BULLETIN

OF THE

FLORIDA STATE MUSEUM

BIOLOGICAL SCIENCES

Volume 9 Number 6

THE PLEISTOCENE FELIDAE OF FLORIDA

Bjorn Kurten

UNIVERSITY OF FLORIDA

Gainesville

1965

Numbers of the BULLETIN OF THE FLORIDA STATE MUSEUM are published at irregular intervals. Volumes contain about 300 pages and are not necessarily completed in any one calendar year.

Communications concerning purchase or exchange of the publication and all manuscripts should be addressed to the Managing Editor of the Bulletin, Florida State Museum, Seagle Building, Gainesville, Florida.

Published June 8, 1965 Price for this issue $.95

THE PLEISTOCENE FELIDAE OF FLORIDA

Bjorn Kurten [1]

Synopsis: The Pleistocene deposits that have yielded fossil remains of Felidae in Florida may be separated roughly into two age groups, an early fauna probably dating from the Illinoian or early Sangamon or both, and a late fauna mainly of Wisconsin date. Seven species of Felidae have been identified in these faunas:

Felis atrox, the extinct giant jaguar, has been found at only two sites in northern Florida, probably of Wisconsin date.

Felis onca, the jaguar, is plentiful in both faunas and has been identified at a number of sites. The fossil form (*Felis onca augusta*) is larger than the living jaguar. Its various distinctive characters in relative proportions are simply functional or allometric byproducts of larger size. By the Late Pleistocene it became somewhat smaller and relatively less plentiful.

Felis concolor, the puma, occurs in both faunas but is known from only three sites. The Pleistocene puma appears to be identical with the living form.

Felis rufus, the bobcat, is relatively scarce in the early fauna but is the dominant species numerically in the late fauna. The earliest (Illinoian?) form is distinguished by its large size, and is described as ***Felis rufus koakudsi***, new subspecies. This subspecies was later replaced by the modern subspecies, *Felis rufus floridanus*.

Felis pardalis, the ocelot, is recorded at two sites, both of early date.

Felis yagouaroundi, the jaguarundi, has been found at three sites, all probably dating from the Wisconsin.

Smilodon fatalis, the sabertooth, has been found in several sites, and is more common in the early than in the late faunas. The Florida form is less advanced than the late Wisconsin sabertooth of Rancho La Brea, and *Smilodon floridanus* is relegated to the synonymy of *Smilodon fatalis*. The size of *Smilodon* gradually increased during the Middle and Late Pleistocene. A very small specimen in the highly heterochronic fossil assemblage of the Santa Fe River may represent an early stage in this sequence, possibly the species *Smilodon gracilis*.

---

[1] The author is Lecturer of Paleontology at the University of Helsingfors, Finland. He completed this study while on an NSF Visiting Foreign Scientist Fellowship at the Florida State Museum. Manuscript received 30 June 1964.—Ed.

Kurtén, Björn. 1965. The Pleistocene Felidae of Florida. Bull. Florida State Mus., vol. 9, no. 6, pp. 215-273.

CONTENTS

INTRODUCTION

New fossils of Felidae from the Pleistocene of Florida, most of them collected recently and not previously reported, form the basis of the present contribution. The amount of material available for study is considerable, so that quantitative studies and comparisons are now possible for the first time.

The majority of the specimens examined are in the collections of the Florida State Museum, University of Florida (UF). Additional material was examined in the private collections of Mr. James H. Gut (JHG), Sanford, Florida, and Florida Diving Tours (FDT), Ocala, Florida. Numerous specimens were borrowed for study from the Florida Geological Survey (FGS), Tallahassee, the U. S. National Museum (USNM), Washington, D. C., the American Museum of Natural History (AMNH), New York, N. Y., the Academy of Natural Sciences (ANSP), Philadelphia, Pa.; the Illinois State Museum (ISM), Springfield, Illinois; the Texas Memorial Museum and Bureau of Economic Geology (UTBEG), Austin, Texas; Los Angeles County Museum (LACM), Los Angeles; and the University of California Museum of Paleontology (UCB), Berkeley.

Almost all the measurements were taken in the manner defined by Merriam and Stock (1932). Abbreviations used in tables of measurements are as follows:

a, approximate
B, breadth
Ba, anterior breadth
Bbl, width of blade (of upper carnassial)
D, depth
e, estimated
L, length
Lm, length of metastyle (in upper carnassial)
Lp, length of paracone (in upper carnassial) or protoconid (in P_4)
N, number of specimens in sample
S.D., standard deviation

LOCALITIES

The following is an annotated list of Florida localities that have yielded fossil felid material mentioned in this paper. Reference is made to other publications in which the stratigraphy, correlative age, or paleoecology of each of these deposits is described in detail. Fig. 1 shows the geographic distribution of the sites.

Illinoian and/or Sangamon Age

For discussions regarding various views on the correlation of these deposits see Bader (1957), Brodkorb (1957) and Auffenberg (1958, 1963).

Arredondo, Alachua County. Several different fissures in the Ocala Limestone of this area have fossiliferous fillings (Bader, 1957; Brodkorb, 1959). Bader (1957) expresses grave doubts as to the practicability of correlations on any basis but faunal analysis. Brodkorb suggests that the fissure fillings may be dated as Illinoian because they underlie the Wicomico Terrace. Auffenberg (1958) suggests that some of the deposits may extend well into the early Sangamon. The present paper describes material from two distinct localities at Arredondo: Pit II (see Bader, *op. cit.*), and Pit I, which yielded a skeleton of *Smilodon*.

Haile I A, Alachua County. The stratigraphy and avifauna have been described by Brodkorb (1953); Auffenberg (1963) lists the snakes and discusses the paleoecology. The locality is regarded as an ancient spring head. Recent evidence (Auffenberg, pers. comm.) suggests that this deposit is probably older than he originally presumed (1963).

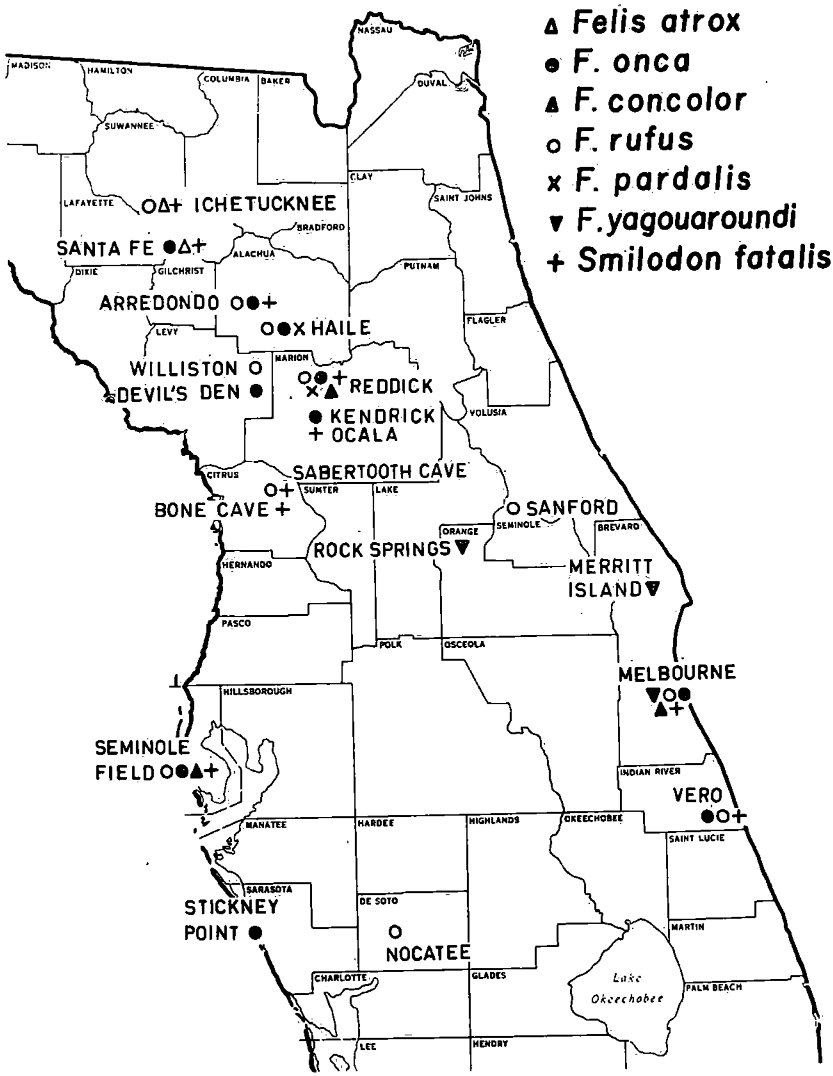

Fig. 1. Distribution of felid species in Pleistocene fossil localities of Florida.

