therefore, much less valuable than the snappers.\(^1\) It was suggested that a fishery directed specifically at grunts, to a level of 3 000-4 000mt per year, might help to redress the balance, the grunt catch being used for animal feed.\(^2\)

Claro also conducted a study of fish populations on the northeast shelf. Waters on this shelf are the shallowest (2 or 3 m average) in the archipelago and, therefore very vulnerable to variations in temperature and salinity consequent upon variations in the supply and circulation of fresh water to them. It was found that "the ichthiofauna of the mangals on the northeast zone have been seriously affected in density, diversity and fish biomass, especially in the juvenile stages, by salinization of the shallow basins (acuatórios) "(Claro, 1990: 12). The major cause of the increase in salinization of these shallow waters seems to have been a decrease in river outflow resulting from the building of numerous dams. The problem, according to Claro (1990: 12), was likely to be accentuated by the construction of causeways (piedraplenes ) across this shallow inland sea from the mainland to areas of tourist development, such as Key Coco, on the keys and islands on the outer edge of the shelf. Such causeways, constructed of rock debris placed on the sea floor, are the type of "heroic" projects undertaken by brigades of volunteer workers, called contingentes , who work longer hours, and are paid and fed

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1 This problem is not restricted to fisheries in Cuban waters. See Pauly (1979: 7) for a brief discussion.
2 According to Obregón (1993) a fishery was directed specifically at grunts for one year but only 300tons were caught.
better than other workers.

The causeways rise from the water at intervals to form bridges which allow boats to pass and, theoretically, permit continued circulation of water within and between basins. The researchers of the Institute of Oceanology seemed to be concerned about their impact but a question to three CIP scale fish biologists regarding them elicited only unconcerned shrugs. A great deal depends, one supposes, on the number of causeways which are built, but it must be pointed out that tourist development is one of the most important foundations of the Cuban development strategy in the 1990s. If the return in hard currency from tourism is envisaged to be greater than that from the scale fisheries on the shelf (which is likely), habitat degradation is likely to continue. Claro also pointed out that, although catches on this shelf had been increasing, their composition had been changing in recent years to, on the one hand, highly productive but low value species such as Atlantic thread herring and, on the other, slow growing but previously unexploited species such as skates and rays. As a result of such changes in species composition, the value of the catch was decreasing.

While no statistics are available for the proportion of juvenile fish in catches in the late 1980s and early 1990s, the unease persists. The shrimp bycatch was of continuing concern to Cuban researchers but decreases in shrimp catches and the closure to fishing of shrimp nursery areas which are shared by juvenile fish may lead to some amelioration of this problem. However, more disquieting for the future of scale fish stocks, is the fact that, according to CIP scale biologists, the selective devices described above (corona selectora and vivero selector), in spite of regulations, were not, in fact, widely employed in the fishery.\(^1\) The possibility of growth overfishing, therefore, persists in the

\(^1\) When I asked the three CIP scale fish biologists about the use of these devices, they laughed.
scale fisheries.

16. 1. 6. 2 Profitability. It was clear that expansion in catches and, hopefully, revenues, could no longer be relied upon to improve the economic situation of the scale fisheries and that, as in the shrimp fisheries of the early part of the 1980s, the question of productivity would have to be addressed. The study of costs in the enterprises involved in scale fisheries did not provide a very encouraging picture. Utilization of the fleet in terms of days at sea averaged 46.9% of the planned total, ranging from a high of 59.6% in Santa Cruz del Sur to a low of only 35.5% in Guantánamo (Fig. 16.7). In 1989, the fleet spent 131,542 vessel-days at sea so that, on average, each vessel spent 162 days at sea in that year, or 14.7 days per month. While not strictly comparable, it should be noted that the average number of days at sea for the co-operative fleet of the 1960s as a whole was 160 so that little improvement seems to have been made in the temporal utilization of vessels. Crew work schedules called for 10 days work alternating with five days of rest so that, all other things being equal, vessels should have been able to spend approximately 20 days per month at sea. However, vessels tended to spend more time in port as a result of the necessity for repairs and problems in the boatyards. In addition, it seems, trips were shortened because of lack of ice for preservation of the catch. In a 1993 interview with three scale biologists, it was suggested that 80% utilization or 16 days at sea per month was considered to be a successful use of vessels. The report proposed an increase to 177-185 days at sea per year and suggested that it might be accomplished by co-ordinating crew rest periods with vessel repair schedules and by constructing new ice plants. More efficient use of the fleet might also have been accomplished by assigning more

Their superior, M. H. Obregón, was more circumspect but still gave the impression that these devices had fallen into disuse.
Fig. 16.7. Completion of Planned Days at Sea by Enterprise: 1989
than one crew, working in rotation, to each vessel.

Given the spatial misallocation of the fleet noted previously, with vessels often travelling far from their home ports (e.g. from La Coloma on the western Gulf of Batabánó to the Diego Pérez Key on the east) the actual fishing time for vessels must have been quite low. Such misallocation also added to fuel costs in the fleet. Once again, the solution proposed was the introduction of enterprise fishing zones which were designed on the basis of such factors as the history of areas utilized by enterprises, provincial boundaries and enterprise zones in the lobster fishery. The zones proposed were not quite exclusive (the western part of the southwest shelf [zone B₃] for example, was open to the enterprises of Batabánó, Matanzas and Cienfuegos) but their introduction would have resulted in some degree of spatial rationality and cost-reduction.

Other costs in the fisheries were a source of problems. For example, in some years, the total value of fishers' salaries was higher than the value of the catch and, in fact, between 1988 and 1989 salaries rose while the value of the catch decreased (CIP, 1991: Fig. 11).¹ Repairs and raw materials, involving spare parts and items such as net mesh which had to be imported using hard currency, also added to costs in the scale fisheries.

The CIP researchers attempted to summarize the profitability of the fisheries using several indices which are shown in Fig. 16.8. The average ratios of cost to catch value were as follows: 1.5 to 1 per vessel; 1.7 to 1 per day at sea; 1.75 to 1 per ton produced; and, summarizing all costs and revenues, 1.77 to 1 per peso earned, a rather disastrous situation. As can be seen from Fig. 16.8, there was considerable variation from enterprise to enterprise in these indices but no enterprise showed profitability in its scale fishery

¹ The report does not supply an explanation for this discrepancy.
Fig. 16.8. Value and Cost of Production
c. Per Ton Produced

- Value
- Cost

D. Cost per Peso Earned

Cost per Peso Earned

Fig. 16.8. Value and Cost of Production
operations. It would be interesting to examine the profitability of enterprises by shelf but the data supplied in the report summary is aggregated by enterprise rather than by establishment and, as noted previously, some enterprises operated on more than one shelf. It is interesting to note, however, that the enterprises of Santiago de Cuba (2.19) and Guantánamo (3.43), both situated on a coast with an extremely narrow shelf, had the worst cost to revenue ratios in the country. The report authors employed a Schaefer curve to examine the relationship between revenues and costs in the fisheries (CIP, 1991: Fig. 9). Since the equilibrium point between the two (the theoretical open-access equilibrium) was to the left of the top of the curve, they came to the conclusion that, because of the low value of catches, the price system and the structure of the industry, it was not possible to achieve MSY profitably.

