

3

THE SIGNIFICANCE OF THE FAUNA FROM THE CHARLIE LAKE CAVE SITE

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The Charlie Lake Cave site, Peace River District, northeastern British Columbia, is the only excavated, dated site in Canada in which an association of fauna and a fluted point assemblage occurs. There are two major reasons for a detailed analysis of the fauna. First, because the fauna includes a variety of small vertebrates, it provides us with important information concerning animal populations in a newly deglaciated landscape. Second, it provides a glimpse of the subsistence activities of Paleoindians in the Peace River area. As this region was close to the retreating ice sheets, the fauna reflects subsistence strategies employed by Paleoindians as they colonized newly available land. These topics are discussed in more detail in this chapter than has been possible in previous, more descriptive, studies (Driver 1988, Fladmark, Driver, and Alexander 1988).

THE SITE

The Charlie Lake Cave site is located on the south-facing slope of a low sandstone escarpment which forms the north side of the Stoddart Creek valley, a few hundred metres downstream from Charlie Lake, British Columbia. Detailed description of the site is unnecessary in view of previous publications (Fladmark, this volume, Fladmark, Alexander and Driver 1984, Fladmark, Driver, and Alexander 1988). The faunal remains discussed in this chapter were recovered from a deep gully between a small sandstone cliff in the bedrock escarpment and a large block of sandstone (referred to as the "parapet") downslope from the cliff face. Charlie Lake Cave is located in the bedrock cliff, but contains shallow deposits with little time depth. Excavations penetrated the gully deposits to a

depth of about 3.5 metres. Cultural and faunal material were found in all major strata except the lowest zone (Zone I), which consisted of large sandstone boulders in a silt/clay matrix.

Radiocarbon dates show that the earliest fauna was deposited between 10,700 BP and ca. 9000 BP in a silty clay with larger sandstone clasts. This depositional unit, Zone II, is divided into two subzones. Subzone IIa dates 10,700 to 10,000 BP, and contains the fluted point assemblage described elsewhere (Fladmark, this volume, Fladmark, Driver, and Alexander 1988). Subzone IIb dates 10,000 to 9000 BP and contains flakes but no other diagnostic cultural remains. The two subzones are separated on the basis of slight changes in sediments, but both were probably the result of re-deposition of glaciolacustrine sediments mixed with weathered bedrock and larger bedrock clasts.

At the time of the deposition of Zone II sediments, the gully would have been accessible from east and west ends. One should not think of fauna being deposited in a closed sediment trap, but rather that the downslope "parapet" allowed sediments moving down the hillside to accumulate behind it. Bones may have been incorporated in the sediments either by moving downslope and becoming trapped behind the rock or by being added to the accumulating pile of sediments by natural or cultural agencies which introduced bones from any direction.

THE FAUNA

The fauna from subzone IIa is fairly sparse when compared with the thousands of specimens recovered from later zones at the site (Driver 1988).

Identified specimens are recorded in Table 1. The mammal fauna is dominated numerically by ground squirrels (*Spermophilus* sp.), which do not occur in the area today, and which disappear completely from the faunal record shortly after the end of Zone II (ca. 9000 BP). It is not possible to identify the species of ground squirrel represented, but either Columbian (*S. columbianus*) or Richardson's ground squirrel (*S. richardsonii*) are present; other species can be excluded on the basis of size or dental morphology. Other important species include snowshoe hare (*Lepus americanus*), bison or large artiodactyl (all assumed to be *Bison* sp.), and a large lagomorph (*Lepus* sp.) which may be either arctic hare (*Lepus arcticus*) or a jackrabbit (e.g., *L. townsendii*). Neither of these large lagomorphs occurs in the region today and either species would be expected in an open, unforested environment. The single specimen of muskrat (*Ondatra zibethicus*) in this subzone is a tooth. The specimen is stained a much darker brown than other rodent teeth from these deposits, and is identical in colour to specimens from the upper part of the site. It is interpreted as a specimen which fell from the section during excavation, and should not be considered as part of the fauna. The avian fauna is dominated by cliff swallow (*Hirundo pyrrhonota*), and many of the unidentified passerine bones are probably also from this species. This early occurrence suggests that swallows readily extended their northern summer migration to follow the retreating ice sheets. A few fish bones were also found in the upper part of this subzone. None were identified, but specimens from subzone IIb have been identified as sucker (*Catostomus* sp.).

