Preliminary Identification of 11 Subfossil Canid Skulls from Little Fish Lake, Alberta, Canada

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Introduction
The Canidae have a long and complex evolutionary history. The oldest known direct ancestor of the modern Canidae evolved in North America during the Miocene around 9 million years ago (Wang and Tedford, 2008; Wang et al., 2004; Tedford et al., 1987). These ancestors then moved across the Bering Land Bridge into the Old World of Asia and eventually became extinct in North America (Olsen and Olsen, 1977). By the Late Pleistocene, the Old World canids had evolved into many forms including wolves (Canis lupus), coyotes (Canis latrans) and foxes (Vulpes spp.; Matthew, 1930). These species migrated back into North America across the Bering Land Bridge and moved into nearly every ecological niche, including the prairies of Alberta (Nowak, 1979).

Also moving into the Alberta prairies during this time were prehistoric peoples who traveled with their domesticated dogs (Canis familiaris; Olsen, 1974; Matthew, 1930). The oldest domesticated dog material from Canada is a mandible that was collected in the Yukon and dated at possibly 12,000 years before present (Beebe, 1980) and a skull from the Crowsnest Pass region dated at 6400 years before present (Driver, 1976 as cited in Bryan, 1991).

Domesticated dogs are descendents of wolves (Wang and Tedford, 2008; Vilà, 1997); therefore, dogs and wolves can interbreed and create viable offspring (Gray, 1954). This close relationship can cause confusion when attempting to identify isolated canid material found at archaeological sites. In general, dog skulls can be differentiated from wolf skulls in multiple ways. With domestication the skull has become shortened, the teeth smaller and the tooth row crowded. Also, most domestic dogs have a much higher cranio-facial angle than wolves (Lawrence and Bossert, 1967). However, skull identification of wolf/dog hybrids is more problematic.

Little Fish Lake (LFL), near Dorothy, AB, is an ephemeral prairie lake with a multi-taxic subfossil bonebed located along the southeastern edge on a loose quartzite sand beach (Ralrick, 2007). It was concluded that this bonebed was developed as a time-averaged allochthonous site that included pulses of toxic algae induced mass mortalities. Twelve large canid skulls were collected from this bonebed (Figure 1). All are now accessioned at the Royal Alberta Museum in Edmonton, AB, and accession numbers are available upon request. For simplicity, field numbers will be used in this abstract. One of the skulls is fragmentary and species level determination cannot be made (LFL 12, Figure 1).

Discussion and conclusions
Forty-nine measurements were taken on the remaining eleven LFL skulls as well as fifty known wolf skulls (twenty-five of each sex), fourteen unsexed wolf skulls, two male, three female and thirty-two unsexed large breed domesticated dogs such as Huskies and German Shepherds, and four known wolf/dog hybrids. Preliminary bivariate comparisons indicate that nine of the skulls cluster with wolves, while two (LFL8 & LFL9) cluster with the hybrids. Principle component analyses will be run in the future in an attempt to corroborate these results.
Several of the canid skulls are from old individuals, one with severe dental pathologies (LFL 7). Some archaeologists believe that severely worn teeth are an indication of human intervention or care because wild animals could not survive with such a high degree of tooth damage (Walker, 1975). However, wild wolves with canines worn down to the gum line are known (Mech, 1988; Pasitschniak-Arts et al., 1988; Cross, 1940), including an alpha female from Yellowstone that survived and hunted successfully with four broken canines (Van Valkenburgh pers. comm., 2006). Also, many specimens of the large Late Pleistocene canid, the Dire Wolf (Canis dirus), also show severely worn teeth (Van Valkenburgh and Hertel, 1993) and they were obviously not domesticated nor under the care of humans.

Archaeological artifacts such as tipi rings and cairns indicate that First Nations peoples inhabited the area surrounding LFL in the past (Gryba, 1984). Therefore, some of the canids found at LFL may, in fact, have been domesticated dogs or hybrids.

Six skull fragments were sent to the IsoTrace Lab at the University of Toronto for radiocarbon dating. The results from oldest to youngest were: 1760 ± 70 (LFL9); 1490 ± 70 (LFL8); 1480 ± 80 (LFL 1); 1140 ± 40 (LFL2); 640 ± 40 (LFL5); and 300 ± 50 (LFL7) years before present. These dates indicate that these animals are not modern wolves or dogs and were deposited over an approximate time span of 1400 years. Therefore, they were deposited naturally into a time-averaged accumulation, perhaps as victims of the previously mentioned toxic algal blooms.

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References
Gray, A.P., 1954, Mammalian hybrids, a check-list with bibliography: Commonwealth Agricultural Bureau, Bucks, UK.

Figure 1. Twelve large canid skulls in dorsal view collected from the Little Fish Lake area with associated field numbers. Scale bar in centimeters.