HAILE II B, ALACHUA COUNTY. Mainly on the basis of its numerous bat fossils Auffenberg (1963) suggests that this deposit represents a Pleistocene cave, probably near a scrub area.

HAILE VII A, ALACHUA COUNTY. Auffenberg (1963) lists the snakes from this deposit, and suggests that it represents a sinkhole pond.

HAILE VIII A, ALACHUA COUNTY. A rich fossil deposit in the Haile complex which has not yet been reported upon in the literature.

WILLISTON III, LEVY COUNTY. See Holman (1959) for a list of the reptiles and amphibians of this site.

REDDICK I, MARION COUNTY. The stratigraphic relations of the local deposits in this limestone quarry are dealt with in some detail by Brodkorb (1957) and by Auffenberg (1963). The very rich fauna of this locality is still incompletely studied, but Gut and Ray (1963) list by name all the species of vertebrates so far been identified from here. The birds have been described by Brodkorb (1957) and the snakes by Auffenberg (1963). See also Ray, Olsen and Gut (1963).

KENDRICK I, CUMMER LUMBER CO., Quarry, Marion County. Presumably the same considerations apply to the Pleistocene fissure fillings of this area as to nearby Reddick. The exact locality of the single specimen of *Felis onca* found here is unknown, except that it came from one of the numerous limestone quarries in the immediate area.

OCALA, MARION COUNTY. The type specimen of Leidy's *Smilodon floridanus* came from a fissure filling in this general region. It is probably of about the same date as the material from Reddick and Kendrick.

SABERTOOTH CAVE OR LECANTO CAVE, CITRUS COUNTY. The rich fauna of this locality was described by Simpson (1928), who correlated it with the Late Pleistocene faunas of Seminole Field, Melbourne, and Vero. Auffenberg (1958) regards a Sangamon age as more probable.

BONE CAVE NEAR FLORAL CITY, CITRUS COUNTY. This locality is discussed in Auffenberg (1958). It contains an admixture of Holocene material, but the *Smilodon* specimen discussed in the present paper came out of the Pleistocene fauna, correlated by Auffenberg with Reddick I B (early Sangamon?).

Wisconsin Age

For a discussion of the complexity of deposits of this age and their admixture with material of Holocene Age see Weigel (1962) and Auffenberg (1963).

Devil's Den, Levy County. The large and important fauna of this sinkhole (see Arata, 1961) has not yet been described. It appears to date from the Late Pleistocene and probably also from part of the Holocene.

Ichetucknee River Beds, Suwannee and Columbia Counties. Material from these beds is somewhat heterochronic and probably includes most or all of the Wisconsin as well as the recent. Simpson (1929a, 1930) lists the mammalian fauna; Auffenberg (1963) lists the snakes and discusses various fossil sites along the river.

Melbourne, Brevard County. Several localities in the Melbourne Bone Bed have yielded a large and well-known fauna, most recently revised by Gazin (1950) and Ray (1958). The material is Late Pleistocene (Wisconsin) and recent.

Merritt Island, Brevard County. Extension of the Melbourne formation.

Nocatee, De Soto County. Fossiliferous clays probably of Late Pleistocene date.

Rock Springs, Orange County. The age of this fauna is apparently late Pleistocene, but Miocene and Recent beds also occur here (see Auffenberg, 1963; Ray, Olsen and Gut, 1963).

Sanford, Seminole County. This is material removed from Lake Monroe by hydraulic dredges (Gut, 1938). The age is presumably Late Pleistocene.

Santa Fe River, Locality I, Gilchrist and Columbia Counties. A series of localities upstream from the junction between the Ichetucknee and Santa Fe Rivers. Brodkorb (1963), reported on the avifauna from these deposits, but most of the rich mammalian fauna still awaits study. Preliminary investigation by Clayton E. Ray and S. David Webb indicate that the fauna is heterochronic. Many fossils are undoubtedly Late Pleistocene, others may be as old as the Blancan. The "old" group evidently includes the giant flightless bird *Titanis walleri* described by Brodkorb (*op. cit.*), as well as a mastodon and borophagine dog. None of the felids described here is likely to be that early, although some of the material might be middle Pleistocene in age.

SEMINOLE FIELD, PINELLAS COUNTY. A large fauna, described by Simpson (1929b). Although some of the material collected here may be Holocene, it seems clear that the main part of this fauna is of Wisconsin age and to be correlated with the assemblages from Melbourne and Vero.

STICKNEY POINT, SARASOTA COUNTY. Material dredged out of channel, of indeterminate age, presumably Pleistocene.

VERO, INDIAN RIVER COUNTY. The recent revision by Weigel (1962) lists the voluminous literature on this site. The stratigraphic sequence is the same as at Melbourne and the age of the bone bed is Late Pleistocene (Wisconsin) and recent.

SYSTEMATIC DESCRIPTIONS

Felis atrox Leidy

Giant Jaguar

MATERIAL EXAMINED:

SANTA FE RIVER, LOCALITY I, FDT 124, right M_1.

ICHETUCKNEE RIVER. UF 9076, skull (fig. 2) and lower jaws of a single individual.

The two rami and the complete skull from the Ichetucknee River had been disarticulated and were collected by Messrs. Kent and Kirk Ainslie on Dec. 31, 1963, and Jan. 11, 1964, respectively. The skull lacks I^1, I^2, P^2 and M^1 on both sides and the left P^4, while all the lower incisors have been lost, and the right C_1 and P_4 are broken. Otherwise the dentition is excellently preserved. The skull and mandibles are also in good condition, barring some breakage of the posterior nasal opening and the loss of the right coronoid process.

The measurements of this specimen are shown in table 1 together with the range of variation recorded in the Rancho La Brea sample published by Merriam and Stock (1932). The Ichetucknee specimen, apparently a large male, exceeds most of the Rancho La Brea skulls in size, and the values fall close to the upper limit of the recorded range. The dentition is but slightly worn.

True jaguar has not been found in the Ichetucknee beds.

The M_1 from Santa Fe I is of about average size for the Rancho La Brea material (see Table 1). Its presence in the Santa Fe River