A more diverse fauna occurs in subzone IIb. This diversity need not result completely from a more diverse biota; it may be partly the result of an increased sample size. The mammalian fauna is dominated by snowshoe hare, setting the trend for the entire Holocene assemblage in which this species is consistently the most numerous (Driver 1988). Ground squirrels are a minor component of the fauna, and occur mainly in the lower part of the subzone. Microtines are better represented, and include *Microtus xanthognathus* (chestnut-cheeked vole), a relatively rare species, although still present in the region today. Small *Microtus* could not be identified to species because diagnostic teeth were missing, but either meadow vole (*M. pennsylvanicus*) or long-tailed vole (*M. longicaudus*) were present. Gapper's red-backed vole (*Clethrionomys gapperi*) was present and bison also occurs. In the avian fauna, cliff swallow

no longer dominates. Aquatic birds are well represented, including grebes (*Aechmophorus* sp. and *Podiceps auritus*), a small number of surface feeding ducks, ruddy duck (*Oxyura jamaicensis*), coot (*Fulica americana*), and a rail. Upland birds include the *Tetraoninae* (grouse or ptarmigan) and a set of phalanges from short-eared owl (*Asio flammeus*).

ORIGIN OF THE FAUNA

The taphonomic history of the entire fauna is difficult to establish, mainly because many species are present in small numbers. Furthermore, the fauna as a whole consists predominantly of small mammals and birds, and recent taphonomic studies have concentrated much more on the larger mammals. Nevertheless, it is important to try to understand the origin of the fauna in view of the association with artifacts. If one were to propose that the entire faunal assemblage was the result of human hunting, then this site would provide a view of Paleoindian subsistence very different to the widely held hypothesis that the early occupants of North America were subsisting largely on big game.

Specimens which owe their presence at the site to human activity cannot be identified unequivocally. The most convincing case can be made for bison. A number of bison and unidentified large artiodactyl bones (assumed to be bison) display cut marks (Fladmark, Driver, and Alexander 1988) in locations consistent with human butchery (Table 2). Binford (1981) has noted that similarities in artiodactyl anatomy from species to species result in similar patterns of butchery in cultures separated widely in time and space. The location of cut marks on the specimens described in Table 2 can be reproduced in ethnographic and archaeological examples (e.g., Binford 1981, Frison 1973). Many bison and large artiodactyl bones display spiral fractures, some with a well-defined point of impact, which has also been cited as good evidence for smashing of bones by humans (Binford 1981).

However, one cannot be completely certain that the bison and large artiodactyl bones arrived at their ultimate location as a result of human activity. A number of specimens demonstrate good evidence for carnivore chewing (Table 2). Unfortunately, on no specimens do the carnivore marks and cut marks overlap, and one cannot determine positively whether humans or carnivores modified the bison bones first. However, if one assumes that the carnivores chewed the bones after they had

The Significance of the Fauna from the Charlie Lake Cave Site

Table 1. Identified fauna, Zone II, Charlie Lake Cave, 1983 season.