There is no question, then, that the scale fisheries, operating at a catch level of MSY, were not only not profitable but must have been a drain on resources which might have been directed elsewhere. It must be remembered, however, that the objective in Cuban fisheries up to this time, was not to operate at MEY but, as has been described, at some, as yet undefined OSY. As Mena noted in 1985, the main objective in the development of the Cuban fishing industry was not obtaining profits but producing food for the population and generating employment. It may be said, therefore, that the scale fisheries were successful in meeting declared objectives. However, whether the resources employed in subsidizing the fishing industry could have been more economically and socially better employed in other sectors of the economy does not seem to have been a subject of study in Cuba at the time. It seems, however, that the financial situation of the fisheries in the late 1980s was such that it could no longer be ignored. On the cost side, the
CIP report proposed a reduction of 158 vessels in the scale fleet,¹ the assignment of fishing zones, rationalization of vessel engines, measures to improve the number of days at sea, elimination of inefficient gear and payment by fishers for the costs of fuel, food, gear, ice and bait. It also recommended the elimination of the enterprise of Santiago de Cuba from these fisheries along with one of the two northwest shelf establishments (Arroyos de Mantua or Puerto Esperanza) of the enterprise of Pinar del Río. On the revenue side, it suggested changes in the price structure and re-orientation of the fisheries toward unexploited resources of the shelf edge. The emphasis was, however, on cost reduction.

According to Obregón (1993), MIP accepted 80% of the recommendations of the report in 1991 but these did not include the closure of inefficient establishments. Catch levels were maintained with 124 fewer vessels and overall cost/value ratio was reduced by $0.03/peso earned for a total saving of $4 million out of an annual cost of about $30 million. Progress in improving the economic situation of the scale fisheries was, however, interrupted with the abrupt and substantial decrease in the delivery of oil from the Commonwealth of Independent States to Cuba which, along with other problems consequent upon the dissolution of the Soviet Union, resulted in the imposition of the "Special Period in Peacetime" in 1991. The fuel situation in the country became so dire that the more inefficient enterprises were removed from the scale fisheries and, in the spring of 1993, the entire scale fleet ceased fishing while all available fuel was diverted to the export-oriented fisheries.² CIP biologists (Interview, 1993) were confident that

¹ Fishers put out of work went to other vessels, replaced retiring ones, were given work elsewhere in the industry or in other sectors such as agriculture.
² This meant, especially, the lobster and shrimp fisheries. It is not clear whether the fishery for small tunas continued to operate.
this was a temporary measure but the fuel situation in the country at the time of writing (mid-1995) had not improved and seems in fact to have deteriorated so it is improbable that these fisheries have resumed operations at their former scale. This cessation or reduction of operations may have unanticipated beneficial effects on over-exploited populations of the more valuable species.

The scale fisheries of the Cuban insular shelf in the 1980s suffered from numerous problems. Increases in effort during the decade accompanied by habitat destruction and the reluctance of fishers to employ selective gear resulted in overfishing of more valuable species and a progressive displacement of effort toward the exploitation of less valuable species. The biological impact of such actions was revealed in changes in the species composition in fish assemblages. The economic situation of the fishery was distinctly unhealthy. On the revenue side, while the overall catch level remained in the proximity of MSY, the value of the catch must have declined along with changes in its species composition. Costs increased with growth in effort, fuel costs and wages. As a result, no fishing enterprise operated profitably in the scale fishery, although some reduction in costs was reported in the early 1990s. The situation of the scale fisheries in the 1980s indicates that they may have been employed as an "employer of last resort" for fishers displaced by the rationalization of the more valuable lobster and shrimp fisheries. Such a policy would have been in accordance with the fisheries objectives for the country and may have made economic sense in remote areas of the country where fishers' opportunity costs were low, but whether such displaced fishers could have been more effectively employed in other economic sectors does not appear to have been a subject of study.
16.2 THE TUNA FISHERY

Landings in the tuna fishery, after reaching a peak of 2,774.4 mt in 1976, shared in the abrupt decrease experienced by other fisheries in the late 1970s (Fig. 12.10). The average catch for the period 1981-1985 fluctuated somewhat and at 1,874.9 mt was some 360 mt less than that for 1976-1980. The larger part of the catch was made in the traditional fishing area (the southwest and the northwest zones) with a lesser amount coming from the the northeast zone. In the early 1980s some 60 vessels (mostly wooden Cayo Largos with some adapted ferrocement scale vessels) operating from seven establishments (LaColoma and Nueva Gerona on the southwest shelf, Arroyos de Mantua and Puerto Esperanza on the northwest and Caibarién, Punta Alegre and Nuevitas on the northeast) were involved in the fishery (CIP, 1981). The fleet as a whole was relatively old, with an average vessel age of 15.3 years (CIP, 1981: 5).1 Fishing gear and methods remained essentially similar to those in use since the beginning of the fishery.

16.2.1 Problems in the Fishery

Unlike the situation in the other fisheries, the decrease in catches in the late 1970s does not seem to have been a result of overfishing, at least of the principal species. Baisre and Páez (1981: 33) considered that stocks of skipjack and blackfin were, in fact, underexploited. However, a study conducted in 1981 (CIP, 1981a) found a number of problems in the operation of the fleet. The number of days at sea per vessel per month ranged from only 11.1 to 18.3 for an average of 15.6.2 This low fleet utilization rate was

1 Six vessels in the Pinar del Río combine were greater than 20 years of age and one "criollo" vessel, the 'Sorpresa' of the Nuevitas establishment was 67 years old (CIP, 1981: 5).
2 It is not at all clear from the report whether these data refer to the total number of days at sea including travelling time to and from the fishing grounds or to days actually spent fishing. The term "days at sea" (días mar) is employed in most of the report. However, "days fished"
ascribed to such factors as poor weather, lack of spare parts and maintenance but, as in the previous period in the history of the fishery described in Chapter 12, scarcity of bait and lack of "bite" (see page 222) were the most serious problems.

The continuing scarcity of bait in the fishery, according to Carles (1993), was a regional problem which was most severe on the southwest shelf where the largest number of vessels operated. It seems likely, therefore, that overfishing may have been a contributory factor to the scarcity, but natural environmental changes and the types of habitat alteration described in the scale fishery section of this chapter may also have had an impact on stocks of these small pelagic fish.

Lack of bite is a rather more complex problem. In this fishery, a school of tuna must be found for fishing to take place. As we have seen, fishers' experience is very important in this operation. On the western shelves, especially the southwest, so-called "residential" schools could be found in places where, for example, local upwelling provided a fairly stable food supply for the tuna. Fishers could find these locations by dead reckoning and coastal triangulation. Those operating from ports on the north central and northeast shelf, where some stocks were more migratory, sometimes had to range further (up to 20 miles) to find schools marked by accompanying sea birds. However, on all shelves, location of a school of tuna did not necessarily result in a "bite" occurring and it often did not. Valle (1991) stated that of 20 or 25 schools sighted, only two might have been fished.