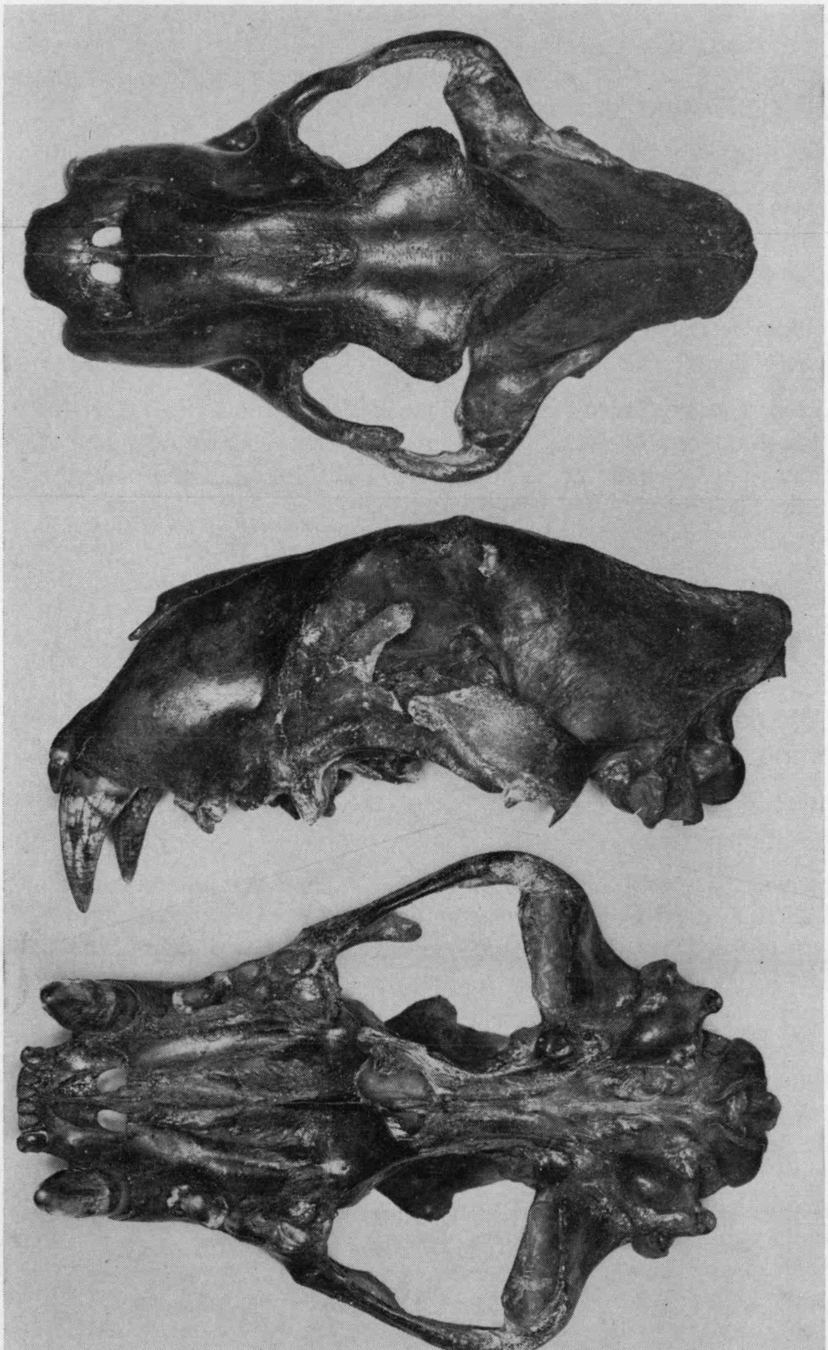

Fig. 2. UF 9076, skull of *Felis atrox,* Ichetucknee River beds, dorsal, lateral, and ventral views.

Beds is of interest, for this is the only locality where both *Felis atrox* and *Felis onca* have been found. Though the ranges of the two species in the Pleistocene may have overlapped, they are not associated at any of the localities enumerated by Simpson (1941). As the Santa Fe River Beds are highly heterochronic, it is quite likely that the association here is entirely spurious, and the two species actually inhabited this area at different times.

The tooth is only slightly worn. Most of the outer and hind part of the protoconid is damaged, and the posterior root is broken.

REMARKS. *Felis atrox*, which has not previously been recorded from Florida, does not appear to have been a member of the typical late Pleistocene fauna in the main part of the state. Possibly this species did not range into the peninsula proper. The seeming incompatibility between it and the true jaguar may have something to do with this, but whether it was due to interspecific competition or to ecological differentiation is not altogether clear. The latter explanation is suggested by the fact that the jaguar is mainly a forest animal, while *Felis atrox* appears in association with plains animals at Rancho La Brea. Although *Felis atrox* may be related to the jaguar as Simpson (1941) suggests, it must have looked very different in the flesh. With its slim build, long legs, and relatively small head it was obviously highly cursorial.

Felis onca Linnaeus
Jaguar

MATERIAL EXAMINED:

SANTA FE RIVER, LOCALITY I. FDT 176, right C^s; FDT 483, right C_1; FDT 484, left C_1; FDT 487, left P^4; FDT 490, part of left mandible with P_3-M_1.

REDDICK I. FGS V-5690, fragment of right maxilla with P^4 and debris of canine; right P_4; distal roll of left humerus; complete right and left radii; fragments of right and left ulnae; left scapho-lunar; left unciform; left pisiform; left series MC I-IV (fig. 3); right MC IV (pathological); right navicular; left ectocuneiform; left MT II and IV; proximal ends of left MT II and V. UF 2446, proximal ends of right MT IV-V; UF 2565, juvenile right ramus fragment with D_3-D_4; UF 2858, right C^s and left maxillary fragment with broken C^s, alveolus for P^2, and roots of P^3; UF 3003, right ramus with P_3-M_1 and root of C_1 (fig. 4); UF 8875, right C^s; UF 8876, left C^s; UF 8877, right maxillary fragment with P^3 and alveolus for P^2; UF 8878, right P_4; UF 8879, right mandible fragment with P_4-M_1; UF 8886, distal end of left tibia;

UF 8888, right navicular; UF 8889 two left astragali; UF 8890, right astragalus; UF 8893, left scapholunar; UF 8897, left navicular; UF 8899, left MC III.

ARRREDONDO II. UF 1717, left MC V (female?).

KENDRICK. UF 8891, right calcaneum (female?).

HAILE II B. UF 3004, left maxilla with P^3-P^4 and the alveoli of C^s-P^2.

HAILE VII A. UF 3463, left humerus, radius and ulna (fig. 5); UF 8455, juvenile right mandible with milk teeth (fig. 4); UF 8956-8957, distal ends of left and right tibiae; UF 8958, right astragalus; UF 8981, left radius; UF 9122, right radius; UF 9123, distal end of left tibia;

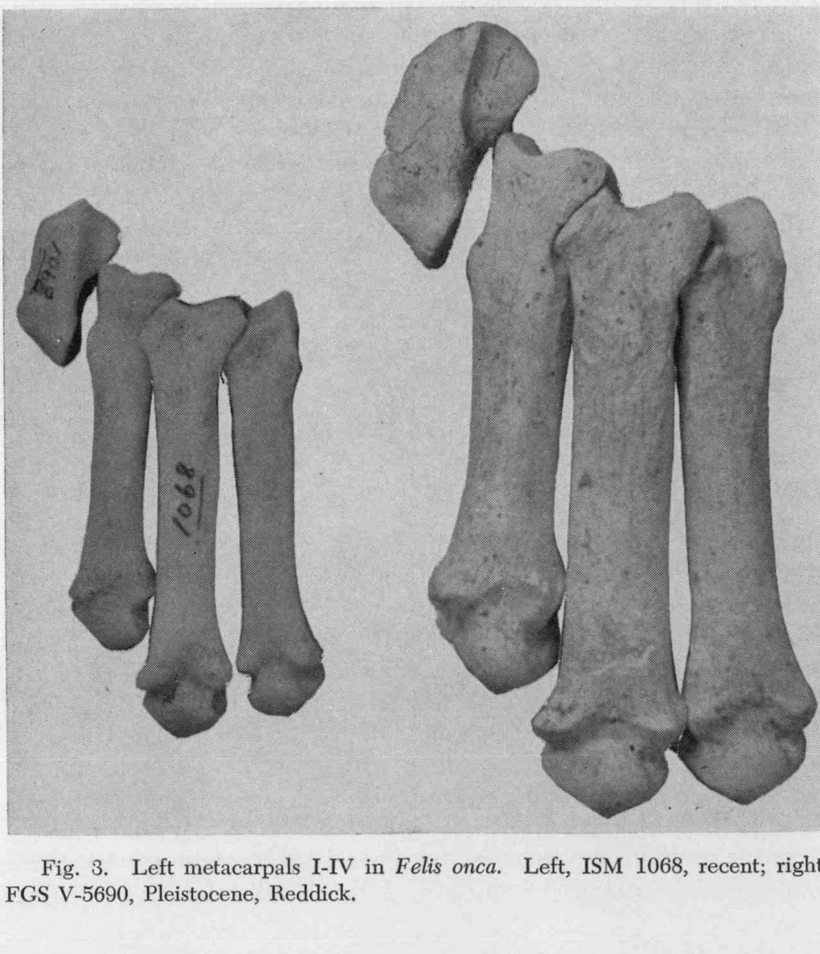

Fig. 3. Left metacarpals I-IV in *Felis onca*. Left, ISM 1068, recent; right, FGS V-5690, Pleistocene, Reddick.

UF 9124, left astragalus; UF 9125, left ectocuneiform; UF 9126, right MC IV.

DEVIL'S DEN. UF 8980, right humerus (fig. 5).

STICKNEY POINT. FGS V-5696, posterior part of a skull (fig. 6).

MELBOURNE. USNM 11470, right mandible; USNM, no number, right and left P^4, right P^3 fragment, right P_4 germ, left M_1. Simpson (1941) ascribed the mandible and a P^4 to *Felis onca augusta.*

VERO. USNM 11411, left P^4. Hay (1919) made this specimen the type of *Felis veronis,* which Simpson (1941) showed to be a synonym of *Felis augusta.* Dimensions in table 2.

SEMINOLE FIELD. AMNH 23536, left D_4; AMNH 23537, left D^3; AMNH 23539, left P^3; AMNH 23540, fragment of right P_4.

Simpson (1929b) briefly noted these isolated teeth as *Felis veronis,* but later (1941) he referred them to *Felis onca augusta.* The milk teeth represent animals about the same size as the juvenile jaws from Reddick I and Haile VII (table 4), while the permanent premolars are somewhat smaller than the average for the fossil jaguar.

