

## Morphological Differences Between Lynx and Bobcat Skulls

### Abstract

This study sought to identify characters of potential value in discriminating between the skulls of the Canada lynx (*Felis lynx*) and bobcat (*Felis rufus*) in British Columbia. Skulls of 32 bobcats and 29 lynxes were examined. Differences were found in the angle of the infraorbital foramen, the size of the postorbital process of the jugal bone, and the number of minor palatine foramina. These, plus previously described differences, were ranked in order of utility for species identification. Separation between the species was greatest for the angle of the infraorbital foramen, height of the postorbital process of the jugal bone, proximity of the major palatine foramen to the orbital rim of the hard palate, and the shape of the choanal border of the palatine. No single character separated the species; however, each specimen could be identified using a combination of three characters. The rank order of discriminatory value of the characters may aid in judging the likelihood of correctly identifying skull fragments.

### Introduction

The bobcat and the Canada lynx are sympatric in British Columbia. Methods of distinguishing between each cat species from its bony remains are useful to biologists, wildlife technicians, archaeologists, and forensic investigators. Recognition of intact skulls is not difficult, but identification using bone fragments and damaged skulls is problematic. This study sought to expand the inventory of skull characters that may be of potential value in species identification.

Previous works have identified interspecific differences between lynx and bobcat skulls in the positions of the hypoglossal foramen and the major palatine foramen, shapes of the presphenoid bone, temporal ridge, and choanal border of the palatine, frequency of zygomatic bones, and sizes of the teeth, mandible, zygomatic arch, tympanic bulla, nuchal crest, postorbital process of the frontal bone, and interorbital region (True 1887; Pratt 1942; Glass and Martin 1978; Werdelin 1981; Trail and Tumilson 1984). This report redefines many of these variables as discrete attributes or threshold ratios, describes additional characters, and provides some information regarding constancy within each species.

### Methods

The skulls of 32 bobcats and 29 lynxes collected in British Columbia were examined. The bobcat sample contained 17 males, 4 females, and 11 of unknown sex. The lynx sample contained 10 males, 6 females, and 13 of unknown sex. All skulls were from adult animals and are representative of locations scattered over much of the

geographic range of each species within the Province. The lynx sample had a mean basal length of 102.7 mm (89.7-109.9), and the bobcat sample had a mean of 104.5 mm (86.6-116.2). Specimens are held by the Cowan Vertebrate Museum, University of British Columbia; the Royal British Columbia Museum; and the Selkirk College Biology Collection.

Bobcat skulls were identified by the presence of both a narrow presphenoid bone and a confluence of the hypoglossal foramen with the posterior lacerate foramen. Lynx skulls were identified by the presence of both an inflated presphenoid bone and separation of the aforementioned foramina (Cowan and Guiguet 1965; Banfield 1974; Trail and Tumilson 1984). Skins were not available for inspection from most specimens.

Each skull was examined with respect to the variables listed in Figure 1 and Table 1. Measurements (to 0.05 mm) were taken using a metric dial calliper.

### Results

The robust development of the zygomatic arch of the bobcat skull tilts the infraorbital foramen so that its long cross-sectional axis lies closer to the horizontal than that of a lynx. The long axis of the cross-section of the foramen, when viewed from the front and aligned with a straight edge, intersects the nasal bone. The well developed zygomatic arch also provides greater closure of the orbit in the bobcat, with a jugal postorbital process larger than the space in the rim of the orbit. In most lynxes, this space is larger than the postorbital process of the jugal, and the infraorbital angle does not intersect

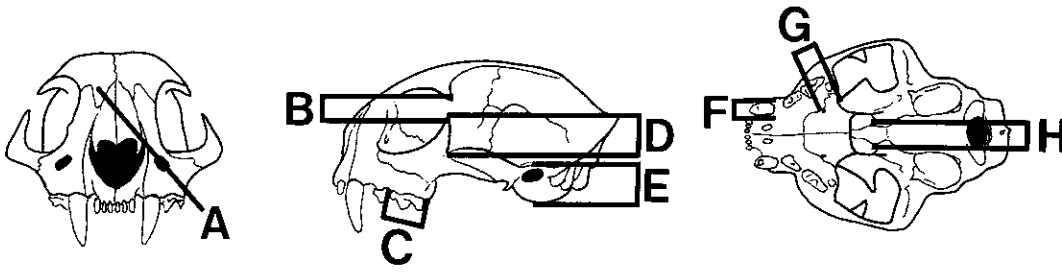


Figure 1. Skull variables: A, angle of infraorbital foramen; B, space in rim of orbit; C, alveolar length of P<sup>4</sup>; D, height of postorbital process of jugal; E, depth of tympanic bulla ventral to temporal crest; F, alveolar width of C<sup>1</sup>; G, least distance of major palatine foramen from orbital rim of hard palate; H, greatest width of presphenoid bone (irrespective of shape).