(días pescado) is used at least once (p. 2) and the description of the causes for the low utilization rate implies that this is what was being measured. It is assumed here that this is the case.
16.2.2 Developments in the 1980s

It is not possible to speak of a "new management regime" in the tuna fishery. As noted previously, the only regulation which existed in the 1980s was a minimum legal size dictated more by processing needs than by biological necessities. It seems, in fact, that adults and juveniles of the species involved exhibited different spatial distributions so that the incidence of the former in catches was not high. Catch bureaus were introduced but functioned more as research, than as regulatory or management bodies (Valle, 1991). One of their most important tasks was to collect accurate statistics, not only about the catch but also about the bait fishery and the number of schools sighted and the incidence of the bite. According to Valle (1991), however, there was some resistance to this record keeping, fishers asserting that they were paid to fish, not to write.

A great many avenues of research were initiated to attempt to deal with the problems described above. With respect to the bait problem, several experiments were conducted: in fishing at night with lights using Japanese lift nets (bouke-ami nets) (Valle, 1991); in constructing and employing octagonal wooden tanks for storing bait in centralized locations in fishing areas for longer periods of time than they could survive in tanks on board vessels (CIP, 1980); and in introducing pumps on vessels to circulate water in the bait tanks (Carles, Cárdenas, Alpízar, 1991). In all cases, these experiments were successful in increasing the survivability of bait but none of them were introduced into the fishery, possibly because of fisher resistance, this being, in spite of its relatively short history, the most traditional of Cuban fisheries. However, it is more likely that the principal reason was the cost involved in introducing such innovations into the fishery. All such experiments were suspended with the introduction of the Special Period in Peacetime in 1990.
and finding bait continued to be a severely limiting factor in the fishery.

The location of schools of tuna continued in the traditional manner. The spatial concentration of migrating pelagic fish like tuna can be manipulated to some extent by the use of fish attracting, or aggregating, devices (FADs), "structures that create floating artificial habitats which are suspended at the surface, slightly below the surface, or in midwater between the surface and the bottom" (de Sylva, 1981). Such devices have been employed successfully in many parts of the world but although Cuban tuna specialists were familiar with them, there were no plans to test them in local waters (Carles, 1993).

As noted previously, an increase in the bait supply might have helped to increase the length of the bite. Another strategy to deal with this problem is to increase the number of fish caught when a school is biting. As we have seen, it had been suggested previously that the number of fishers per vessel be increased and that they be accommodated by extending the fishing gallery further forward along the sides of the vessel. The average number of crew members in some establishments was as low as 7.2 in the early 1980s (CIP, 1981). In the later 1980s, a new, larger vessel with a forced water circulation system that could accommodate 14 fishers was designed. However, it was not built.

Some degree of apparent spatial irrationality persisted in the fishery. On the northwest shelf, for example, it was found that 40% of the effort of the Puerto Esperanza fleet was concentrated in one statistical square close to the port. In addition, 73.5% of effort in that square was expended in one fishing area (Carles and Valle, 1992). The Arroyos de Mantua fleet also concentrated 38.6% of its effort in one nearby statistical square. Carles and Valle (1992: 7)
concluded that "In general, fishing effort in the northwest zone has not been suitably applied in relation to the squares with better yields, especially in the area of Puerto Esperanza." The investigators blamed this on poor management in the establishments in question and on the fact that vessels made daily trips from the port and could not, therefore, make trips to more distant fishing areas. The possibility exists, however, that exploiting nearby squares represented rational behaviour on the part of fishers. It may well have been more profitable to fish there than in more distant ones (even with higher tuna densities) that would have involved more travelling time and higher costs.

Effort in the small tuna fishery experienced a general decline during the 1980s, after reaching a maximum of 86,642.9 fisher days at sea in 1982. This was partly a result of the fact that the number of vessels engaged in the fishery peaked at a national total of 69 in 1980 and thereafter declined to 55 in 1988. As was the case with the other scale fisheries, operations of the tuna fleet were suspended in the spring of 1993. It is not known at the time of writing whether they have resumed.

The apparent decline of the tuna fishery in the 1980s had several sources. The scarcity of bait fish, difficulty in locating tuna schools and the lack of "bite" persisted. Mechanisms were investigated to deal with these problems but it may be that the revenue obtained from the fishery was not sufficient to justify the expenditures necessary to introduce and disseminate them. Poor management at the level of the establishment led to temporal and spatial misallocation of the fleet, itself composed of aging vessels. The fishery of the 1980s presents an overall impression of a sector subject to a degree of neglect.
PART VI

SUMMARY AND CONCLUSIONS
CHAPTER 17
SUMMARY AND CONCLUSIONS

This dissertation has described the marine resources of the Cuban insular shelf in their ecological setting and has documented the history of their exploitation from aboriginal times to the present. It has also presented an evaluation of the degree of success achieved by Cuban collectivist organization in avoiding the "Tragedy of the Commons" in the shelf fisheries.

Cuba is fortunate among Caribbean insular states in the large extent of its shelf, an area of relatively high productivity within tropical seas. Within it, three ecological complexes with associated marine resources were identified. The estuarine-littoral complex, subject to intense riverine influence, is occupied by fast-growing species, such as shrimp and mullet, which are able to adapt to a rich but highly fluctuating environment. Further from terrestrial influence, the coral reef-seagrass complex shows much greater stability in its physical parameters and its inhabitants, like lobsters and demersal snappers and groupers, are relatively slow-growing and longer-lived than species of the estuarine-littoral complex. The third complex, the oceanic waters close to the shelf edge, is characterized by low productivity and highly migratory species such as skipjack and blackfin tunas and the billfishes. The varied distribution of the three ecological complexes gives each of the four relatively isolated parts of the shelf, distinctive physical and ecological characteristics and, therefore, a different mix of exploitable marine resources.

Archaeological evidence and the historical record of the observations of the first Spaniards to reach Cuba indicate that all aboriginal peoples in the
archipelago exploited the marine resources of the shelf, and that the later Agricultural groups did so using sophisticated vessels and a complex array of fishing gear. Their tools and techniques allowed these people, inhabiting permanent settlements, to expand fishing operations from the nearshore estuarine-littoral complex into the more distant coral reef-seagrass complex. Their impact on marine populations, given their small numbers, was probably restricted to the local scale.

Spanish occupation of the archipelago proved to be disastrous for its aboriginal occupants. Whether their rapid disappearance was a result of their susceptibility to Old World diseases and the brutal treatment they received at the hands of the Spaniards or of inter-marriage, miscegenation and assimilation, or some combination thereof, remains undiscoverable. But disappear they did, and, along with them went most of their knowledge of shelf resources, and their fishing gear and techniques, leaving behind only a few fish names and possibly the canoe.

A combination of Spanish dietary preferences for meat and slow population growth meant that shelf resources, with the exception of turtles and manatees, remained almost untouched for some four centuries after the Conquest. When fishing resumed in the mid-nineteenth century it was conducted by immigrants from the Canaries, Mallorca and coastal areas of the Iberian peninsula, and was thoroughly Spanish in character, containing little, if anything, from the aboriginal past. During this late colonial period a consumption pattern of fish, typical of Caribbean slave societies, developed in Cuba: rural peoples, including slaves, ate cheap imported dried or salted cod while the urban upper class consumed fresh fish and shellfish. The demand for the latter was concentrated in Havana and it was satisfied by fisheries on the southwest and northeast shelves, and by expansion outside of the
archipelago to the Dry Tortugas, Florida and Campeche Bank.