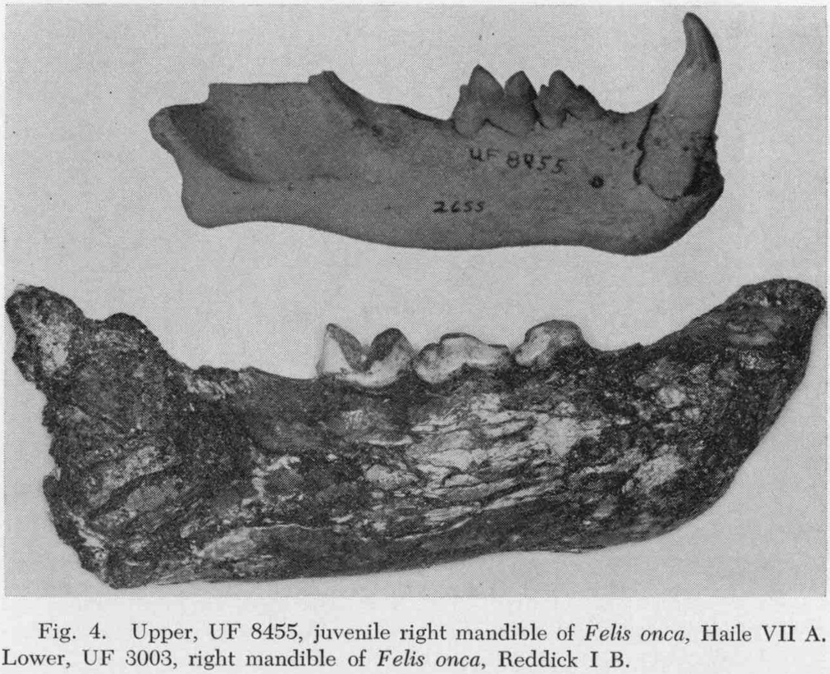

Fig. 4. Upper, UF 8455, juvenile right mandible of *Felis onca,* Haile VII A. Lower, UF 3003, right mandible of *Felis onca,* Reddick I B.

REMARKS. The jaguar specimens from Reddick I are remarkable for their great size and the robust, heavy build of the limb bones, which may be evaluated from the accompanying tables. The morphology and relative proportions of the limb bones in many ways approximate those of *Felis atrox,* as illustrated by Merriam and Stock, more closely than the small modern jaguar skeleton with which they have been compared. However, the size of the Reddick bones falls far short of that in *Felis atrox,* and the limb bones show no distal elongation as in the extinct species.

Fig. 5. Arm bones of *Felis onca.* Left, UF 3463, left ulna, radius, and humerus of one individual, from Haile VII A. Right, UF 8980, right humerus from Devil's Den.

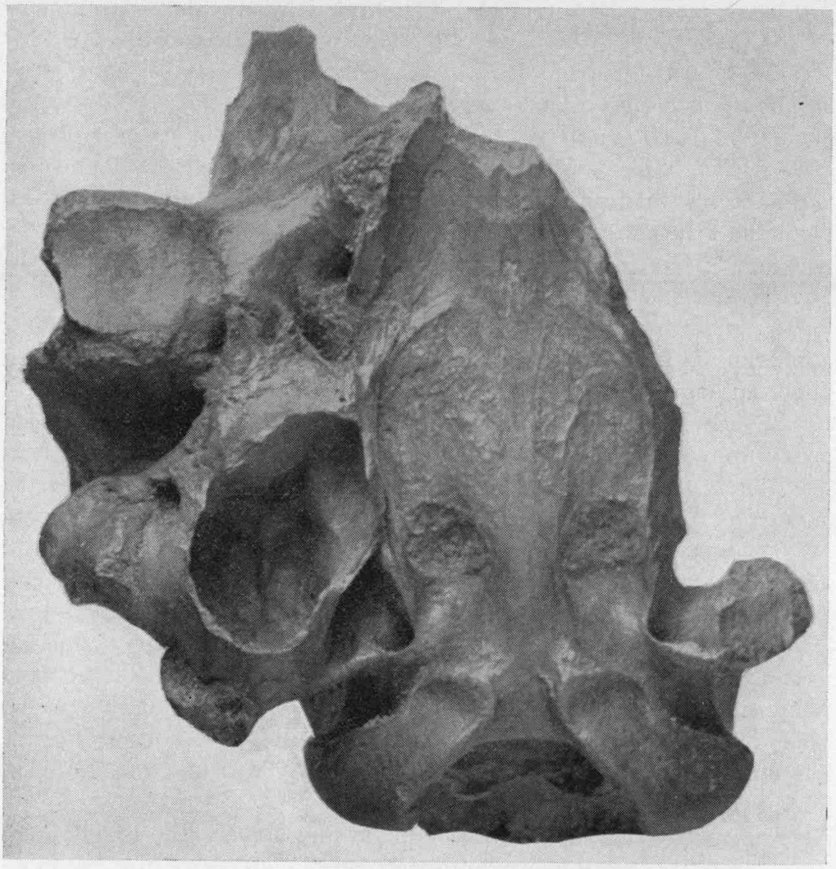

Fig. 6. FGS V-5696, rear part of skull of *Felis onca*, channel at Stickney Point, ventral view.

The size of the limb bones and especially of the teeth suggests a division into a larger and a smaller group, probably representing the two sexes (see Simpson, 1941). Both groups seem to reach very large dimensions in the Reddick I material. The upper carnassial of FGS V-5695 is especially noteworthy; its length equals that of the smallest *Felis atrox* specimen recorded by Merriam and Stock.

The juvenile specimen, UF 2565, consists only of that part of the ramus carrying the two cheek teeth. The metaconid part of the milk carnassial has been broken off. What remains of the talonid suggests that it was weakly developed; it does not form a distinct cusp as in *Smilodon*. The milk teeth are unworn and well preserved.

D_3 has a large anterior cusp. The broken ramus shows fragments of the germ of P_4, which was still deeply embedded in the jaw.

The limb bones from Haile VII A (tables 7, 9, 11, 13; fig. 5) represent animals of the same size as the Reddick material. The juvenile mandible (fig. 4) is noteworthy because of its excellent state of preservation. The milk dentition is represented by the canine and the two cheek teeth. In front the permanent I_1 and canine are pushing up; their tips reach the level of the gum. Behind the milk carnassial an opening is developing into the cavity containing the germ of M_1.

For a jaguar of this age the specimen is large; nevertheless the teeth appear to be definitely smaller than those of the juvenile *Felis atrox* figured by Merriam and Stock in their Plate 32, fig. 5, for which these authors unfortunately give no measurements. The cheek teeth are slightly larger than those from Reddick (table 4). The carnassial has a well-developed metaconid oriented vertically, not tilted backward as in *Smilodon*. The talonid is a weak basal swelling; while in *Smilodon* it forms a second cusp. The accessory cusps of D_3 are weaker than in the Reddick jaw, and the anterior cusp is reminiscent of some *Smilodon* specimens figured by Merriam and Stock. The other characters of the jaw and teeth, however, are not smilodontine. The deciduous canine is larger, and the diastema between it and D_3 is shorter than in juvenile *Smilodon*; the germ of the permanent canine shows it to be a much larger tooth than in *Smilodon* and to lack the sharp posterior ridge of the latter; and finally the coronoid process, though most of it has been broken off, clearly was much larger than in the sabertooth.

The specimen from Stickney Point is also remarkable for its great size (table 5). All the measurements are in excess of the recorded range for the recent jaguar tabulated by Merriam and Stock, and all of the width measurements fall within the range of *Felis atrox*. However, simple graphic bivariate analysis (fig. 7) demonstrates that the specimen is certainly a large true jaguar, and not a small *Felis atrox*. The length of the skull, as expressed by the postglenoid length, falls far short of the minimum in *Felis atrox*, while the great width is simply what would be expected in a *Felis onca* of this length. The morphological characters of this specimen are in general those of a powerful *Felis onca*, except for the shape of the jugular process where it borders the condylar foramen; this is more like that in *Felis atrox* as figured by Merriam and Stock (p. 197).

The Santa Fe I material (see tables 2-3) represents large jaguars of about the same size as specimens referred to *Felis onca augusta* Leidy by Simpson (1941) and others. There is nothing to differentiate the Santa Fe specimens from late Pleistocene material of *Felis onca* in Florida, although the possibility that some of them belong to the older faunal stratum cannot be ruled out. See also the general discussion below.

Simpson (1941) referred the Florida fossil jaguars to the subspecies *Felis onca augusta* Leidy, distinguished from the recent jaguar by its larger average size.