Taxon	Subzone IIa	Subzone IIb
<i>Pisces</i> (fish)	4	14
<i>Amphibia</i> (frogs)		2
<i>Aechmophorus</i> sp. (large grebe)		2
<i>Podiceps auritus</i> (horned grebe)		15
Medium sized grebe		4
<i>Anatini</i> (surface feeding ducks)	1	2
<i>Anas crecca</i> (green-winged teal)		1
<i>Anas platyrhynchos</i> (mallard)		1
<i>Oxyura jamaicensis</i> (ruddy duck)		1
<i>Tetraoninae</i> (grouse or ptarmigan)		13
<i>Rallidae</i> (small rail)		2
<i>Fulica americana</i> (American coot)		10
Charadriiformes (small wader)	2	
<i>Asio flammeus</i> (short-eared owl)		8
Passeriformes	1	11
<i>Hirundo pyrrhonota</i> (cliff swallow)	16	3
<i>Lepus americanus</i> (snowshoe hare)	18	145
<i>Lepus</i> sp. (large hare/jackrabbit)	4	
<i>Marmota</i> sp.		1
<i>Spermophilus</i> sp. (ground squirrel)	122	24
<i>Peromyscus</i> sp. (deer mouse)	6	2
<i>Clethrionomys gapperi</i> (Gapper's red-backed vole)		2
<i>Ondatra zibethicus</i> (muskrat)	1	
<i>Microtus</i> sp. (vole)	2	3
<i>Microtus xanthognathus</i> (chestnut-cheeked vole)		2
Microtine	2	19
<i>Canis</i> sp. (wolf/dog)		1
<i>Mustela nivalis</i> (least weasel)		2
<i>Mustelidae</i> (weasel family)		1
<i>Bison</i> sp. (bison)	8	11
Large artiodactyl	3	6

been discarded by humans, then the sample of bones may be biased by either selective transportation of bones to the site by carnivores or selective destruction and removal of bones from the site by carnivores. One should certainly not assume that the large ungulate and bison bones are lying where they were discarded by hunters. Thus, although the evidence strongly favours the hunting of bison by Paleoindians, the assemblage is not simply the refuse left after a successful hunt. In this regard, it is interesting to note that a minimum of three bison are represented by only twenty-eight fragments. This suggests that either humans or carnivores were very selective in their choice of bones.

While analysis of surface damage to the bones of large mammals may provide evidence of their taphonomic history, this method reveals much less about the origin of smaller vertebrates. For example, a complete undamaged phalanx of a snowshoe hare could be the result of *in situ* death, discard by a human or animal predator, or downslope movement of bones originally deposited upslope by either of the first two processes. Broken bones may also result from human or animal predation or from mechanical effects during and after deposition, and no keys have been developed to distinguish such breakage patterns. Furthermore, modes of damage caused by particular predators vary widely. For example, humans may cook small

vertebrates whole, strip the meat and cause minimal bone damage, or may pound bones into small fragments. In a review of the actions of great horned owls (*Bubo virginianus*), Kusmer (1986) noted that bones of prey such as duck or snowshoe hare might be discarded as picked skeletons or might be broken during consumption. It would be extremely difficult to distinguish these processes from those produced by humans. At the microscopic level, erosion of bones due to digestive processes may be detectable (e.g., Kusmer 1986), but insufficient studies have been undertaken to distinguish the effects of various predators, and the effect of human digestive processes on small bones is also unknown. As humans, mammalian carnivores, and owls may all discard bones before consumption of prey, absence of digestive erosion cannot be used to rule out any of these predators.

Element frequency is not very useful in analyzing even the most common small vertebrates at the site. Bones were recovered from 3 mm mesh during excavation, and it is likely that some specimens were missed as a result of this recovery procedure. For example, ground squirrel metapodials are infrequent, whereas those of snowshoe hare are common; this may well result from the smaller ground squirrel bones passing through the screen. For snowshoe hare one finds that the frequency of phalanges is correlated with size. Thus, first phalanges are more common than second phalanges and third phalanges are missing. Analysis of relative abundances of limb bones of ground squirrel (Table 3) demonstrates that frequency of elements deviates strongly from the pattern expected for complete skeletons, but the reasons for the over-abundance of forelimbs is difficult to determine. On the other hand, snowshoe hare conforms reasonably closely to the expected pattern (Table 4).