In spite of development in the late-colonial period, fishing remained a relatively unimportant economic activity until the enactment of the Customs-Tariff Law in 1927, aimed at stimulating industrial development within the economy. Under its protection, canneries for lobster and tuna were built. Fisheries development continued during and after World War II. Of special significance was the introduction of industrial fishing methods into the shrimp fishery. Havana and the provincial capitals continued to be the main domestic markets and the United States became the most important export market for Cuban fish products.

During this period, government attention began to be directed, however sporadically, to the fisheries. A General Fisheries Law, which remained in force until 1981, was enacted in 1936. In the late 1940s and 1950s, attempts were made to create fishers' cooperatives, a distant-water trawler was purchased, the National Fisheries Institute and Fisheries Research Centre were established and work was begun on a fisheries terminal in Havana.

The examination of the fishing industry in the immediate pre-revolutionary period presented in Chapter 9 demonstrated that fishing in Cuba was not the type of traditional subsistence activity common in developing countries with large fish-eating populations. It was, on the contrary, largely commercially-oriented to domestic urban markets, and to an export market, especially in the United States, for high value species. It is true that, apart from the shrimp fleet, the level of technology in both vessels and gear was low and many fishers and their families lived in poverty in isolated communities. However, many also enjoyed urban rather than rural living standards and the fishery appeared to be in the early stages of a transformation toward more intensive exploitation of high value species for
export markets.

The Revolution in 1959 resulted in a quantum leap in government intervention in all aspects of the Cuban economy, including the fisheries. However, although collectivization increased, it did so not immediately but in stages that had little to do with the fishery and a great deal to do with ideological shifts among the political leadership about the development strategy and organization of the economy in general, complicated by the idealistic attempt to transform the Cuban people into "New Men". In spite of some confusion, a two-pronged fisheries strategy was developed: cheap protein was to be supplied to the Cuban people by a distant-water, industrial trawler fleet; and the shelf fisheries would concentrate on the exploitation of high value species for export.

In the early post-revolutionary period, a number of measures were introduced to improve the lives of fishers and to ensure delivery of good quality marine products throughout the country. Housing was built for fishers and their families and the processing sector and most of the retailing sector was nationalized. The industry was subject to scientific evaluation by foreign experts under the auspices of the FAO and of the Soviet Union and allied nations, and modernization began in the fishing fleet and in shipyards and port facilities. For the first decade after the Revolution, the shelf industry was mixed in nature with private fishers working alongside members of new government sponsored cooperatives. However, cooperatives and private fishers were eliminated and replaced by fishing combines in the complete nationalization of the economy which occurred in 1968 as part of the Revolutionary Offensive.

Paradoxically, at precisely the time when the Cuban state finally became the sole owner of the means of production in the shelf fisheries, official
attention and scientific research were focussed instead on the distant-water fisheries. While the importance of the high value export fisheries on the shelf for generating earnings in convertible currency was recognized, management of the fisheries was neglected. Capital was invested in modernizing the various shelf fleets, innovations in fishing gear were introduced and spread throughout the shelf and, as a result, effort in the fisheries increased, apparently, without constraint. The result was that, in spite of state ownership and control, the fisheries came to operate like open-access fisheries the world over. Externalities abounded until abrupt drops in catches in the late 1970s warned of stock depletion in the most important fisheries. At the same time, widespread introduction of 200 nm limits by most coastal states in 1977 and the subsequent exclusion of Cuban distant-water fleets from most of the areas where they had been fishing, resulted in a reappraisal of the fishing strategy which had been in force since the early 1960s. In spite of fishing agreements made with some coastal states, the marine resources of the shelf gained in relative importance in the Cuban fishing strategy precisely at a time when, it appeared, they were being exploited at or even beyond, sustainable limits, and without any regard to costs.

In the first two decades after the Revolution, the lot of fishers and their families improved substantially, partly as a result of a general improvement in living conditions for all of the population living in rural and remote areas but also because of policies directed specifically at the fishing sector. While such improvement would probably have occurred, in time, without the Revolution, it would likely have been restricted to those fishers involved in the high value fisheries and would probably not have spread to the more remote fishing communities in the archipelago. This widespread rise in the living standards must be considered a positive achievement.
The Cuban authorities can perhaps be criticized for investing scarce resources in a large distant-water trawler fleet but it must be remembered that they were not alone in misjudging the future of such fisheries. The early 1960s were a time of widespread optimism about the potential of the world's marine resources to feed hungry populations at relatively low cost, and many countries, developed and developing, invested in such fleets. Much stronger criticism can be directed at the neglect of scientific research and management and the consequent unconstrained growth in effort which occurred in the valuable shelf fisheries. Bioeconomic analysis of the fishery, as we have seen, had been developed before this time and was widely available in the fisheries literature. However, it is possible that those scientists involved in the shelf fisheries, being mainly biologists, may not have been immediately convinced of the utility of operating a fishery at MEY. It is also possible that they, or the authorities, may have mistakenly thought that the goal of generating as much in hard currency earnings as could possibly be extracted from the shelf fisheries required that they should fish as hard as possible. Adoption of MEY as a fisheries goal may also have been prevented by ideological constraints at the policy level against what may have seemed like capitalistic ideas. Whatever the reason or reasons, it is clear that development of the shelf fisheries in the first two decades after the Revolution was influenced as much, if not more, by wider national economic development policies and ideological shifts than by a carefully considered, centrally-planned fisheries management strategy. While the catch from the insular shelf grew during this period there is no way to ascertain the cost, either in strictly financial or in societal terms, at which that growth was obtained.

The evaluation of the major fisheries presented in the latter part of this dissertation indicates that the Cuban command economy was able to respond
with some speed to the crisis faced by the shelf fisheries in the late 1970s. This is not to say, however, that the measures taken were applied equally successfully in all of the fisheries nor that they were always appropriate.

The shrimp fishery was the leader in management innovations some of which, such as the catch bureau, were also introduced into the other fisheries. A real-time management system was introduced along with a number of other regulatory measures. In a demonstration of an important advantage possessed by the command economy, effort in the fishery was reduced substantially in a very short period of time without the necessity for the type of expensive buy-back scheme typical in countries with free-market economies. Displaced workers, it should be noted, were not simply discarded but replaced retired ones, were employed in other fisheries or other parts of the industry, or in other economic sectors. As a result of all of these measures, recruitment in the fishery was restored.

The problem of growth overfishing, which had characterized the fishery in the 1970s, was overcome to some extent by a more rational spatial and temporal allocation of effort towards areas where catches could be made with more nearly optimal size composition and, therefore, value. However, the small mesh size of Cuban shrimp nets in comparison with those of shrimp fisheries in some other countries and the rather large percentage of small shrimp allowed in catches, indicate that growth overfishing may still be occurring in the fishery.