Some illuminating comparisons may be made by using the recent jaguar skeleton as a standard and expressing the excess size of the fossil specimens as percentages of the dimensions in the recent (essentially the same method as the ratio diagram of Simpson, 1941). It must be remembered that the recent skeleton used is a single indi-

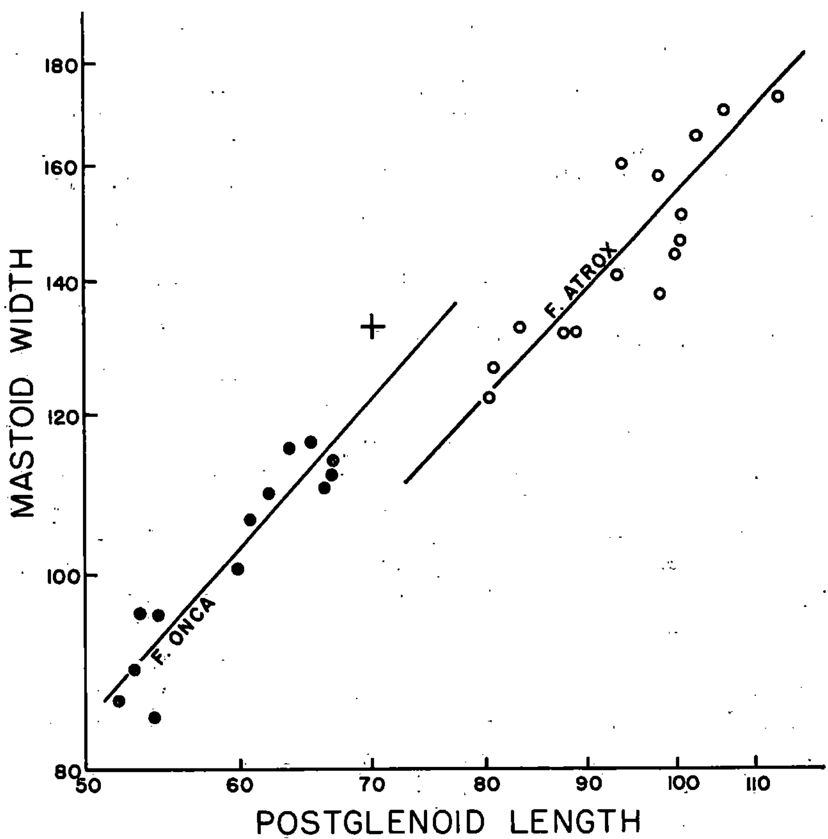

Fig. 7. Allometric relationships between mastoid width (ordinate) and postglenoid length (abscissa) in *Felis onca* (solid circles) and *Felis atrox* (hollow circles). The specimen from Stickney Point (fig. 8) is represented by the cross.

vidual and not a standard or a norm for the living jaguar; actually it is a relatively small individual.

The long bones and metapodials from Reddick I and Haile VII are 37 to 47 per cent longer than those of the modern skeleton, with a mean of 42 per cent. The greatest diameters of the carpal and tarsal bones from Reddick are 40 to 69 per cent larger than in the modern skeleton, with a mean of 55 per cent. The greater increase in carpal and tarsal diameters over long bone lengths reflects the comparative stockiness of the limbs.

The dimensions of the long bones and metapodials reflect the greater weight of the middle Pleistocene form. The increase by 42 per cent in linear dimensions indicates an increase in volume of nearly 190 per cent, so that the great Reddick jaguar probably weighed almost three times as much as the modern female specimen used for comparison. As the cross section of the long bones should also increase in proportion, with a weight increase of 190 per cent the transverse diameter should increase by some 69 per cent. Actually the shaft width of the Haile and Reddick long bones and metapodials varies between 52 and 75 per cent greater than in the modern skeleton, and the mean of about 66 per cent is very close to the anticipated figure.

Simpson (1941) records the fossil jaguars of North America as subspecies of the modern species. McCrady *et al.* (1951) consider *Felis augustus* a good species on the basis of the great differences in its relative proportions and of its intermediate size between living jaguars and *Felis atrox*. This proposal loses much of its force when it is considered that the changes in relative proportions appear to be functions of size. The stoutness of the limb bones is directly proportional to the increase in weight. In all the metric characters I have investigated, the fossil jaguars represent a direct continuation of the allometric trends of the living population. The example shown in fig. 7 indicates that the great relative width of the skull, which is one of the differential characters McCrady *et al.*, used, results from simple allometry. Figure 8, an example of dental allometry, also indicates *Felis augustus* is nothing but a large *Felis onca*. These comparisons could easily be multiplied. For instance, limb bone proportions show the same relationships; the relatively short limbs of the large fossil form are like those of the jaguar and completely different from those of *Felis atrox*.

Thus size is the basic character differentiating this group of fossil jaguars from the recent forms. In living jaguars, as Simpson (1941) points out, size is directly related to climate; the smallest forms are

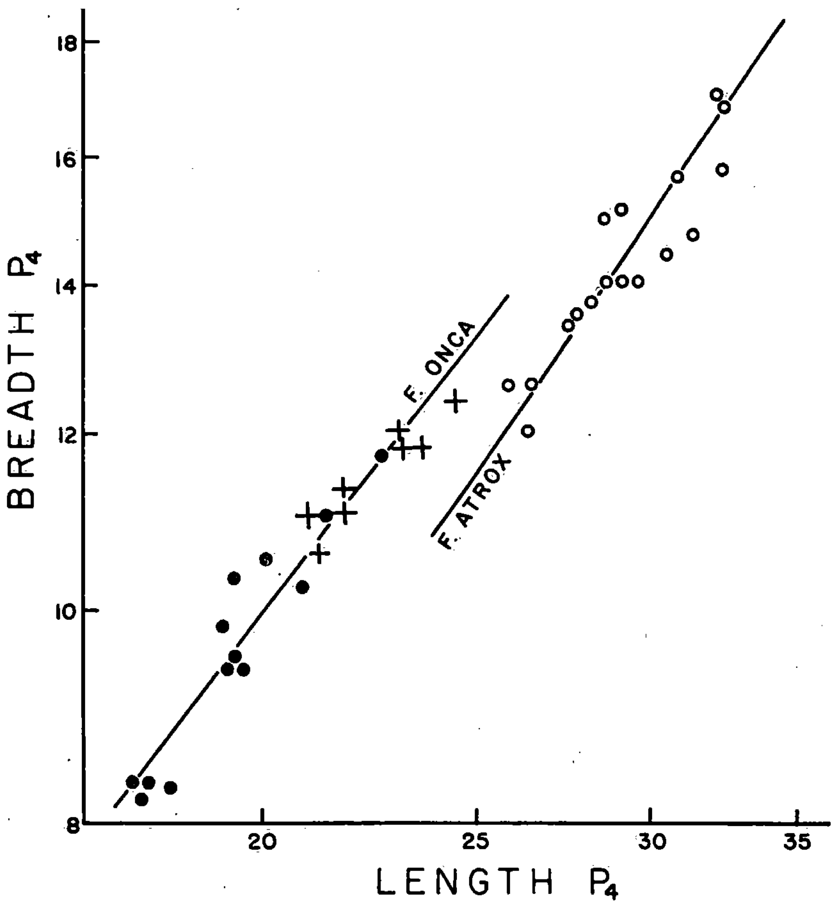

Fig. 8. Allometric relationships between breadth (ordinate) and length (abscissa) of fourth lower premolar. Dots represent recent *Felis onca*, crosses fossil *Felis onca augusta*, and circles *Felis atrox*.

found in the equatorial area, from which clines of increasing size extend north and south. The large size of the fossil form may thus be related to the climate, at least to some extent. Further, the large Pleistocene form probably was in direct genetic continuity with the recent jaguars in the areas where they survive.

The situation in this species is evidently analogous in many respects to that in the Old World *Crocuta crocuta*, in which similar systems of clines climb north and south from an equatorial low (Kurten, 1958); the extinct northernmost form in Europe exceeded all the others in size, but was connected with the smaller forms by a series of transitional populations. The amount of differentiation seen in the jaguar, however, is definitely inferior to that in the spotted hyenas.

The *Felis onca* material from the older fauna (Reddick, Kendrick, Haile, Arredondo) seems, on an average, slightly larger in dimensions than that in the younger fauna (Devil's Den, Melbourne, Vero, Seminole Field). The humerus from Devil's Den is only 27 per cent larger than that of the recent specimen, while the long bones from Reddick and Haile are 39-47 per cent larger. The cheek teeth of the jaguars in the early fauna are between 11 and 47 per cent larger than in recent ISM 1068, with a mean increase of 27 per cent; the corresponding figures for the late fauna are -1 and 36 per cent, mean 21 per cent. Statistically these differences are of doubtful significance, but the indication that the jaguar tended to decrease in size during the late Pleistocene is well worth keeping in mind. This trend has been observed in several other animals (Hooijer, 1950; Kurten, 1958).

