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NOTE

LATE PLEISTOCENE COLLARED LEMMING (*DICROSTONYX TORQUATUS*) FROM NORTHEASTERN BRITISH COLUMBIA, CANADA

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Charlie Lake Cave is a terminal Pleistocene/Holocene archaeological and paleontological site in northeastern British Columbia (Driver, 1988; Fladmark et al., 1988; Driver et al., 1996). Located in the Peace River District to the east of the Rocky Mountains (56°16′35″N, 120°56′15″W), the major feature of the site is a deep gully in front of a cave formed in a low sandstone escarpment. The gully runs parallel to the hillside, and has been filled with sediments moving down the hill since 10,500 B.P., resulting in up to 4.5 m thick deposits. The site is well stratified, and there is a strong correlation of radiocarbon age and depth, suggesting stratigraphic integrity. The site contains vertebrate assemblages deposited by natural agencies and human hunters, and there is also a long sequence of archaeological components at the site. The importance of the site was demonstrated by Fladmark's excavations in 1983 (Fladmark et al., 1988). Further excavations at the site were undertaken in 1990–1991, and remains of collared lemming (*Dicrostonyx torquatus*) were recovered during the second series of excavations. The specimens are described and their significance evaluated.

IDENTIFIED SPECIMENS

Two seasons of excavation (1983 and 1991) sampled the late Pleistocene deposits at Charlie Lake Cave. No *Dicrostonyx* specimens were identified from the 1983 fauna. Only a sample of the 1991 fauna has been studied in detail. This yielded two lower first molars. A subsequent search through unanalyzed material produced a largely complete mandible with a complete tooth row (Fig. 1). A left m1 (SFU HbRf-39 16398) and the right mandible (SFU HbRf-39 16957) were recovered from Layer 105 in stratigraphic subzone IIb, whose dating (discussed below) is the very late Pleistocene. As the isolated left m1 is less worn than the corresponding tooth in the right mandible, two individuals are represented. An isolated right m1 (SFU HbRf-39 15502) was found in the modern humus, but is almost certainly redeposited. Its colour is the same as rodent teeth from the lowest deposits at the site. Assuming that no mixing of samples occurred in the field or laboratory, the most likely explanation for this specimen is that it was excavated during the 1983 season, missed during screening, and incorporated into modern topsoil beside the 1983 excavations. In 1991, the excavation area was enlarged and the specimen was recovered from the humus layer in a new excavation unit. Field notes from 1991 mention that 1983 backdirt was found with the topsoil. This specimen is 0.4 mm longer than the other first molars, and represents a third individual. All specimens from Charlie Lake Cave are stored in the Museum of Archaeology and Ethnology, Simon Fraser University.

IDENTIFICATION

Dicrostonyx is usually identified from paleontological specimens on the basis of the distinctive features of the molars, including: re-entrant angles of equal depth on both lingual and buccal sides of the teeth; seven triangles and anterior and posterior loops on m1; re-entrant folds lacking cement (Banfield, 1974; Anderson, 1985). On the basis of these characters, the three Charlie Lake Cave specimens are identifiable to the genus *Dicrostonyx*.

Distinguishing between the two extant North American species of the genus, collared lemming (*D. torquatus*) and Ungava lemming (*D. hudsonius*), is more difficult, but the presence of an anterior internal loop on m3 identifies *D. torquatus* (Banfield, 1974). The Charlie Lake specimen exhibits this feature, which is most easily seen by counting the re-entrant angles on the lingual side of the tooth. In *D. torquatus* there are three angles (Fig. 1), whereas in *D. hudsonius* there are two.

Identification of the Charlie Lake specimen as *D. torquatus* is consistent with identifications of other paleontological specimens from western North America (Mead and Mead, 1989). It also fits the modern distribution of the two species, in which *D. hudsonius* is confined to the Ungava-Labrador peninsula in the eastern Arctic, while *D. torquatus* is found in tundra on the mainland and islands of North America and Eurasia (Banfield, 1974).

Morlan (1989) has shown that lemming teeth decreased in size from Pleistocene to Holocene times in the Yukon. The three lower first molars from Charlie Lake Cave have occlusal surface lengths of 3.7, 3.8 and 4.2 mm. These are within the range of measurements of 34 specimens from late Wisconsinan *Dicrostonyx* from Bluefish Cave 1, and are longer than any of the 30 modern specimens measured by Morlan. The relatively large size of the Charlie Lake Cave specimens is further evidence for a Pleistocene age.