The economic situation in the fishery was not ascertainable with the available information. In the early 1990s, no study had yet been carried out of the cost structure in the fishery and this must be considered a serious deficiency in the management system. In the 1980s, the total catch fell, probably as a result of a combination of long-term environmental changes
and local habitat damage. Whether the reduction in costs consequent upon the cuts in effort which occurred during the decade, along with the improved size-composition of the catch were sufficient to offset this decrease, is unknown but it is clear that without these measures the economic situation in the fishery would have been much worse. While it is not known where, in relation to MEY, the Cuban shrimp fishery is operating it is probable that it is in as good, if not better, economic condition than most others in the world.

Unlike the shrimp fishery, the lobster fishery was subject to substantial increases in effort during the 1980s, a consequence, it appears, of a need to generate as much hard currency as possible from this, the most valuable fishery in the country. In spite of such increases, catches fell in the late 1980s and the fishery "collapsed" in 1990, partly as a result of the impact of Hurricane Gilbert in 1988. These events, coupled with the rather small minimum legal size in the Cuban fishery compared with that in other countries, raised the possibility that recruitment overfishing was a danger to the fishery. As with the shrimp fishery, economic data for the lobster fishery are not available. It is certain that revenues in the fishery are well known, if not published, but costs have not been subject to study. However, a comparison with the lobster fishery in West Australia has indicated that, while catches in both fisheries are similar, the Cuban fishery has much lower average costs and probably generates considerable resource rent. A further comparison with the disastrous condition of the lobster fishery in Florida suggested that tight regulation found in the Cuban fishery is a necessity for success in the exploitation of such valuable marine species.

The Cuban lobster and shrimp fisheries, then, while perhaps not operating at MEY, seem to have made contributions to the economy of the country by generating revenues in hard currency at costs which are low
compared to those in such fisheries in other countries. The situation in the scale fisheries, however, is much more similar to that of open access fisheries in other parts of the world. Biological overfishing during the 1970s was compounded by excessive increases in effort, the use of gear with very low selectivity and habitat destruction during the following decade. Overfishing of valuable species led to changes in the structure of fish assemblages and to a consequent progressive displacement of effort toward species of lesser value.

The economic situation in the scale fishery was disastrous. In this, the only fishery which has been subject to economic analysis, no enterprise operated profitably and the whole must have been subject to heavy subsidy from other sectors of the fishing industry, if not from the economy in general. The explanation for the fact that such a poor economic performance was tolerated in the scale fisheries probably lies in the fact that full employment was a fundamental tenet of Cuban ideology. The scale fisheries then, were probably being employed as an "employer of last resort" both to absorb fishers displaced by the rationalization of the export fisheries and to ensure continued employment in remote communities. While the Cuban authorities can be criticized for not attempting to discover whether such workers could have been more effectively employed in other economic sectors, the fact that the scale fishery was the first in the country to be subject to economic analysis may indicate a first move in that direction.

It is clear from the above summary of the fisheries in the last decade and a half that the Cuban command economy has not successfully eradicated all negative externalities from the shelf fisheries. In the push for hard currency revenues, especially in the current dire economic circumstances in which the country finds itself, the temptation to increase pressure on stocks, compounded by environmental change and habitat damage, means that stock
externalities (biomass reduction, growth and recruitment overfishing) remain a concern for the future. On the other hand, excessive competition, along with the concomitant race for fish and distortion of factor inputs, seems to have been reduced in the export fisheries without at the same time removing incentives for individual vessels and crews to continue to work efficiently. In addition, the economic condition of the export fisheries with their high revenues, low costs and consequent generation of resource rents gives some cause for optimism. It is to be hoped that the type of economic analysis to which the scale fisheries were subject in the early 1990s will be expanded to the other fisheries so that more rational allocation of resources, within the framework of the fisheries objectives of the country, may be achieved.

The major danger for the future is that the present government falls and that a free enterprise economy is reintroduced to the country by exiles returning from the United States. Given the political leanings of many of the power brokers in the exile community such an economy would not likely be characterized by a great degree of state intervention. However, as we have seen, such intervention is crucial in the case of the fishery and, if it were eliminated or even reduced, the situation would be disastrous for the shelf fisheries. In addition, if the shelf resources are made available to recreational fishers and if, as has been suggested, Cuban exile fishers in the United States are given the right to return and participate in the fishery, there is no doubt that the shelf fisheries would quickly be reduced to the same sorry state as that of fisheries in Florida.
APPENDIX I
RESEARCH IN CUBA
As noted in the introduction, the Cuban shelf fisheries have not been the subject of much research by foreign investigators. In order to do justice to the subject, therefore, research in Cuba was a crucial component of this dissertation. Ideally, it would have been carried out during a prolonged stay in the country so that contacts among fishers, fisheries scientists, and Ministry personnel could have been cultivated. Unfortunately, because of my full-time teaching duties at a community college, this option was not open to me, and my time in Cuba was restricted to relatively short visits in 1990 (7 weeks), 1991 (4 weeks) and 1993 (6 weeks). The visits were arranged under the terms of an agreement for research interchanges between Simon Fraser University and the University of Havana. There follows brief accounts of each of these visits.

1990

Bibliography Search

In June, July and August of 1990, I spent approximately 7 weeks in Havana. During my stay, I was formally attached to the Marine Research Centre (Centro de Investigaciones Marinas, CIM) of the University of Havana. The trip had two major objectives: a bibliographical search for information on the Cuban shelf fishing industry; and field observation of fishing boats, catch techniques and processing plants. The first objective was accomplished, if not entirely in the way I had envisaged; the second was not.

Within a few days of my arrival, the director of CIM (Dra. María Elena Ibarra Martín) supplied me with a letter of introduction requesting, on my behalf, the co-operation of scientific and technical information centres. This allowed me access to libraries, such as that of the Ministry of the Fishing Industry (Ministerio de la Industria Pesquera, MIP), which would not
otherwise have been open to me. Most of my work was done in this library, in the National Library (Biblioteca Nacional, BN) and those of CIM and the Institute of Oceanography of the Academy of Sciences (Instituto de Oceanografía, IO).

Since my total time in Cuba was limited and since I believed that part of it would be taken up by visits to fishing ports and processing plants, my aim was to review as much material as possible and to obtain copies of those papers, documents, etc. which appeared to be relevant to my thesis. While I still believe that this was a reasonable approach certain features of the library system, described below, caused some problems and, from time to time, led to a degree of frustration on my part.

Firstly, none of the libraries in which I worked had open-access collections. Books, journals, etc. were obtained by filling out a form, usually in duplicate (with carbon paper) and handing it to a counter employee who processed it and sent it off for the item to be found. Waiting time was never less than 20 minutes and often more than 30. The average success rate was about 85% and it was often difficult to find out the reason for unfilled requests. A simple,"It isn't here" was the commonest explanation.

Secondly, copying was a problem. There were no public copying machines or services in Havana. Many institutions possessed a copying machine but it was usually located in the office of someone important and was used sparingly. In one instance I was forced to copy a set of very important statistics by hand, a task which took about a total of 30 hours. The National Library possesses a microfilm service which consists of one microfilm camera and one operator. The cost at the beginning of my visit was US $0.05 per page but this was raised to $0.50 U.S. at the end of July. Unfortunately, the National Library possesses only a small collection of
materials of relevance to the fishing industry. However, I was able to persuade the person in charge of the microfilm department to copy materials, delivered by me, from other libraries. On the face of it, this was a fairly straightforward solution but in operation it proved to be rather complicated.

