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Scimitar Cat (*Homotherium serum* Cope) from Southwestern Alberta, Canada

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*Deceased

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Abstract
Skull and tooth fragments of *Homotherium serum* recently recovered from the Wally’s Beach site (DhPg-8) in southwestern Alberta provide the first indications that scimitar cat populated the area of the St. Mary Reservoir. AMS radiocarbon dating provides a 2 sigma range calibrated age of Cal BP 12 715 to 12 655. This is the fourth known occurrence of the species in Canada, the first outside of Yukon, and is currently the youngest precisely dated occurrence of the species in North America. Well-preserved dentition combined with the temporal and geographic context allows the sample to be identified as *Homotherium serum*. The specimen is significant as it represents an extension of the geographic and chronological range of the species.

Keywords
*Homotherium serum*, Homotheriiini, Dentition, Wally’s Beach, Pleistocene
Introduction

The Wally’s Beach site, near Cardston in southwestern Alberta, consists of a series of Late Pleistocene paleontological and archaeological remains which were exposed by erosion associated with the operation of the St. Mary Reservoir (Hills et al. 2014; Kooyman et al. 2012; Waters et al. 2015). Species present include *Equus conversidens*, *Camelops hesternus*, *Bootherium bombifrons*, *Rangifer tarandus*, and *Bison antiquus* among others. A number of species are also represented by preserved tracks, including *Mammuthus* (McNeil et al. 2005:1255). Recently, skull and tooth fragments of an individual scimitar cat, *Homotherium serum*, were discovered. The purpose of this paper is to describe and illustrate this specimen, and to discuss its location and date in relation to other known occurrences of the species.

Geological Setting and Context

The Wally’s Beach site (also known by its Borden designation DhPg-8) is located in southwestern Alberta near the town of Cardston (Fig. 1), in the drawdown zone of the St. Mary Reservoir (Hills et al. 2014). While the *H. serum* remains are paleontological, the Wally’s Beach site is predominately an archaeological site and is therefore defined by the Borden system. The Borden system divides Canada into a series of small blocks inside larger blocks based on latitude and longitude. The capital letters in the Borden designation identify the large block, while the lower-case letters denote the small block to which the site belongs. Each archaeological site is then designated sequentially within these blocks (Borden 1954).

Cranial remains of *H. serum* were discovered in-situ, within a 16-18cm radius. The location consists of Late Pleistocene loess and eolian sands, upon which a Holocene paleosol developed (Hills et al. 2014:25) The specimen was recovered from the very top portion of the...
Pleistocene sediments, embedded in the carbonate horizon that resulted from the development of the overlying paleosol. The enamel layer of one of the canines shows extensive fibrous root etchings on the surface (Fig. 2). This suggests that this tooth was incorporated in the soil horizon while it was actively forming, before the soil’s final burial.

A bone sample from the skull provides an AMS (Beta 440230) 2 sigma range calibrated age of Cal BP 12 715 to 12 655 (conventional age of BP 10 740 ±40). This date was calibrated using IntCal13. The CN (carbon:nitrogen) ratio of +3.3 is within the normal range expected for live protein, therefore the collagen was well-preserved (the δ13C value of -19.3 o/oo and δ15N value of +6.6 o/oo are also both within the normal range expected for live protein). This date places the specimen in the Late Pleistocene and makes it the youngest dated specimen of *Homotherium serum* in Canada.

**Materials and Methods**

The following description is based on fragments of five incisors, two upper canines, the left lower canine, the upper fourth premolar, the lower first molar, and an unidentifiable root (Fig. 3). Preservation is largely restricted to the enamel layer of each tooth. The canine fragments were measured using electronic calipers providing digital readouts to the nearest millimetre (see Dental Remains Recovered). Several small skull fragments (DhPg-8-3847) are also present within the assemblage, but were not considered in this study. The skull fragments are too small and fragmented for partial skull reconstruction, therefore the teeth were the focus of this analysis.