CHRONOLOGY

After the formation of the deep gully at the site, glaciolacustrine sediments were washed down the hillside and into the gully. This process began shortly before 10,500 B.P. The sediments from the first period of this activity are collectively referred to as Zone II, which is divided into four subzones (IIa through IId) (Driver et al., 1996). Layer 105, from which the *Dicrostonyx* mandible and one molar were recovered, is the major layer in subzone IIb. Radiocarbon dates from this layer are 10,290 ± 100 B.P. (CAMS 2317) on a raven (*Corvus corax*) scapula, and 10,560 ± 80 B.P. (CAMS 2134) on a bison (*Bison* sp.) phalanx. Other radiocarbon dates from subzone IIb range from 10,770 ± 120 B.P. (SFU 454) to 10,380 ± 160 B.P. (SFU 378). Dates from subzone IIc are consistently later than IIb, which suggests good stratigraphic integrity at the site. Therefore, the lemming mandible is associated firmly with other faunal specimens from Zone IIb dated between 10,770 and 10,290 B.P. (Note that the definition and numbering of stratigraphic zones has been revised since earlier publications on the site. Consult Driver et al. [1996] for concordance with earlier reports).

ASSOCIATED FAUNA

Charlie Lake Cave faunas span the end of the late Pleistocene to the historic period (Driver, 1988; Driver and Hobson, 1992). Subzones IIa and IIb contain fewer taxa when compared with later periods, but this is probably due to the small number of specimens recovered. In addition to the lemming, the following taxa have been identified from IIa and IIb: duck (Anatinae), woodpecker (Picidae), raven (*Corvus corax*), cliff swallow (*Hirundo pyrrhonota*), a large hare (*Lepus* sp.), snowshoe hare (*L. americanus*), deer mouse (*Peromyscus* sp.), a marmot or woodchuck (*Marmota* sp.), ground squirrel (*Spermophilus* sp.), a wolf-sized canid (*Canis* sp.), and bison (*Bison* sp.). Relatively few identifications can be made to species. The large hare is much larger than snowshoe hare, and comparable to both arctic hare and jackrabbit. Ground squirrels could not be identified to species, but arctic ground squirrel (*S. parryii*) is not present. The canid is very similar to wolf (*C. lupus*), but human involvement at the site (Fladmark et al., 1988) means that domestic dog might have been present, and therefore the genus identification is preferred.

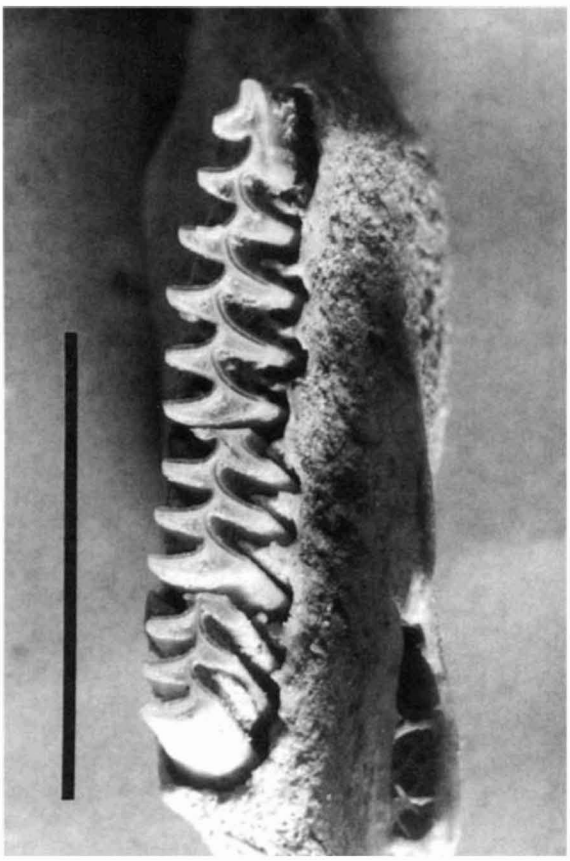

FIGURE 1. Right mandible, *Dicrostonyx torquatus,* Excavation Unit 29, Layer 105, Charlie Lake Cave (SFU HbRf-39 16957). Scale bar equals 5 mm.

DISCUSSION

Lemmings are relatively rare in late Wisconsinan faunas. A recent review notes only 24 North American Pleistocene sites containing lemmings, of which 17 contain *D. torquatus* (Mead and Mead, 1989). Specimens in association with radiocarbon dated faunas come from seven sites. Other sites are either dated by other means, or there is not a good association between the fossil lemmings and dated materials. Three sites (Eagle and January Caves, Alberta, and Old Crow, Yukon) are mid-Wisconsinan, with ages ranging from about 33,000 to 23,000 B.P. Two sites (Elkader, Iowa, and Moscow Fissure, Wisconsin) date between 17,000 and 20,000 B.P., and demonstrate that *D. torquatus* was able to expand east along the southern margin of the Laurentide ice sheet at the height of the last glaciation. Specimens dating to the last few millennia of the last glaciation have been found at sites in the west (Bell Cave, Wyoming, and Bluefish Caves, Yukon) with dates around 12,000 B.P. The stratigraphic position of collared lemming in relation to radiocarbon dates suggests a similar late Wisconsinan age for some other western sites (Bush Shelter, Little Box Elder Cave, and Little Canyon Creek Cave, all from Wyoming). The distribution of collared lemming south of the ice sheets suggests that maximum summer temperatures were lower than today (Graham, 1992).