Felis concolor Linnaeus

Puma, Cougar

MATERIAL EXAMINED:

REDDICK I. UF 8895, left astragalus.

SEMINOLE FIELD. AMNH 23540, fragmentary right P_4 (specimen of *Felis onca* under same number); AMNH 23541, right P^4; no number, fragmentary left P_4.

Simpson (1929b, 1941) described the upper carnassial and referred it to *Felis inexpectata* (Cope). All of the material (table 14) is well within the size range of modern puma.

REMARKS. The astragalus of the puma differs from that of the jaguar in a number of characters, several of which may be noted in ventral view, as shown in fig. 9. The fauna ectal (astragalocalcaneal) facet is much constricted posteriorly and tapers almost to a point; in the jaguar it is much broader. The sustentacular facet also tapers backward to a greater extent than in the jaguar. In front the ectal facet is rather deeply notched just behind the head; the notch is weak or absent in the jaguar. The medial crest of the tibial trochlea is drawn out backwards almost to a point in ventral view; in the jaguar this process is broad and blunt. The neck of the puma astragalus is relatively longer than that of the jaguar. The medial side of the bone carries a shallow, broad, vertical groove in the puma but has an almost flat surface in the jaguar. In all these respects UF 8895 corresponds to the puma and differs from the jaguar.

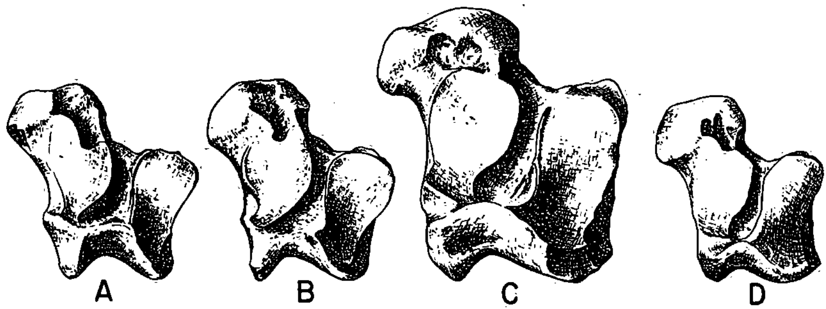

Fig. 9. Left astragali of *Felis concolor* and *Felis onca*, ventral view. A UF 8895, *Felis concolor, Reddick*; B USNM 172688 *Felis concolor,* recent; C UF8889, *Felis onca augusta,* Reddick; D ISM 684295, *Felis onca,* recent.

The size of the fossil astragalus from Reddick I is the same as in the recent puma (table 9), slightly larger than in the recent jaguar skeleton, but much smaller than in the fossil jaguars from Reddick I. The puma is a relatively large-footed cat, and its foot bones are proportionately larger than those of a jaguar of similar size. I have seen no other bones from Reddick that I could ascribe to puma. The slender metapodials of the puma are quite different from the heavy bones of the Reddick jaguar.

Ray (1958) ascribes a radius and foot bones from Melbourne to puma (as *Felis inexpectata*), but notes they are indistinguishable from comparable elements of recent *Felis concolor*. Unlike the jaguar, the fossil puma does not differ appreciably in size from its living descendant. This is also true for most fossil pumas from other parts of North America, as Simpson's (1941) fig. 4 shows.

Most fossil pumas of North America have been referred in recent years to the species *Felis inexpectata*, which simpson (1941) noted is insufficiently distinguishable from *Felis concolor*. Actually the fossil puma resembles the living puma even more closely than the fossil *Felis onca augusta* resembles the living jaguar. Thus retaining *Felis inexpectata* as a species distinct from *Felis concolor* serves no useful purpose. As a subspecies *inexpectata* would be valid primarily for the Middle Pleistocene pumas, as the type comes from Port Kennedy Cave. The puma material from Conard Fissure and Cumberland Cave is relatively large, and this may be a distinctive character for the Middle Pleistocene form. The earliest available name for a Late Pleistocene subspecies of puma appears to be either *Felis hawveri* Stock or *Felis daggetti* Merriam, both from California. However, the Late Pleistocene form may turn out to be identical with living subspecies of puma.

Felis rufus Schreber

Bobcat

Felis rufus koakudsi,[1] new subspecies

TYPE: UF 3246, skull fragment with right P^3-P^4 and left P^4 (fig. 10).

TYPE LOCALITY AND HORIZON: Reddick, Marion County, Florida; Pleistocene, probably early Sangamon or late Illinoian.

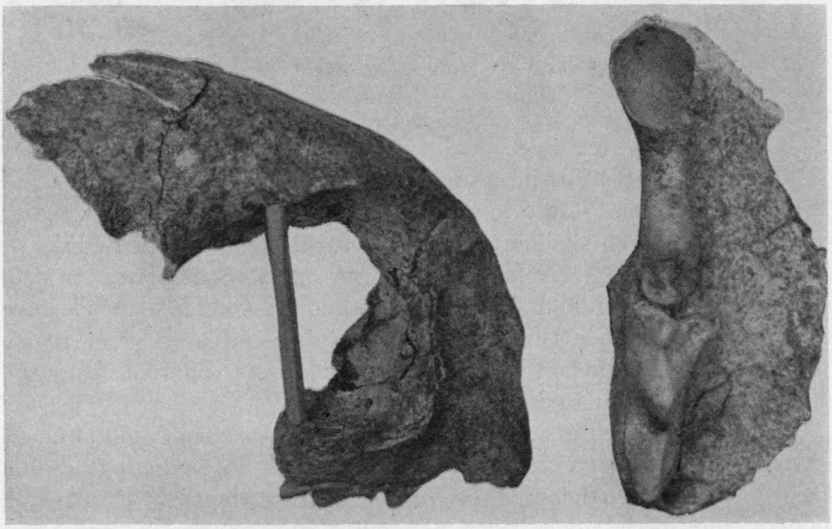

Fig. 10. UF 3246, skull fragment of *Felis rufus koakudsi*, new subspecies. type. Left, lateral view; right, ventral view of dentition.

DIAGNOSIS: Size, especially of carnassial, larger than in other known *Felis rufus* (dimensions of type in table 15).

REMARKS: Small cats are comparatively rare at Reddick I. The only specimen of bobcat is a fragmentary skull consisting of the main part of the right side of the face with the orbit and postorbital process and fragments of the left side. P^3-P^4 are present on the right side (as usual in lynxes there is no trace of P^2) as well as the alveoli for the canine and M^1. Only the carnassial and the M^1 alveolus are preserved on the left side.

The skull and teeth resemble those of the recent bobcat except in size. Like so many other Pleistocene forms, the Reddick bobcat is definitely larger than its present-day ally, so that it even compares

[1] Derivation: "Wildcat" in Muskogee, one of the languages of the Seminole Indians; also the name of a noted Seminole chief, usually spelled Coacoochee.

with the Canada lynx in size. The data are summarized in table 15; figures 11-12 give scatter diagram comparisons between *Felis rufus*, *Felis canadensis*, and the Reddick lynx.

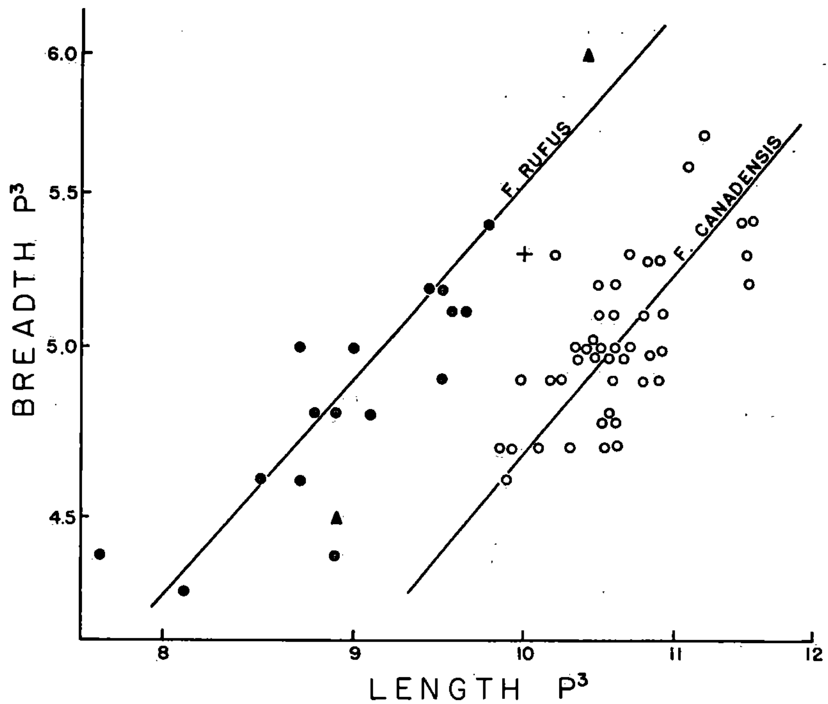

Fig. 11. Allometric relationships between breadth (ordinate) and length (abscissa) of third upper premolar in lynxes of North America. Dots, *Felis rufus floridanus* and *Felis rufus baileyi*, recent; triangles, *Felis rufus floridanus*, late Pleistocene; cross, *Felis rufus koakudsi*, type, Reddick; circles, *Felis canadensis*.