The identification of the tooth fragments was reliant predominately upon Rawn-Schatzinger (1983; 1992), although several other sources (Antón et al. 2014; Biknevicius et al. 1996; Cope 1893; Martin et al. 2011a; Martin et al. 2011b; Martin et al. 2011c; Martin et al.
2011d; Wheeler 2011) and some comparisons to modern Felidae taxa (Felis concolor, Lynx canadensis, and Leoparduspardalis, Department of Anthropology and Archaeology, University of Calgary) were also utilized.

Results

Systematic Paleontology

We follow the systematics proposed by Antón et al. (2014).

Mammalia Linnaeus, 1758

Order Carnivora Bowdich, 1821

Suborder Feliformia Kretzoi, 1945

Family Felidae Fischer von Waldheim, 1817

Subfamily Machairodontinae Gill, 1872

Tribe Homotheriini Kurtén, 1962

Genus Homotherium Fabrini, 1890

Homotherium serum (Cope 1893)

Referred Specimens

The material used in this study will be stored in the Archaeology collections at the Royal Alberta Museum: DhPg-8-3836, crown of the upper left canine; DhPg-8-3837, crown of the upper right canine; DhPg-8-3838, fragment of the crown from an upper first or second incisor; DhPg-8-3839, fragment of the crown from the lower right second incisor; DhPg-8-3840, fragment of the crown from the lower left second incisor; DhPg-8-3841, fragment of the crown from an upper incisor; DhPg-8-3842, fragment of the crown from an unidentified incisor; DhPg-
DhPg-8-3843, crown of the lower left canine; DhPg-8-3844, metacone of the upper left fourth premolar; DhPg-8-3845, paracone of the lower right first molar; DhPg-8-3846, partial root; DhPg-8-3847, several small skull fragments. Cataloguing of these materials followed the Borden system.

Dental Remains Recovered

The *Homotherium* genus is particularly characterized and separated from other saber-tooth cats by its dentition, and this is particularly useful in distinguishing *Homotherium* from its close *Smilodon* relatives, also present in North America during the Pleistocene. A total of 11 tooth fragments identified as belonging to *Homotherium serum* were recovered at Wally’s Beach. The teeth recovered indicate that only a single individual is represented; no elements are duplicated and the size and wear on the teeth are consistent for a single individual. In addition, the remains were discovered in situ. Distinct, fine serrations are present along the cutting edge of each tooth and are characteristic of *H. serum*, as serrations are present on all teeth of both juvenile and adult specimens (Rawn-Schatzinger 1983). “The term “finely serrate” as used by Cope (1983) and Churcher (1966) refers to the consistent and regular serration of *H. serum*’s teeth,” (Rawn-Schatzinger 1992:4). Within this specimen, serrations are most clearly pronounced on the upper canines (Fig. 4), upon which they are present along the entire length of the anterior and posterior edge (Rawn-Schatzinger 1983; 1992; Wheeler 2011:28).

The most distinctive of the teeth recovered from Wally’s Beach are the upper canines (Fig. 5), of which only the enamel caps are present. As noted by Rawn-Schatzinger (1983:53), "the permanent canine has one-half of its length covered with enamel.” As such, it is reasonable to assume that these enamel caps represent approximately one-half of the original length of each tooth. The fragment of the left tooth (DhPg-8-3836) is 51.8 mm in length and 20.1 mm wide.
antero-posteriorly at its widest aspect, while the right (DhPg-8-3837) is 48.2 mm long and 18.7 mm wide. Medio-laterally, the left tooth is 8.3 mm wide and the right is 8.4 mm, once again at their widest aspects. This corresponds with descriptions by Rawn-Schatzinger (1983:52; 1992:3) of *H. serum* upper canines which are laterally compressed or flat as compared to conical-tooth cats. Also unique to *Homotherium*, and exhibited in this specimen, is that the canines are relatively short and broad in comparison to other saber-tooths (Martin et al. 2011a:6; Martin et al. 2011d:208; Wheeler 2011:27) and that they are more complex on their lingual surface (Rawn-Schatzinger 1983:52). Both teeth are relatively straight with a very slight posterior curvature.