TABLE 1. Frequency of occurrence of morphological features in lynx (n = 29) and bobcat skulls (n = 32) listed in order of discriminatory value. (Three damaged skulls could not be completely measured.)

Character State	Lynx	Bobcat
Angle of infraorbital foramen projects dorsal to caudal border of nasals (vs. intersects with nasal bones).	0.97	0
Choanal border semicircular.	1.00	0.03
Height of postorbital process of jugal bone above temporojugal suture < space in orbital rim.	0.96	0.06
Distance between major palatine foramen and orbital rim of hard palate < width of presphenoid bone.	1.00	0.10
Distance between major palatine foramen and orbital rim of hard palate < alveolar width C <sup>1</sup> .	1.00	0.19
Distance between major palatine foramen and orbital rim of hard palate < space in rim of orbit.	1.00	0.23
Depth of tympanic bulla ventral to temporal crest < alveolar length P <sup>4</sup> .	0.93	0.16
Height of postorbital process of jugal above temporojugal suture < width of presphenoid bone.	0.57	0
No more than one minor palatine foramen.	0.96	0.44

the nasal bones. Minor palatine foramina are limited to a total of one or zero in most lynxes, whereas most bobcats have two or more.

These characters plus others from the literature were ranked in terms of constancy of interspecific differences. The greatest separation between the species involved the angle of the infraorbital foramina, the features of the zygomatic arch described above, the position of the major palatine foramina, and the shape of the choanal border of the palatine (Table 1). In the lynx, the major palatine foramina are close to the orbital rim of the hard palate. This distance is less than the alveolar width of C<sup>1</sup>, less than the diameter of the presphenoid bone, and is less than the size of the space in the rim of the orbit. The choanal border of the lynx skull is semicircular, whereas that of the bobcat skull is squared. Other features examined showed less than 80 percent separation. Nevertheless, every lynx skull conformed to a majority of the lynx-typical statements in Table 1 and every bobcat skull conformed to a majority of the bobcat-typical

conditions in Table 1. No bobcat skull had more than four lynx-typical character states, and no lynx skull had less than seven (Figure 2). Every

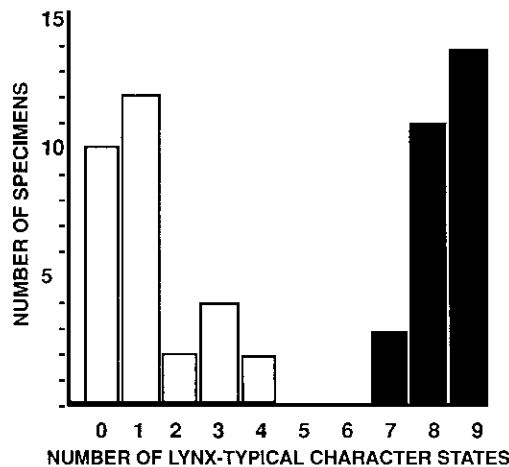


Figure 2. Number of lynx-typical character states found in a sample of 28 complete lynx skulls (black bars) and 30 complete bobcat skulls (open bars).

specimen conformed to a majority of the first three species-typical features in Table 1, and the greatest number of differences was found when using the first seven or more characters.

## Discussion

Lynx and bobcat skulls show morphological overlap sufficient to hamper identification based on single characters used in taxonomic keys. The need to employ both the hypoglossal foramen and the shape of the presphenoid bone in identification of skulls was emphasized by Trail and Tumlison (1984). Several additional variables for use in skull identification have been presented here. These are the number of minor palatine foramina, the height of the postorbital process of the jugal, and the angle of the infraorbital foramen. The latter was most frequently different between the species. The rank

order of these and other characters presented in Table 1 suggests their potential value in identifying skull fragments.

Anatomical constancy was greater for lynx skulls than for bobcat skulls, but atypical specimens might exist for any character state. For example, Manville (1959) found a bregmatic bone in one of 472 lynx skulls. These findings caution against relying on any single character for field identification of bone fragments or complete skulls.

Although interspecific overlap has been documented with respect to the characters of lynx and bobcat skulls, every skull in this study conformed to a majority of species-typical features. The probability of correct visual identification of lynx and bobcat skull parts is therefore likely to rise dramatically by incrementally considering a combination of characters.

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