The size of the carnassial greatly exceeds that in the living bobcat (table 16). In fact, the Reddick P^4 is as large as some of the largest specimens of *Felis canadensis* recorded by Merriam and Stock (1932). The fossil specimen is not *Felis canadensis* because its paracone is too large in relation to the total length of the P^4 crown (fig. 12). The third premolar in the bobcat tends to be relatively broader than in the Canada lynx, and in this respect the Reddick specimen also conforms to the *Felis rufus* pattern (fig. 11).

In addition the average relationship between the length of P^3 and P^4 (index 100 LP^3/LP^4) differs slightly in *Felis rufus* and *Felis canadensis*. Table 16 shows the Reddick specimen is within the observed range of variation of the bobcat and not of the lynx. However, it must be noted that Merriam and Stock's lynx sample shows anomalously low variation and is probably not truly representative of the range in that species. In any case the dentition of the Reddick skull appears to be of bobcat type and morphologically distinct from the Canada lynx, although in size this animal must have been approximately equal to *Felis canadensis.*

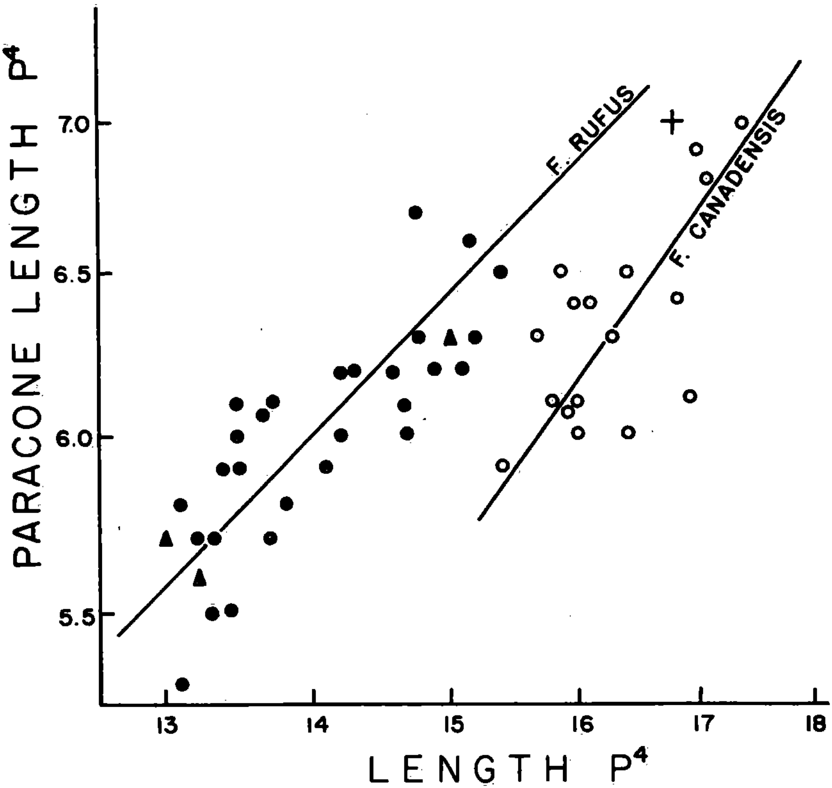

Fig. 12. Allometric relationships between length of paracone (ordinate) and total crown length of upper carnassial in lynxes. Symbols as in fig. 11.

In keeping with its large size, the specimen is broad-faced for a bobcat (see table 16, interorbital width), but this character is positively allometric (Kurtén and Rausch, 1959) and a high value is to be expected. The narrowness of the postorbital constriction is evidently due to the fact that this dimension is negatively correlated with skull size in lynxes (*ibid.*). Unfortunately the postorbital process is broken at the tip, but it seems to have been more weakly developed than in the average bobcat, and perhaps more like the Canada lynx. However, this character is highly variable within both species.

Fossil bobcats of Middle Pleistocene age have been described under the names *Lynx calcaratus* by Cope (1899) and *Lynx compressus* by Brown (1908) from Port Kennedy Cave and Conard Fissure, respectively. Statistics for these (samples) are given in tables 15-17. The upper carnassial of these forms, although slightly larger than in the modern bobcat, is still much smaller than that of the Reddick specimen. The Conard Fissure form may have been approximately contemporaneous with the Reddick subspecies.

REFERRED SPECIMENS: Haile VIII. UF 3103, right mandible (fig. 13). Arredondo II. UF 1716, right humerus, lacking the proximal end.

The Haile VIII specimen is referred to *Felis rufus koakudsi* on the following grounds: (1) Its unusually large size, especially the carnassial which exceeds all other fossil bobcats from Florida (table 17); (2) The age of the fissure at Haile is pre-Sangamon maximum, and may be approximately the same age as Reddick 1.

The mandible belonged to a young individual with unworn teeth, which accounts for the shallowness of the ramus. The large carnassial carries small but clearly identifiable metaconid and talonid elements, not too commonly seen in bobcat.

The apparently pre-Sangamon age of the Arredondo II fauna suggests that the bobcat from this locality belonged to the same population as the Reddick 1 form. The humerus, indeed, is slightly larger than the largest recent specimen available to me for comparison (table 19). Morphologically the only significant character of this specimen seems to be the unusually great width of the bar enclosing the entepicondylar foramen.

Holman (1959) mentioned *Felis rufus* from Williston III, Alachua County, but did not describe the material. If the age of this fissure filling is the same as that of Reddick, the material would presumably be *Felis rufus koakudsi*.

Felis rufus floridanus Rafinesque

MATERIAL EXAMINED:

SABERTOOTH CAVE. AMNH 23405, right maxilla and left mandible.

The upper and lower jaws of a bobcat from this locality were described by Simpson (1929a). For measurements, see tables 15, 17. The size of the teeth is somewhat below the average for recent

Felis rufus floridanus but well within the observed range for that subspecies. As this form cannot be *Felis rufus koakudsi*, it suggests that the Sabertooth Cave fauna postdates that of Reddick I, as Auffenberg (1958) believes.

ICHETUCKNEE RIVER. UF 9257, left mandible.

A specimen of the same appearance as the modern form (table 17).