Observations during excavation suggest that some portions of small vertebrates were deposited as articulating units. For example, I observed articulated limbs or feet of ground squirrels and *Tetraoninae*. The articulating set of short-eared owl phalanges from Zone IIb were presumably deposited as a single unit. Such patterns may suggest rapid burial and relatively undisturbed sediments, but they do not identify the mode of death nor the means of transportation to the site. Overall, the small vertebrate fauna from Zone II suggests transportation to the site by either owls or raptors, rather than by mammalian carnivores. Carnivores would be expected to reduce bone to small fragments by chewing and ingestion; many

of the bones of snowshoe hare and ground squirrel are either complete or more than half complete (Tables 4 and 5).

Unfortunately, one cannot completely rule out the possibility that some of the small vertebrates may have been brought to the site by humans. Analysis of damage to small vertebrate skeletons by humans has received little attention in the archaeological literature, and, as noted above, treatment of small vertebrates is likely to be variable. One feature that is missing from all small vertebrate specimens at Charlie Lake is a distinctive burning pattern which often characterizes small mammals eaten by humans (Dansie 1984, Vigne and Marinval-Vigne 1983). There was no evidence of any burning of small vertebrate bones in Zone II.

In order to attempt to resolve the problem of human use of small vertebrates, analysis of bone distribution was undertaken. The distribution of bones is plotted in Figure 1 in which data from both subzones is combined. It is notable that two units (units 3 and 9) frequently contain the greatest percentage of specimens of particular taxonomic categories. Thus, unit 3 contains the highest frequencies of ground squirrel, snowshoe hare, grebes, ducks and coot, and cliff swallow; unit 9 contains the highest frequencies of microtines and grouse. This cannot be accounted for by the depth of sediment. For example, the volume of Zone II deposits in unit 4 is 0.89 m³ while in unit 3 Zone II deposits occupy 0.79 m³. Yet unit 3 contains a much greater concentration of bones than unit 4. Similarly, the volume of Zone II sediments in unit 5 (where relatively little fauna was recovered) is 1.2 m³, while unit 9 contains a relatively large number of bones in 0.43 m³.

Although one could wish for a larger excavation area, it appears that most taxonomic groups occur most densely in the two units furthest from the east and west end of the gully and closest to the gully margins. I suggest that this is because most species were being deposited at the site by owls or raptors which roosted in or on the rocks bordering the gully. It is notable that the only specimens which were definitely hunted by humans (bison and large artiodactyl) have a somewhat different distribution. This taxonomic group is the only group which does not appear with the highest frequency in either unit 3 or unit 9; it is also the only group whose highest frequencies are in the three western units - 4, 5, and 6. These western units also produced the four artifacts from the fluted point assemblage of subzone IIa. The

Table 2. Bison and large artiodactyl bones, Zone II, Charlie Lake Cave, 1983 season.

Element	Portion	Carnivore damage	Cutmarks
Cranium	3 fragments		
Tooth	Premolar		
Vertebra	Fragment		
Sacrum	Anterior	Right side	
Pelvis	Fragment		
Rib	Midsection	Both ends	Medial side
Humerus	Distal + shaft	Proximal end	
Humerus	Distal	Epicondyles	Epicondyles
Humerus	Shaft fragment	One end	Epicondyles
Radius	Distal +shaft		
Radius	Shaft		
Ulna	Proximal	Proximal end	Olecranon
Carpal	Whole		
Metacarpus V	Proximal		
Metacarpus	Proximal		
Tibia	Proximal + shaft		
Tibia	Distal + shaft	Both ends	
Tibia	Shaft		
Metapodial	Shaft		
Phalanx 1	Whole		
Phalanx 2	Whole		
Phalanx 2	Whole		
Phalanx 2	Proximal		
Sesamoid	Whole		
Sesamoid	Whole		

projectile point, scraper, and bead were excavated from unit 5, and the core/scraper from unit 4. Unit 5 produced over 90 per cent of the flakes from the cultural assemblage of subzone IIb. Thus, there is clear evidence that human activities were associated with the western end of the gully, while the major deposition of smaller vertebrates occurred at the eastern end, notably at the gully margins, and without associated artifacts. This associational data strengthens the case that only bison and large artiodactyl bones were deposited as a result of human activity.