The convex nature of the posterior as opposed to the anterior face of the upper canines, as in this specimen, was noted by Cope (1893:897). Both canines exhibit heavy post-depositional root etching.

Several incisor fragments were also identified. All display a slight posterior convex curvature and all are procumbent and rather robust, as is characteristic of *Homotherium* (Martin et al. 2011a:8; Wheeler 2011:28). The first fragment (Fig. 6A; DhPg-8-3838) is comprised of the anterior portion of the enamel cap. Partial cuspules are present on both lateral sides of this fragment, allowing it to be identified as either the upper first or second incisor (Rawn-Schatzinger 1983:53), although the side is indeterminable in this state. An additional incisor fragment (Fig. 6B; DhPg-8-3839) consists predominately of the posterior and medial portion of the enamel cap. Basal cuspules are present on both lateral sides of the fragment, one partial and the other complete. This tooth has therefore been identified as the lower second incisor (Rawn-Schatzinger 1983:53). The medial cuspule is noticeably higher on the tooth than the lateral, indicating that this is the right second incisor (Martin et al. 2011b: Figure 4.8). Yet another incisor fragment, consisting predominately of the posterior and lateral portion of the enamel cap,
exhibits mirrored identical features (Fig. 6C; DhPg-8-3840). This tooth has been identified as the lower left second incisor.

Yet another obviously incisiform fragment consists of a lateral portion of the enamel cap, and terminates just below a basal cuspule (Fig. 6D; DhPg-8-3841). This tooth has been identified as part of the upper incisor dentition; however further identification is not possible. It is larger than the lower second incisors already identified for this specimen and is therefore not a lower first incisor, as the lateral incisors are typically larger and more robust in both saber-tooth cats and modern carnivores (Biknevicius et al. 1996). The obvious cuspule present on this fragment also excludes it from being identified as the lower third incisor, as this tooth lacks basal cuspules in *H. serum* (Rawn-Schatzinger 1983:52). This incisor is therefore part of the upper dentition, however is not identifiable within a sequence. A fifth incisor fragment (DhPg-8-3842) is poorly preserved and further identification is not possible.

Also present within this sample is a lower canine (Fig. 7; DhPg-8-3843), of which the entire crown appears to be present. As noted by Rawn-Schatzinger (1983:53), enamel covers approximately one-third of this tooth, which indicates that this fragment is likely representative of one-third of the original length of the tooth. Although the lower canines of *Homotherium* are diagnostically reduced and incisor-like (Biknevicius et al. 1996:518; Wheeler 2011:32), at 19.6 mm long this tooth fragment is noticeably larger than all the incisor fragments present in this sample, which is typical in *H. serum* (Rawn-Schatzinger 1983:50). In their description of *Homotherium serum*, Antón et al. (2014:263) state that in the occlusal view the lower canine has “a strong lateral flattening, and a small size, just slightly larger than the i3.” This lateral compression is also exhibited in this specimen and is also characteristic of *H. serum* (Rawn-Schatzinger 1983:53). It is also much smaller than the upper canines, which would allow the cat...
more clearance when biting (Wheeler 2011:29). A small basal cuspule located on its medial aspect (Rawn-Schatzinger 1983:53) indicates that this tooth is the left. This specimen also exhibits a distinct convex posterior curvature which is more pronounced than in the upper canines.

