Radiocarbon dates, HbRf 39

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Radiocarbon dates have been submitted at various times and to a number of laboratories, and for a variety of purposes. The following descriptions provide the context for the submission of samples, and the separate spreadsheet provides a summary of the individual dates. Paper copies of sample information and laboratory results have also been curated in the physical archive.

Charcoal and bone collagen dates 1983/1984

The 1983 excavations revealed two important features of the site: it was stratified, and it contained a very early cultural component. Knut Fladmark's strategy was therefore to submit specimens of both charcoal and bone for radiocarbon dating to the SFU radiocarbon laboratory, established by Erle Nelson (SFU faculty member), where Keith Hobson was technician. The lab at this time used beta-particle counting – the earliest radiocarbon dating technique that had been developed in the 1950's. A somewhat tense correspondence followed the submission of the samples for dating, and it seems likely that by the time this was all sorted out two samples (SFU 356 and SFU 453) may have had their provenience switched (see discussion in the 1996 Driver et al. paper in the journal Arctic). These are the only two dates from the site that seem completely out of place, and my personal assessment is that this was caused by human error in mixing up the samples.

At about the same time as these dates were being run at SFU, Erle Nelson was also experimenting with AMS dating, at the Radioisotope Direct Detection Laboratory (RIDDL). Driver was working on the fauna from the site in the mid-1980's and took advantage of these new developments to submit two bone collagen samples. It appears that Fladmark independently submitted one charcoal sample. There is no official documentation for this latter RIDDL date – it seems to be a personal communication to Fladmark from Erle Nelson. However, there is an official report for the two faunal specimens.

It is also worth noting that Fladmark's handwritten notes describe three other RIDDL dates, with values in the 39,000 to 42,000 BP range. These were obtained on "charcoal flecks" from the lowest layers. These were almost certainly much older organic materials that had been eroded from the ancient sedimentary rocks around the site, and are basically "infinite" ages. These were never reported in publications, and there appear to be no lab numbers surviving for these, nor an official report.

Bone collagen dates 1991/2

Following the 1991 season, Driver submitted more samples of bone via Erle Nelson to the Center for Acccelerator Mass Spectrometry (CAMS) at the Lawrence Livermore National Laboratory in California. Seven samples were submitted, but only six dates are reported, probably because the last sample did not produce sufficient collagen. The report for the six dates is handwritten by Erle Nelson, and three of the dates are also reported officially by the lab. Because Erle's information exactly matches the information from the official reports for three dates, we assume that the other three dates that he reported are also accurate.

It should be noted that Driver has an aversion to dating charcoal and much prefers to date collagen from animal bones. This is because charcoal is chemically inert and can be transported as a sedimentary particle, making it easy for charcoal from an earlier deposit to be eroded and redeposited in a later deposit. In forested environments tree roots can penetrate deeply into sediments, and if a forest fire occurs, much later charcoal (from burnt roots) can be introduced into earlier layers. Bone is more susceptible to weathering, so if bones are eroded out of an early layer they will probably be destroyed before they can be redeposited in a later layer. Furthermore, bones on an archaeological site are likely to have been brought there by people shortly after the animal died and sometimes exhibit cutmarks and distinctive breakage patterns that show human involvement. Because we are generally interested in dating when humans were at a site, animal bones often provide more reliable dates than charcoal. The few charcoal dates that Driver has submitted have either been from a hearth, where we can assume human involvement, or are fragile charred twigs, that are unlikely to have been redeposited from early layers.

Dates submitted as part of bison aDNA study – early 2000's

Beth Shapiro wrote her PhD on bison evolution at Oxford under Alan Cooper's supervision, and Cooper visited SFU and collected samples of the HbRf-39 bison bone for Shapiro's aDNA work. A number of these specimens were also radiocarbon dated at Oxford, and Shapiro provided Driver with the dates in e-mails in 2002 and 2003. These were subsequently confirmed by checking the Oxford online database. For reasons that are not currently clear, Shapiro sent an e-mail to Driver in 2003 reporting OxA-11961 on faunal specimen 1848, with a date of 10378 +/- 36 BP. A search of the Oxford database provides the same information that Shapiro reported, but it is not listed as coming from "Charlie Lake Cave", and can only be found by looking at "details" in one of the dropdown menus. The same specimen was subsequently dated in another study, so it may be best to ignore this Oxford date in future.

Ice-free corridor studies

In early 2000's Driver sent Michael Waters a couple of bison specimens to date – Waters was interested in applying more refined collagen extraction methods to get a better understanding of the age of Clovis. This project was forgotten until John (Jack) Ives contacted Driver about 2014 to get more dates on HbRf 39 as part of a larger project to study bison aDNA in the middle of the ice-free corridor, with a focus on new specimens from Alberta. Driver selected specimens

for Ives to include in the project, and Ives tracked down the dates that Waters had run about a decade earlier. All of these dates were run through the UC Irvine AMS facility (UCIAMS), and there is a report available on the specimens Driver sent to Ives. Two of the submitted specimens did not yield enough collagen. Waters sent Driver the UCIAMS results from the two specimens that had been dated earlier, but there is no associated lab report. However, Waters did report the dates in Chapter 31 of the book *Paleoamerican Odyssey* (2013).

Cougar study

Grant Zazula asked Driver to provide information on a possible cougar tooth reported in Driver's 1988 paper in *Canadian J. of Earth Sciences*. Driver sent the tooth to Zazula, who confirmed that he believed it was a cougar tooth, and therefore of interest for studying late Holocene northward dispersal of cougars. The plan was for Beth Shapiro to extract aDNA from the specimen and confirm its identity, but no results are yet available. However, the specimen was dated at UCIAMS, and helps date the upper layers at the site.

Charcoal and bone collagen dates 2019 - 2022

Driver was awarded a SSHRC grant in 2019, and this included a budget for further radiocarbon dating to refine the Holocene chronology. Driver submitted 5 faunal specimens in May 2019 to the Lalonde AMS Facility at University of Ottawa. Only two yielded sufficient collagen for radiocarbon analysis. Driver then submitted another 5 specimens in August 2019, four charcoal samples from the 1990/91 seasons, and one faunal specimen from the 1983 season. The charcoal samples were chosen to avoid the problem of dating intrusive roots, with one specimen from a hearth that had been covered by a flat rock, and another that appeared to be a charred twig.

At the time of writing a further 10 samples have been submitted to the Ottawa laboratory, but results are not expected until early 2023.