PALEOENVIRONMENTS

At the time of the initial deposition of subzone IIa sediments extensive glacial lakes may have filled many valleys in the region (Mathews 1978, 1980). The chronology of proglacial events is not particularly well dated, but by 10,200 BP at the latest the Clayhurst stage of Glacial Lake Peace, with shorelines at the elevation of the Charlie Lake Cave site, had drained. For much, if not all, of Zone II times the environments in this region would have been

characterized by immature river systems, probably carrying much greater loads than modern rivers. Slopes would have been unstable as a result of glacial lake drainage.

The paleoenvironmental implications of the Zone II fauna have been discussed elsewhere (Driver 1988). One can argue convincingly that the change from subzone IIa to subzone IIb marks the transition from a largely open landscape to one in which coniferous forest was predominant. In IIa the presence of bison, a large lagomorph, ground squirrels, and cliff swallows are indicative of open conditions, while snowshoe hare indicate the presence of some forest. The virtual absence of waterfowl from subzone IIa seems to indicate that drainage regimes were not sufficiently stable to allow colonization by the plants and animals upon which waterfowl depend. In IIb there is a notable decline in ground squirrels and cliff swallow, and the large lagomorphs are absent. The increased frequency of snowshoe hare, together with the presence of chestnut-cheeked vole and Gapper's red-backed vole suggest that boreal forest domi-

nated the environment. The increase in waterfowl demonstrates that a variety of productive aquatic habitats were established and that migratory species had extended their northern range.

Sediments from Zone II cannot be correlated across excavation units, except in so far as one can distinguish the two subzones. Lack of microstratigraphy, coupled with the sloping nature of the deposits means that subdivisions of subzones based on arbitrary excavation levels only have meaning within an individual excavation unit. Only excavation unit 3 contains sufficient fauna to warrant analysis of changing frequencies of species within subzones. Figure 2 plots the relative frequency of waterfowl, cliff swallow, snowshoe hare, and ground squirrel for ten arbitrary levels in layer 15 in unit 3. A date of $10,100 \pm 210$ BP (RIDDL 393) was obtained on ground squirrel bone from 15-10. A date of 9990 ± 150 BP (RIDDL 392) was obtained on bison bone from 15-6. The IIa/IIb boundary is between 15-6 and 15-7. 15-1 probably dates to about 9500 BP.

The most striking aspect of these data is the rapidity of the change in the fauna. This is particularly notable in the switch from ground squirrel as the most abundant small mammal in subzone IIa to snowshoe hare in IIb. Waterfowl also appear suddenly in the upper part of IIb. The suddenness of the change is also reflected in palynological studies from the region. MacDonald (1987) has analyzed lake bed cores from sites about 120 km northeast of Charlie Lake. At the base of the cores there is a zone dating 11,000 to 10,000 BP with high relative frequencies of sedges, grasses, and

herbs, together with deciduous trees such as birch and aspen. At about 10,000 BP there is a rapid increase in conifer pollen (mainly spruce), which MacDonald interprets as the establishment of boreal forest.

Palynological and faunal evidence suggests that the open environment which followed deglaciation lasted no more than 1000 years. Paleoindian occupation took place within that interval. The establishment of boreal forest occurred quite rapidly, possibly over a period of a few hundred years. The new vegetation drastically altered the nature of the faunal community.

SUBSISTENCE

As discussed above, one can only make a convincing case for Paleoindian predation on bison at Charlie Lake Cave. In spite of the variety of other fauna, only bison is consistently associated with artifacts and only bison displays definite evidence of human procurement and processing. At Charlie Lake Cave we are seeing an isolated incident in Paleoindian life; perhaps a couple of days is represented. Whether or not this subsistence pattern represents a common event in the seasonal round cannot be determined. It has been argued that the big-game hunting aspect of Paleoindian subsistence has been over-emphasized and that in some areas of North America a wider range of smaller species was utilized (see, for example, Frison 1977, Johnson 1987). At Charlie Lake there is good evidence for large mammal hunting and the interpretation of Paleoindians as big-game hunters should not be overthrown, at least for this area of

Table 3. Ground squirrel limb bones, Zone II, Charlie Lake Cave, 1983 season.