Thirdly, only one of the libraries (MIP) allowed formal external loans. (I was given permission to make informal loans from the CIM library, a privilege for which I was extremely grateful). The MIP library, which had the most extensive collection of materials with relevance to the fishing industry, allowed loans for a period of 15 days. However, I discovered to my dismay that only 3 works could be borrowed at a time and then only if duplicate copies existed. After some negotiations with personnel in both libraries, I was able to arrange for the National Library to request materials from the MIP library as formal interlibrary loans with myself as designated carrier. This allowed me to borrow 5 works at a time, even if there were no duplicates, a substantial improvement. Each time I made a loan, the full bibliographic information for each work was typed in a letter in a sealed envelope which I then carried to the National Library with the borrowed documents.

Fourthly, the libraries were rather dispersed (See Fig. 1) and bus service in Havana was extremely poor with average waiting times of 20 to 30 minutes. During late July and August, the Cuban vacation period, this was compounded by there being more riders and fewer buses. Waiting times of one hour or more were not uncommon. As a result a great deal of my time was spent either waiting for, or riding on, buses.
Fifthly, I was not the only customer of the microfilm services of BN. In early July, a French researcher had approximately 4,000 pages waiting to be microfilmed. In early August, my work was displaced by that of a Russian researcher who required a dozen complete books to be copied before he returned to Moscow. In late July, the person in charge of microfilming "heard" that I had returned to Canada for a few weeks and, consequently, had given my copying a low priority. However, such delays became irrelevant when, in late July, the air conditioner in the microfilm shop and the water supply, necessary for developing film, both broke down. The result was a cessation of services which had not resumed by the time of my departure.

In spite of the above difficulties, my plans proved to be not wholly chimerical. During my stay, I was able to obtain, on microfilm, approximately 150 (about 4,000 pages) of documents of relevance to my dissertation. In addition, I left another several hundred pages to be microfilmed when work
conditions at the National Library returned to normal. These were later sent to me.

Additional information was obtained through contact with the Institute of Geography of the Academy of Sciences. I had two meetings with Lic. Jorge Ibañez Zamora, the geographer who constructed the map of the fishing industry for the *Nuevo Atlas de Cuba* published in 1987. At the second meeting, after clearance was obtained from the Director of the Institute by Dra. Ibarra, I was allowed to copy, by hand, the statistics upon which the map was based.

**Field Work**

I was not so successful with my plans for visits to the fishing industry to observe fishing techniques, processing plants and other aspects of operations. At our first meeting, Dr. Ibarra indicated that visits to observe fishing in progress, as well as to processing plants, could be arranged. A similar, positive, view was offered by Dr. Julio A. Baisre, Director of Science and Technology, my official contact in the Ministry. I was, therefore, very optimistic that this part of my research would be accomplished. Unfortunately, this did not turn out to be the case and this aspect of my visit became a focal point for a fair amount of stress.

The reasons for this may be seen from my log of official contacts (Fig. 2).

**Fig. 2**

**June**

**Sun 24:**
Arrive in Havana. Told that Dra. María Elena Ibarra (MEI) would like to see me Monday afternoon

**Mon 25:**
To CIM to meet MEI. She was not there. Left note asking for definite meeting time and date.

**Tues 26:**
To CIM at 0800. MEI in office. Talked for 30 minutes. Gave her a copy of my proposal. Positive response.
Thurs. 28:
Received, from MEI, letter of introduction asking, on my behalf, for cooperation of various institutions.
Told to return on 11 July by which date arrangements will have been made with Ministry (MIP) for a programme of visits to the industry.

July
Wed 11:
MIP has not responded to request. Come back Monday 16.

Mon 16:
MIP has not responded. Come back Wednesday.
On my own initiative, obtained an appointment for Tuesday 17 with Dr. Julio A. Baisre, (JB) Director of Science and Technology for MIP, who I had met in the fall of 1989.

Tues 17:
Appointment with JB cancelled. Call tomorrow.

Wed 18:
To CIM. MEI called MIP and obtained approval for my project. She also called JB and arranged an appointment the same day at 1400 h. One hour meeting with JB. Positive response to proposal. Will arrange a visit to a fishing combine including fishing trips for about a week at the end of July/beginning of August.

Frid 20:
One hour meeting with JB. Arranged to return July 30 to find out about arrangements for industry visit.

Mon 30:
To MIP. JB in meeting. Call in the afternoon.
1500 h - called JB. Informed by secretary that he has gone on a trip and that she had not been able to talk to him before his departure.

Tues 31:
Called JB. He will be gone until Thursday. Call Friday morning.

August
Frid 3:
1030 h - called JB. In meeting. Call back.
1630 h - called JB. Not in but will be tomorrow. Call at 1000 h.

Sat 4:
1030 h - called JB. He is in Sancti Spiritus but is concerned about the arrangements for my visit. Call Monday afternoon.

Mon 5:
Called JB. Arranged an appointment for Wed 7th at 0900 h.

Wed 7:
Met with JB. He is trying to arrange a visit to the fishing combine at Batabanó. There is a problem in that many people, including those in authority, are on holiday in August. Took my passport particulars. Call back at 1500 h same day.
1515 h - called JB. Not in his office.
1630 h - called JB. Perhaps a visit can be arranged for following Monday and Tuesday (13th and 14th of August). My departure date is August 15. Call back Friday morning.

Frid 10:
Called JB. Told by secretary that everything had been arranged and awaited only final approval. Call back at 1300 h.
1330 h - called JB. At lunch. Call back in an hour.
1450 h - called JB. No definite word. Call back before 1700 h.
1630 h - called JB. Nothing has been finalized. Call Monday morning.

Mon 13:
1000 h - called JB. No final arrangements. I gave up.

Tues 14:
0900 h - meeting with MEI. Let her know well in advance of my next trip and visit to industry will be arranged. 
1400 h - meeting with JB at MIP. Apologies. Write or fax in advance of next trip and everything will be arranged.

I must emphasize that telephone communication in Havana is problematical in the extreme. The house in which I lived had no telephone. Public telephones do not exist in large numbers and the most reliable ones are found in tourist hotels. However, finding a telephone was no guarantee of completing a call. Both individual telephones and the system, in whole or in part, are subject to frequent breakdowns. A request to call back at a certain time, as a result, often required not only the reorganization of a day's plans but also a fair amount of anxiety about whether contact would even be possible.

My dependence on official contacts should be explained. It is not possible in Cuba to wander freely around fishing ports and docks looking for fishers to interview. The perimeter of each port is marked by a chainlink fence and the entry is commanded by a gatehouse manned by the Guardia Frontera. I had attempted to gain unofficial entry to three fishing ports during the Field School in the Fall of 1989 and was unsuccessful.
In Miami, I visited and worked in the library of the Rosenstiel School of Marine and Atmospheric Science where I obtained a number of valuable reports and articles on Cuban fisheries. While there I was also able to interview one of the library employees who had been a teacher in the Fisheries School in Havana until she emigrated to the U.S. in 1988. Not only did she supply me with a great deal of information about the organization of the Cuban shelf fisheries, she also provided me with a number of names of people in Havana who might be able to provide me with useful information. Through the School I was also able to meet and interview Dr. José Suárez Caabro, who was a prominent fisheries biologist in Cuba before the Revolution and who supplied me with some valuable historical information.