A single cusp of the upper fourth premolar, or the upper carnassial (Fig. 8; DhPg-8-3844) is also present. This cusp is identifiable as such because the edge is nearly straight, allowing it to function in its role as a specialized cutting tooth, a characteristic unique to *Homotherium* (Rawn-Schatzinger 1983:52; Rawn-Schatzinger 1992:3). The shape of this specimen also indicates that it is the metacone, which is the only cusp within *H. serum* which is distinctively flat (Rawn-Schatzinger 1983). The main ridge of the cusp leans slightly medially and two slight bulges are present on the buccal aspect of the tooth, with a slight vertical groove between them (Cope 1893:897). Combined with indications of post-mortem breakage on the anterior portion of the cusp and a lack of such evidence on the posterior portion, this fragment has been identified as the most posterior cusp (metacone) of the left upper carnassial (Rawn-Schatzinger 1983:54). The identification of this tooth was corroborated by comparisons to modern Felidae samples (*Felis concolor, Lynx canadensis*, and *Leopardus pardalis*, Department of Anthropology and Archaeology, University of Calgary).

A cusp with a pointed and rather symmetrical apex was also recovered (Fig. 9; DhPg-8-3845). The lower carnassial, or lower first molar, of *Homotherium* is distinguished by its two blade-like cusps (Rawn-Schatzinger 1983:54). The paracone in particular is both large and vertical (Martin et al. 2011c:193), indicating that this fragment is the paracone of the lower carnassial. The presence of two vertical concavities on the lingual aspect of the cusp, as well as indications of post-mortem breakage on the posterior but not anterior aspect of the cusp, further
indicates that this is a fragment of the right carnassial. Comparisons with modern Felidae samples (*Felis concolor*, *Lynx canadensis*, and *Leopardus pardalis*, Department of Anthropology and Archaeology, University of Calgary) corroborated this identification. Shearing wear is also present on both carnassial fragments; this is particularly well-preserved on the fragment of the lower carnassial (see Fig. 9A).

The final fragment is a partial root (Fig. 10; DhPg-8-3846). Three separate roots are identifiable on this fragment, the middle of which projects outwards from the other two. Based on comparisons with modern Felidae samples (*Felis concolor*, *Lynx canadensis*, and *Leopardus pardalis*, Department of Anthropology and Archaeology, University of Calgary), it is likely that this belongs to a molar or premolar of *Homotherium serum*. As this fragment is not diagnostic, further evaluation of the tooth roots in *Homotherium* is beyond the scope of this study.

In the present material, the upper canines are lenticular in cross section with serrations present on both the anterior and posterior edges. The canines are blunted with numerous flake scars and the serrations are polished and worn (Fig. 11), indicative of a mature individual. Rawn-Schatzinger (1983) subdivided the scimitar cat into an eight-stage age progression ranging from Stage I, deciduous teeth just erupting beyond the alveolus, to Stage VIII, with extensive wear and teeth blunted by wear polish. These last features are visible on this specimen; hence it is classified as a Stage VIII adult. Rawn-Schatzinger (1983) did not provide an age for Stage VIII adults, however that for Stage VII is two or more years, which equates to the approximate age for complete functional permanent dentition. No teeth in this specimen are in an extreme state of wear evidenced by broken teeth or teeth worn to the pulp cavity (Rawn-Schatzinger 1983:52).
Discussion

The Wally’s Beach scimitar cat specimen provides a significant new addition to the Late Pleistocene paleofauna of southwestern Alberta, Canada. It is the fourth known occurrence of *H. serum* in Canada (Debicki 1983:24; Harington 1977:526-528, 529-531; Harington 1989:95; Harington 1997; Harington 2003:385; Rawn-Schatzinger and Collins 1981:18) and the first in Alberta. The calibrated age of Cal BP 12 715 to 12 655 is corroborated by the specimen’s stratigraphic context and makes this the youngest precisely dated occurrence of this species in North America.

Due to the fragmented nature of the skull fragments recovered, an analysis of the specimen recently recovered from Wally’s Beach was entirely dependent upon the partial dentition. While the distinctive tooth morphology (e.g., fine serrations present along the cutting edge of all teeth) exhibited here was the basis for identifying this specimen, the geographic and temporal context of the finds supports this identification.