Element	Complete element	>50% present	<50% present
Humerus	7		
Proximal humerus			1
Distal humerus		10	9
Radius	3		
Proximal radius		1	2
Distal radius		7	1
Ulna	2		
Proximal ulna		5	5
Distal ulna			2
Metacarpus	2		
Proximal femur		4	2
Tibia	2		
Proximal tibia		3	1
Distal tibia			2
Metatarsus	8		

Table 4. Snowshoe hare limb elements, Zone II, Charlie Lake Cave, 1983 season.

Element	Complete element	>50% present	<50% present
Proximal humerus			2
Distal humerus			3
Radius	1		
Distal ulna			1
Metacarpus	10		
Proximal metacarpus		1	3
Distal metacarpus		2	1
Proximal femur		1	
Distal femur			1
Proximal tibia			1
Distal tibia		1	3
Metatarsus	19		
Proximal metatarsus		4	4
Distal metatarsus		4	3
Phalanx 1	15		
Proximal phalanx 1		2	6
Distal phalanx 1			4
Phalanx 2	9		
Proximal phalanx 2			1

North America.

As discussed above, both faunal and palynological data are best interpreted as a grassland with scattered patches of woodland or forest during the 11,000 to 10,000 BP period. Evidence from Charlie Lake and from paleontological sites in other areas of the Peace River (Burns 1986, Churcher and Wilson 1979) suggests that the fauna available to hunters was dominated by large mammals, specifically bison. There is no evidence that either fish or waterfowl were available in sufficient abundance to constitute a major alternative resource.

Open landscapes dominated by large mammals and containing few vegetable resources suitable for human consumption are mainly confined to temperate and arctic areas of the northern hemisphere. Ethnographic data on hunter-gatherers in such environments show a strong reliance on large mammals, which were often hunted by communal techniques; in fact communal hunting of large mammals as a major subsistence strategy is largely confined to such conditions (Driver 1990). Recent examples of such strategies include bison hunters of the northern Plains, caribou hunters of the Canadian arctic, and caribou hunters of eastern Asia. Archaeological evidence from equivalent landscapes in the Late Pleistocene suggests similar adaptations (e.g., Klein 1973). It is entirely predictable, given what can be recon-

structed of paleoenvironments in the Peace River area, that hunter-gatherers in such an environment would concentrate their efforts on big game, specifically on species which aggregated as herds for at least part of the year.

The Paleoindians at Charlie Lake were a northern extension of populations of bison-hunters who occupied the grasslands east of the Rockies during the Late Pleistocene and early Holocene. In much of that zone bison hunting remained the major subsistence method up to the ethnographic period. However, the rapid encroachment of boreal forest in the Peace River area after 10,000 BP must have necessitated a swift and complex readaptation to new resources with new distributions. By 9000 BP at the latest, and perhaps as early as 10,000 BP, grazing areas for bison had become substantially curtailed, and it seems very likely that bison populations would have declined drastically. Additionally, bison social organization may have changed in response to fragmentation of feeding areas and a reduction in the quality of forage.

While bison populations declined, other resources became more abundant. The increase in waterfowl has already been discussed. Other animals which become more common later in the Charlie Lake sequence include fish, beaver, muskrat, and snowshoe hare (Driver 1988), all typical species of the boreal forest today. The boreal for-