The Charlie Lake Cave specimens are firmly dated to about 10,500 B.P. (average of six dates from subzones IIa and IIb), and are currently the youngest securely dated specimens outside of the modern range (Fig. 2). Charlie Lake Cave is roughly equidistant from Bell Cave to the south and Bluefish Cave to the north, both of which contain lemmings dated at about 12,000 B.P. Three hypotheses might explain the late presence at Charlie Lake Cave. First, there may have been a local population that survived in the area from mid-Wisconsinan through to the late Wisconsinan. Second, lemmings may have moved south from refugia in Yukon towards the end of the Pleistocene. Third, lemmings may have moved north from the central Rockies as biotic communities were re-established in Alberta and British Columbia at the end of the last glaciation. Of these hypotheses, the third is best supported by available data. There is no securely dated palynological or vertebrate fossil evidence for the existence of biotic communities in northeastern British Columbia and northwestern Alberta during the height of the last glaciation, so persistence of lemming through the glacial maximum is unlikely, although not impossible. Burns (1996) has presented a convincing case that most of western Alberta was uninhabitable during the height of the last glaciation, and that after deglaciation an open environment was established from about 11,600 to 10,300 B.P. This was created by pioneer species moving north from unglaciated regions to the south. Using palynological data, MacDonald and McLeod (1996) suggest a herb-shrub vegetation from about 12,000 to 10,000 B.P. from southern Alberta to Yukon, with spruce forests moving from the south into the Peace River region at about 10,000 B.P. Wilson (1996) has also suggested that fauna moved from south of the ice sheets into western Alberta and northeast British Columbia, basing his argument on the persistence of the southern species *Bison antiquus* until about 10,000 B.P. Apland and Harington (1994) suggest that *Bison occidentalis* moved south from unglaciated regions into the Peace River some time before before 10,500 B.P., supporting the hypothesis that the region was recolonized at the end of the Pleistocene, but raising the possibility that northern species were also involved. One of the oldest artifacts from Charlie Lake Cave also suggests initial migration of human populations from the south (Fladmark et al., 1988; Driver et al., 1996).

Lack of specific identification of many of the vertebrates associated with the Charlie Lake lemmings precludes a detailed comparison of species associations. The overall assemblage from pre-10,000 B.P. deposits has been interpreted as deriving from a relatively open landscape (Driver, 1988). Collared lemmings of definite or probable terminal Pleistocene age from sites to the south have been associated with southern species of ground squirrels, *Marmota,* snowshoe hare, and bison, as well as many other taxa that are not present at Charlie Lake Cave (Mead and Mead, 1989). Lemmings probably moved north in conjunction with other southern species that were adapted to open landscapes, and that found the pioneering associations of herbs and grasses an attractive habitat.

CONCLUSIONS

Collared lemming (*Dicrostonyx torquatus*) was present in northeastern British Columbia at 10,500 B.P. This is currently the latest known fossil record of this species outside its modern range. This species was a component of glacial faunas south of the Laurentide ice sheet from about 20,000 to at least 12,000 B.P. During deglaciation of western Alberta and northeastern British Columbia, southern flora and fauna moved north, creating a short-lived open environment along the east side of the Rockies. Collared lemming survived in this environment no

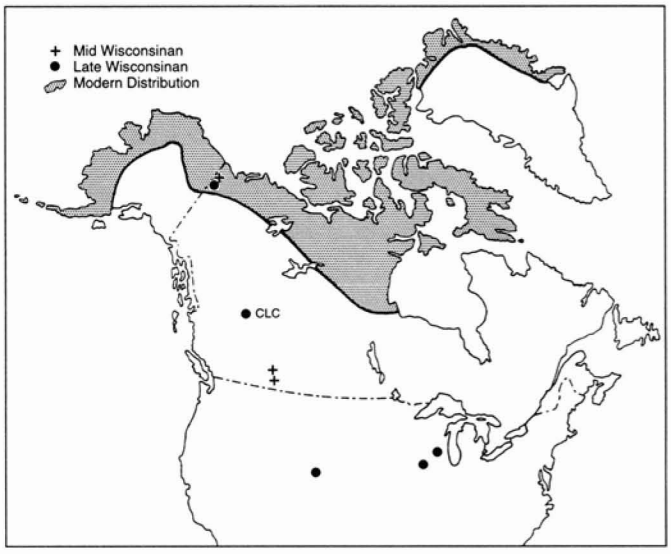

FIGURE 2. Modern distribution of *Dicrostonyx torquatus* and radiocarbon dated fossil specimens, including Charlie Lake Cave (CLC).

later than 10,000 B.P., when the appearance of spruce forests signalled the arrival of essentially modern vertebrate communities.

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