I arrived in Havana on April 21 and took up accommodations at a house for visiting scholars run by the University of Havana. As in 1990, I was formally attached to the Centro de Investigaciones Marinas of the University of Havana.

The goals of my trip were the same as those of 1990: to continue the bibliographical search for information on the fishing industry; and to conduct field observation of fishing boats and processing plants. These goals were accomplished and, in addition, I obtained a number of interviews with fisheries biologists and other officials of the Ministry of Fisheries. My stay in Cuba lasted just over four weeks and proved to be very productive.

Bibliographical Search

I worked mostly in the Ministry library and, as in the previous year, took material to the National Library to be microfilmed. However, after my
experience of the previous year, I did so only after I had translated what I considered to be the most important parts. This proved to be a wise precaution since the microfilm equipment broke down two weeks after my arrival and had not been repaired before my departure. I did not, therefore, obtain as much in the way of reports and papers as I did in 1990 but those that I obtained tended to be more recent and more directly significant to my research. In addition, I left a list of material with the Ministry librarian who promised to send them to the National Library for copying when this became possible. This did not happen.

Interviews

I conducted interviews with Ministry biologists specializing in the shrimp, tuna, lobster and scale fisheries, and with the head of the Department of Regulation. Each of these lasted an hour or more and was recorded for later transcription. These interviews provided the most valuable part of the information obtained during this trip.

Field Work

Dr. M.E. Ibarra, the director of the CIM arranged visits to the fishing industry for me. She also provided me with a car, a driver and arranged for a C.I.M. biologist, Dra. Marízabel Báez, to accompany me and to provide introductions and information. Her help was inestimable. Gas was very scarce in Cuba at the time and the only supply available was for foreigners who could pay in convertible currency. I, therefore, bought the gas for the trips and I suspect that this was a source of some embarrassment to my University of Havana hosts.

On May 14, I was taken to the Combinado Industrial Pesquero (CPI) of Batabanó on the south coast of the province of Havana. Soon after my arrival I conducted interviews with the sub-director and with a biologist attached to
the enterprise. Unfortunately the processing plant was in the process of being relocated and was not in operation. In the afternoon, I was put aboard the shrimp trawler "Albatros" and spent the next 15 hours observing and taking photographs of fishing operations and talking with the crew. This was an invaluable experience.

Two days later, on May 16, I was taken to the CPI of La Coloma to the southwest of Havana in the province of Pinar del Río. Again, I interviewed the sub-director and was given a tour of the enterprise by an official who showed me gear shops, docks, fishing boats, the tuna canning plant and an educational centre established to encourage local young people to become involved in the industry. Unfortunately, it was the closed season for lobster, so I was not able to observe that fishery in action.

1993

I flew from Miami to Havana on May 27 and spent a total of 6 weeks in Cuba. As on previous trips, a great deal of my time was spent in various libraries searching, often unsuccessfully, for papers and reports on the fishing industry. In spite of the severe fuel shortage which existed in the country, the Ministry of the Fishing Industry arranged a visit for me to the fishing port of Caibarién, about 500 km from Havana. Transportation was provided by the University of Havana and paid for by me. While in Caibarién I was able to spend a very valuable day observing fishing operations on a lobster vessel, and visiting a lobster storage centre.

While in Cuba, I also visited the fishing terminals of Havana and Regla and the archaeological museum of the University of Havana and conducted interviews with marine biologists and other fishing specialists.
APPENDIX II

MARINE RESOURCES OF THE CUBAN SHELF
1. Fish

a. Demersal fish

**Lutjanidae**
mutton snapper  pargo criollo  *Lutjanus analis*
grey snapper  caballerote  *L. griseus*
Cuban snapper  cubera  *L. cyanopterus*
lane snapper  biajaiba  *L. synagris*
yellowtail snapper  rabirruba  *Ocyurus chrysurus*
blackfin snapper  pargo del alto  *L. bucanella*

**Pomadasidae**
yellow grunt  ronco amarillo  *Haemulon sciurus*
common grunt  ronco ará  *H. plumieri*
sailor's choice  ronco blanco  *H. parraei*
margate  jallao  *H. album*
bronze grunt  jeníguano  *H. aurolineatum*
black grunt  ronco prieto  *H. bonairense*

**Serranidae**
Nassau grouper  cherna criolla  *Epinephelus striatus*
red grouper  cherna americana  *E. morio*

**Mugilidae**
mullet  lisa or lebrancho  *Mugil liza*
striped mullet  lisa cabezuda  *M. cephalus*
white mullet  liseta  *M. curema*
                        lisa blanca  *M. trichodon*
                        
**Gerreidae**
grey mojarra  mojarra  *Gerres cinereus*
Plumier's mojarra  patao  *Eugereis plumierii*

b. Neritic fish

**Clupeidae**
Spanish sardine  sardina española  *Sardinella aurita*
red-ear sardine  sardina de ley  *Harengula humeralis*
Atlantic thread herring  machuelo  *Opisthonema oglinum*

**Scombridae**
king mackerel  sierra  *Scomberomorus cavalla*
Spanish mackerel  serrucho  *S. maculatus*
painted mackerel  pintada  *S. regalis*
c. Oceanic pelagic fish

**Engraulidae**
anchovy
boquerón
*Engraulis japonicus*

**Carangidae**
jack mackerel  
Crevelle jack
jurel  
jiguagua  
conjinúa  
cibí amarillo  
cibí carbonero
*Caranx sexfasciatus*  
*C. hippos*  
*C. cryus*  
*C. bartholomaei*  
*C. ruber*

**Engraulidae**
anchoy
boquerón
*Engraulis japonicus*

**Scombridae**
skipjack tuna  
blackfin tuna
bonito  
albacora
*Katsuwonus pelamis*  
*Thunnus atlanticus*

**Squalidae**
white shark  
mako shark
jaquetón  
dientuso azul  
jesuita  
zorro
*Carcharhinus falciformis*  
*Isurus oxyrinchus*  
*Carcharhinus signatus*  
*Alopias superciliosus*

white tipshark  
tiger shark  
dusky shark  
blue shark
*Prionace glauca*
*Carcharhinus altimus*

**Istiophoridae**
sailfish  
blue marlin  
white marlin
aguja de abanico  
castero  
aguja blanca
*Istiophorus platypterus*  
*Makaira nigricans*  
*Tetraprurus albidus*

**Xiphiidae**
swordfish
emperador or  
pez espada
*Xiphias gladius*

2. Crustaceans

**Crustaceans**
common, spiny or  
Caribbean lobster
langosta común
*Panulirus argus*

pink shrimp  
white shrimp
 camarón rosado  
camarón blanco
*Penaeus notialis*  
*Penaeus schmitti*

3. Crabs

**Crabs**
stone (moro) crab
land crab  
blue crab

cangrejo moro  
cangrejo de tierra  
jaiba azul
*Menippe mercenaria*  
*Cardisoma guanhumi*  
*Callinectes sapidus*
4. Molluscs
conch
cobo
Strombus gigas
mangrove oyster
ostión
Crassostrea rhizophorae
zebra clam
almeja
Arca zebra