The saber-tooth cats were common primarily during the Pliocene and Pleistocene, periods correspondingly characterized by large prey species which these cats were well adapted to hunt. *Homotherium* is recognized as a wide-ranging genus from throughout Europe, Asia, Africa, and North America (Rawn-Schatzinger 1992), and as the most abundant scimitar cats from northern Eurasia and North America (Martin et al. 2011d). Recently, a specimen from Venezuela (*Homotherium venezuelensis*) has also been described (Rincón et al. 2011), adding South America to the range of *Homotherium* and making it the most geographically dispersed genus of the saber-tooth cats (Antón et al. 2014). *Homotherium* was the only saber-tooth cat that achieved such a wide range (Martin et al. 2011a).
The genus *Homotherium* is the last of a long line of machairodont Homotheriini, ranging in age between four million and 10,000 years (Antón et al. 2014). Their extinction correlated with megafauna extinctions as well as climatic fluctuations (Martin et al. 2011a). Diagnosis of species within *Homotherium* remains a debated issue among researchers. While a single species tends to be recognized for Europe and Asia (*Homotherium latidens*), there are several classifications of North American species (Antón et al. 2014). *Homotherium ischyurus* is often described as an earlier North American species recovered most often from Pliocene and early Pleistocene contexts, while *Homotherium serum* characterizes the Late Pleistocene of North America (Martin et al. 2011c). *Homotherium serum*, while abundant primarily during the later stages of the Pleistocene, was not uncommon earlier in this epoch (Antón et al. 2014).

While both *H. ischyurus* and *H. serum* occupied North America, *H. serum* characterized the Late Pleistocene and may have been the only scimitar species on the continent at the time (Antón et al. 2014). The distribution of *Homotherium* in North America is predominately within the *Camelops* Faunal Province, “which was considered to be composed mostly of pine parkland and characterized by the most cursorially adapted large mammals,” (Martín et al. 2011d:206). *Homotherium serum* is known from over 30 sites in North America which are concentrated in the United States (see Fig. 1; Table 1). Only three sites within Canada (not including Wally’s Beach) are currently known to contain *H. serum* remains (Debicki 1983:24; Harington 1977:526-528, 529-531; Harington 1989:95; Harington 1997; Harington 2003:385; Rawn-Schatzinger and Collins 1981:18). As the only known specimen in Alberta, the remains from Wally’s Beach represent an extension of the range of *H. serum*. Furthermore, as the youngest occurrence in Canada by a significant margin, this specimen may represent a Late Pleistocene extension of the species northward into modern Canada from the United States.
The calibrated age of Cal BP 12 715 to 12 655 for this specimen corroborates its identification as *H. serum*, which characterized the Late Pleistocene of North America, rather than the much older *H. ischyrus* (Antón et al. 2014). More significantly, this specimen is the youngest known precisely dated occurrence of the species in North America. In Canada, three other specimens have been identified from Yukon, however these are significantly older than that recovered from Wally’s Beach. These Yukon specimens date to over 40,000 years BP at Sixtymile Loc. 3 (the only Yukon specimen which has been precisely dated) (Harington 1997; Harington 2003:385), over 25,000 years BP at Old Crow Loc. 21 (Harington 1977:526-528; Harington 1989:95), and 39,900 to 22,200 years BP at Dawson Loc. 9 (Debicki 1983:24; Harington 1977:529-531; Rawn-Schatzinger and Collins 1981:18). In North America more broadly, most specimens date to an earlier Pleistocene context (see Table 1). Only one site contains specimens which have been precisely radiocarbon dated to the last 15,000 years: Laubach Cave No. 2, Texas (13,970 years BP; Graham and Lundelius 2010). The Wally’s Beach specimen is therefore currently the most recent precisely dated specimen in North America and may be a useful indicator of the survival of the species into the Younger Dryas (as defined in Widga et al. 2017).