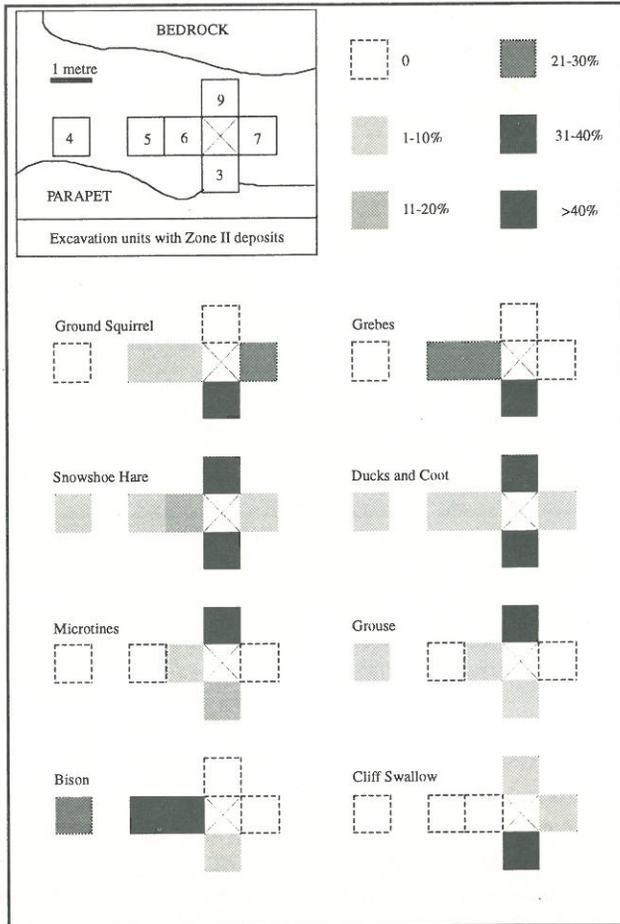


Figure 1. Distribution of selected taxonomic categories by excavation unit, Zone II, Charlie Lake Cave, 1983 season (shading indicates the percentage of specimens of a particular taxon that occur in each unit).

est adaptation of the ethnographically known Athabaskan groups probably developed as early as 9000 BP in the Peace River region of British Columbia.

Acknowledgments

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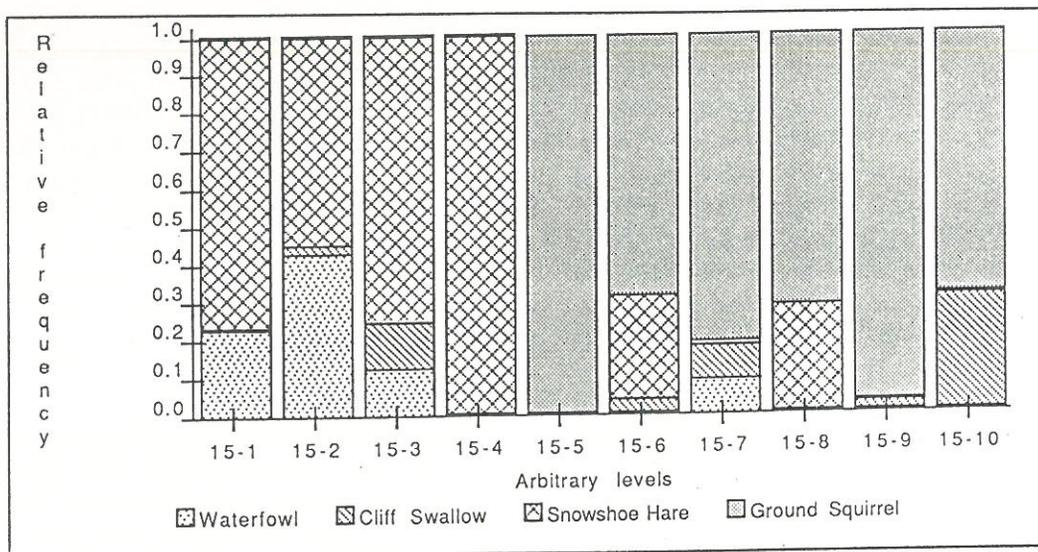


Figure 2. Relative frequency of selected taxonomic groups in arbitrary levels of layer 15, unit 3, Charlie Lake Cave, 1983 season.