5. Sponges
sheepwool sponge
esponja hembra
Hippostrongia lachne
yellow sponge
hembra aforada
H. gossypina
grass sponge
macho fino or
Spongia obliqua
macho
cabo cueva
S. graminea
macho amarillo
S. barbara
macho guante
S. cheiris

6. Turtles
loggerhead turtle
caguama
Caretta caretta
hawksbill turtle
carey
Eretmochelys imbricata
green turtle
tortuga verde
Chelonia mydas
leathery turtle
tinglado
Dermochelys coriacea
I CRUSTACEANS

LOBSTER, *Panulirus argus*
WHITE SHRIMP, *Penaeus schmitti*

PINK SHRIMP, *Penaeus notialis*
LAND CRAB, *Cardisoma guanhumi*

STONE CRAB, *Menippe mercenaria*

BLUE CRAB, *Callinectes sapidus*
II MOLLUSCS

CONCH, *Strombus gigas*

CLAM, *Arca zebra*
MANGROVE OYSTER, *Crassostrea rhizophorae*
III Fish

MULLETS

MULLET, *Mugil liza*

LISA DE ABANICO, *Mugil trichodon*
MOJARRAS

PLUMIER'S MOJARRA, *Eugerres plumieri*

MOJARRA BLANCA, *Gerres cinereus*
SNAPPERS

MUTTON SNAPPER, *Lutjanus analis*

GREY SNAPPER, *Lutjanus griseus*
GROUPERS

NASSAU GROUPER, *Epinephelus striatus*
SARDINES

ATLANTIC THREAD HERRING, *Opisthonema oglinum*

SARDINA ESCAMUDA, *Harengula clupeola*
COJINUA, *Caranx fusus*
MACKERELS

KING MACKEREL, *Scomberomorus cavalla*

SPANISH MACKEREL, *Scomberomorus maculatus*
PAINTED MACKEREL, *Scomberomorus regalis*

PETO, *Acanthocybium solandri*
SMALL TUNAS

SKIPJACK TUNA, *Katsuwonus pelamis*

BLACKFIN TUNA, *Thunnus atlanticus*
SAILFISH, *Istiphorus platypterus*

BLUE MARLIN, *Makaira nigrans*
WHITE MARLIN, *Tetrapterus albidus*

SWORDFISH, *Xiphias gladius*
SHARKS

WHITE SHARK, *Carcharhinus falciformis*

MAKO SHARK, *Isurus oxyrinchus*

MARRAJO, *Hexanchus griseus*
LOGGERHEAD TURTLE, *Caretta caretta*

HAWKSBILL TURTLE, *Eretmochelys imbricata*
GREEN TURTLE, *Chelonia mydas*
APPENDIX III

LANDINGS BY SHELVES: 1952

Source: Naranjo Betancourt and Suárez Caabro (1954)
Southeast Shelf Landings: 1952
Southeast Shelf Landings: 1952
Cienfuegos Landings: 1952
Southwest Shelf Landings: 1952
Southwest Shelf Landings: 1952

- **Species Group**: La Coloma, Isle of Pines, Batabanó Area
  - **La Coloma**:
    - Fish: 87%
    - Coral Reef-Seagrass: 90%
    - Oceanic: 2%
    - Estuarine-Littoral: 8%
  - **Isle of Pines**:
    - Fish: 55%
    - Coral Reef-Seagrass: 41%
    - Oceanic: 58%
    - Estuarine-Littoral: 0%
  - **Batabanó Area**:
    - Crustacean: 35%
    - Coral Reef-Seagrass: 23%
    - Oceanic: 74%
    - Estuarine-Littoral: 3%
Northwest Shelf Landings: 1952
Northwest Shelf Landings: 1952
Cojímar Landings: January-April 1953
Northeast Shelf Landings: 1952
Northeast Shelf Landings: 1952
Northeast Shelf Landings: 1952
APPENDIX IV

POST-REVOLUTIONARY FISHING VESSELS
Wooden Vessels
ETA 25
Length: 7.84 m

SIGMA 33
Length: 10.0 m
JARUCO
Length: 9.77 m

LAMDA 75
Length: 23.30 m
OMICRON 50
Length: 15.63 m

RO 60
Length: 20.19 m
CAYO LARGO (WOOD)
Length: 18.34 m
Steel Vessels
CAYO LARGO (STEEL)
Length: 18.20 m

BARCO CAMARONERO 21
Length: 21.62 m
CAMARONERO 23B
Length: 23.73 m
Ferrocement Vessels
LANGOSTERO 12.9
Length: 12.9 m

JARUCO FC IXA
Length: 10.30 m
LANGOSTERO FCIII
Length: 16.16 m

CAMARONERO FC IV
Length: 18.25 m
LANGOSTERO FC II
Length: 16.15 m
Plastic Vessels
CHAPIN
Length: 3.9 m

DELTA 32
Length: 10.1 m
APPENDIX V

POST-REVOLUTIONARY FISHING GEAR
Antillean Trap

Jaulón

Jaulón con Aletas
Coastal Palm

Automobile Tire

Cement and Palm

Cement
Lobster Net (Chinchorro Langostero)

Bully Net  Tarentín  Vidrio
Cod End 20 mm

Body 25 mm

Copo camarone
Set Net
APPENDIX VI
PROFIT INDEX
Shrimp landings are processed and reported by 10 size groups used internationally for marketing. The profit index is then calculated by:

\[ Ig = \sum_{x=1}^{n} \frac{P_x(C_x)}{f} \]

where \( P_x = \text{value of a group of size } x \)
\( C_x = \text{processed weight of group } x \)
\( f = \text{fishing effort} \)

Processing plants do not record the statistical square in which the catch is made so it is not possible, from this source of information, to discover the spatial distribution of the profit index.

Daily samples are taken from catches of shrimp trawlers on the fishing grounds and the shrimp in them are classified into 3 or 5 size groups. In addition, the statistical square in which they were caught, the number of trawls made and hours of work are recorded. Crew bonuses for the day, which are related to production value, are calculated using this information. The profit index for each area and time can be calculated by:

\[ Ig = \sum_{x=1}^{n} (G_{x1} \cdot \text{cpue} \cdot px) \]

where \( G_{x1} = \text{proportion of payment group } x \text{ in the area or time period} \)
\( \text{cpue} = \text{catch per unit effort} \)
\( px = \text{value per kg of payment group } x \)

From this form of the index, fishing charts can be constructed that permit the guidance of the fleet to areas of greatest concentration of economic profit. It should be pointed out that the Catch Bureau takes care to not recommend fishing in statistical squares in which a high profit index resulted from large catches of small shrimp.

The profit index may also be calculated using information on size
composition and species abundance collected on prospecting cruises:

\[ \text{Ig} = \text{p(1)i. cpuei} \]

where \( \text{p(1)i} = \text{value/kg of the median length observed in stratum i} \) (extracted from Tables)

\( \text{cpuei} = \text{catch per unit effort in stratum i (kg/h)} \)

Thus, from each cruise a chart of the distribution of Ig may be obtained and a sequence of them will also show temporal variations.
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