**Conclusions**

The scimitar cat *Homotherium serum* was a specialized predator which lived during the Late Pleistocene and was widely dispersed across North America (Martin et al. 2011c; Martin et al. 2011d). *Homotherium serum* is most notably identified by its dentition. The serrations present on all teeth allowed for a blade-like function (Rawn-Schatzinger 1983) while the robustness of
the dentition, compared to its sister taxa, allowed for the capture and consumption of large-bodied prey (Rawn-Schatzinger 1992).

The dental materials recovered from Wally’s Beach permit identification of this specimen as *H. serum* based primarily on the presence of serrations on all teeth in addition to other diagnostic aspects of the morphology. Individual teeth can be identified based on distinguishing characteristics outlined by previous researchers, and by comparisons to modern felid taxa. The upper canines are particularly diagnostic due to their laterally compressed form, the serrations present on the entire posterior and anterior edges, and their smaller size and slight curvature which differs from *Smilodon* relatives. The assignment of this specimen to *H. serum* is corroborated based on geographic and temporal criteria. The context of the find is important as it expands the known distribution of the species, while the age of the specimen, at Cal BP 12 715 to 12 655, is currently the youngest precisely dated occurrence of the species in North America and further extends its range temporally. This specimen is significant as it represents the fourth record of *H. serum* in Canada and the first in Alberta, contributing to our knowledge of the distribution of the species in North America, and provides an indicator of the survival of the species into the Younger Dryas (Widga et al. 2017).

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References


### Tables

**Table 1.** Localities containing *Homotherium serum* in Canada and the United States.

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<td>Middle Wisconsinan&lt;sup&gt;10,11&lt;/sup&gt;</td>
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</tbody>
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<sup>1</sup>Graham and Lundelius 2010
<sup>2</sup>Woodruff 2014
<sup>3</sup>Widga et al. 2012
<sup>4</sup>Smith and Cifelli 2000
<sup>5</sup>Graham 1987
<sup>6</sup>Debicki 1983
<sup>7</sup>Harington 1977
<sup>8</sup>Rawn-Schatzinger and Collins 1981
<sup>9</sup>Harington 1989
<sup>10</sup>Harington 1997
<sup>11</sup>Harington 2003
Figure Captions

Figure 1. Distribution of *Homotherium serum* in Canada and the United States (for locality information see Table 1).

Figure 2. Root etching on the upper right canine, lateral aspect. Scale bar = 10mm.

Figure 3. Position of tooth fragments within the dentition of *H. serum* (shaded area represents Wally’s Beach specimen).

Figure 4. Serrations on the posterior aspect of the left upper canine. Scale bar = 10mm.

Figure 5. Upper canines, medial aspect. A, left canine (DhPg-8-3836). B, right canine (DhPg-8-3837). Scale bars = 10mm.

Figure 6. Identifiable incisor fragments. A, upper first or second incisor, anterior aspect (DhPg-8-3838). B, lower right second incisor, medial/lingual aspect (DhPg-8-3839). C, lower left second incisor, lateral/lingual aspect (DhPg-8-3840). D, upper incisor, lateral or medial aspect (DhPg-8-3841). Scale bars = 10mm.

Figure 7. Lower left canine (DhPg-8-3843). A, anterior aspect. B, posterior aspect. Scale bars = 10mm.

Figure 8. Metacone of the upper left fourth premolar (DhPg-8-3844). A, lingual aspect. B, buccal aspect. Scale bars = 10mm.

Figure 9. Paracone of the lower right first molar (DhPg-8-3845). A, lingual aspect. B, buccal aspect. Scale bars = 10mm.

Figure 10. Root fragment, possibly from a molar or premolar (DhPg-8-3846). Scale bar = 10mm.

Figure 11. Polish on the anterior aspect of the right upper canine. Scale bar = 10mm.
Figures

Figure 1

![Map of North America with Wally's Beach marked]
Figure 2
Figure 3
Figure 5
Figure 6
Figure 7
Figure 8

A  B
Figure 9
Figure 10