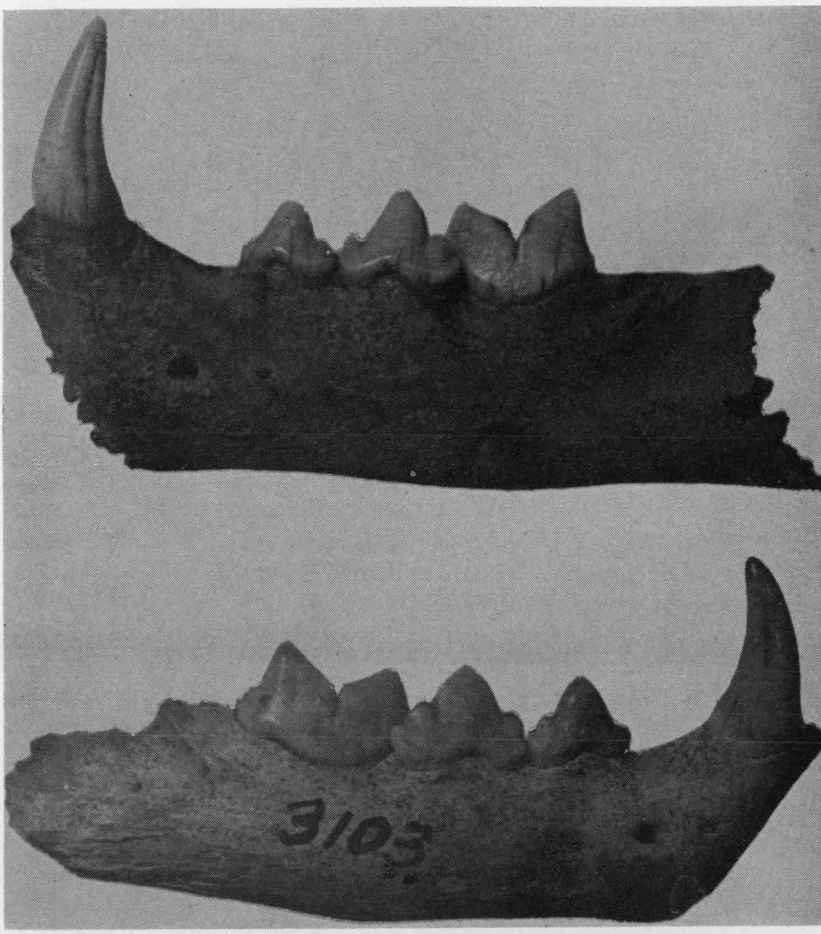

Fig. 13. Mandibles of *Felis rufus*, external view. Above, left jaw of *Felis rufus floridanus*, Ichetucknee River beds. Below, right jaw of *Felis rufus koakudsi*, UF 3103, Haile VIII.

NOCATEE. UF 9121, cast of left mandible.

Some measurements of this specimen are below the observed range in the modern sample (table 17), but as they are not significantly different, it is best regarded as a variant of the modern subspecies.

SANFORD. Gut (1938) listed bobcat among the material dredged from Lake Monroe.

MELBOURNE. MCZ 17781, right P^4; USNM 11205, left M_1; USNM 11479, right P^4; USNM 12948, left mandible; USNM, no number, right mandible, left M_1.

This material (tables 15, 17) closely resembles the modern form (Gazin, 1950; Ray, 1958).

VERO. Hay (1917) mentions a mandible and a tibia; Weigel (1962) lists bobcat on the basis of a radius and a premolar, and notes the small size of the radius.

SEMINOLE FIELD. AMNH 23534, left mandible; AMNH 23535, right mandible; AMNH, no number, four mandibles, left P^3, left P^4; distal humerus fragment, proximal fragments of two left and one right radius, proximal fragment of right ulna, left MC II, left MC IV.

Some of this material, notably the two P_4 and the single P^3, is slightly larger than the observed range for recent *Felis rufus floridanus*, but the difference is very slight in each case (tables 15-18). The humerus has a distal width of 28.0 mm., which is slightly larger than the largest recent humerus in my sample (see table 19). Otherwise the material is within the range of the modern subspecies (Simpson, 1929b).

REMARKS. The data in table 18 illustrate trends of size evolution. This table also includes the statistics for a sample of Late Pleistocene bobcat from New Mexico and California. The material comes from Burnet Cave, New Mexico (ANSP), a cave near Folsom, New Mexico (AMNH), Potter Creek Cave, California (UCB) and Rancho La Brea (LACM).

The figures show a slight decrease in size since the Yarmouth and Illinoian. The dimensions of the Port Kennedy Cave and Conard Fissure bobcats average slightly greater than those of the recent, while the Late Pleistocene forms tend to be intermediate. The change is not comparable to the dwarfing seen in the jaguar. Incidentally, it may be noted that the western form in the Late Pleistocene averaged slightly larger than the Floridian.

The large Reddick subspecies appears to represent an aberrant, short-lived offshoot. Whether the Haile mandible should be referred to this form is not quite certain, but it may be noted that it also has a relatively large M_1, as indicated by the value of the index 100 M_1/P_3 (table 18). This may perhaps be correlated with the large size of P^4 in the Reddick form. *Felis rufus koakudsi* seems to have vanished well before the Sangamon maximum, perhaps at the end of the Illinoian.

Felis pardalis Linnaeus

Ocelot

MATERIAL EXAMINED:

REDDICK I. UF 3858, left mandible (described and figured by Ray, Olsen and Gut, 1963).

HAILE IA. UF 8960, proximal end of right femur.

The Haile IA specimen is tentatively referred to ocelot. It seems much too heavy for bobcat (table 20). It is also rather heavier than the single ocelot specimen available to me, but otherwise resembles this specimen rather closely. As in the ocelot the greater trochanter rises to a somewhat higher level, relative to the head, than in the bobcat; it also has a more pointed profile. The lesser trochanter is somewhat inflected to the medial side instead of protruding vertically backward as in the bobcat. The external margin of the femur extending downward from the greater trochanter tends to be slightly convex instead of concave as in the bobcat. On the other hand UF 8960 differs from the recent ocelot specimen in the length of the neck, the weak development of the tuberosity internal to the digital fossa, and the more elongate cross section of the shaft. Some recent evidence suggests this deposit may be older than Reddick I and its chronologic equivalents (Auffenberg, pers. comm.).

Felis yagouaroundi Geoffroy

Jaguarundi

MATERIAL EXAMINED:

ROCK SPRINGS. UF 4522, right mandible (described by Ray, 1964).

MELBOURNE. USNM 22913 (mentioned by Gazin, 1950, and described by Ray, 1964).

MERRITT ISLAND. UF 9254, right mandible.

REMARKS: The taxonomy of the jaguarundi-margay group is in an unsatisfactory state. Until the recent forms are revised, little can be done with the fossils.

Smilodon fatalis Leidy

Sabertooth

MATERIAL EXAMINED:

BONE CAVE. UF 6540, left maxillary fragment of juvenile individual with D^3.

SANTA FE RIVER LOCALITY I. FDT 488, right P_4 (fig. 14).

REDDICK I. FGS V-5690, left ectocuneiform, left MT IV, right MT II; UF 2537, right pisiform, right MC V, left MC III-IV, left MT II-III. These foot bones may well represent a single individual, for no bones are duplicated, the ones that can be articulated have a perfect fit, and all are of the same size class.

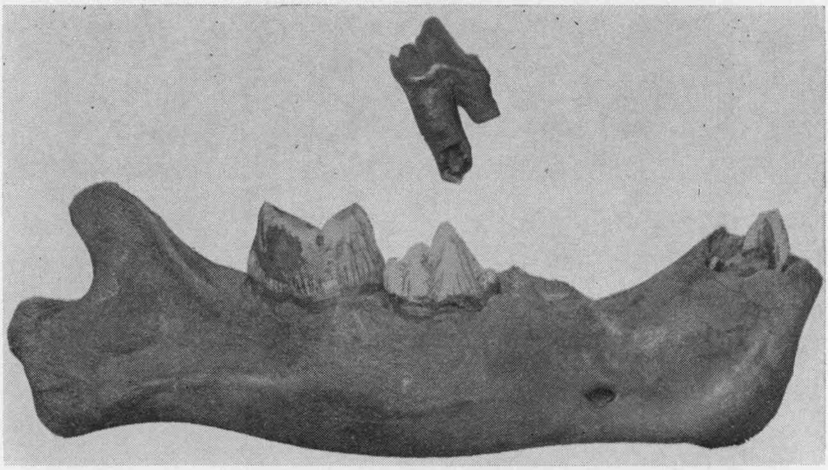

Fig. 14. Above, FDT 488, right P_4 of *Smilodon* sp., possibly *Smilodon fatalis* or *Smilodon gracilis,* probably Middle Pleistocene, Santa Fe River beds. Below, UF 4115, right mandible of young *Smilodon fatalis,* Ichetucknee River beds. Note presence of root of P_3 in front of the partially emerged P_4.

ICHETUCKNEE RIVER. UF 3470, part of right maxilla with P^4; UF 4114, left mandibular ramus with I_3, C_1, and P_4-M_1; UF 4115, right mandibular ramus with roots of C_1 and P_3, and crowns of P_4-M_1 (fig. 14); UF 8979, hind part of skull (fig. 15); UF 9247, fragment of left maxilla with P^4, mirrow image of UF 3470, probably same individual.

ARREDONDO I. UF 2562, a partial skeleton with 10 thoracic and 6 lumbar vertebrae, sacrum, 22 ribs, right innominate, fragmentary right and left scapulae, humerus, radius, ulna, femur, patella, and tibia of both sides, left fibula, left astragalus and calcaneus, left MT II-V and one phalanx. This skeleton, collected by W. Auffenberg, belongs to a subadult individual. The epiphyses of the long bones and vertebrae are not yet completely fused, and some have been lost, for instance the distal epiphyses of all the forearm bones.

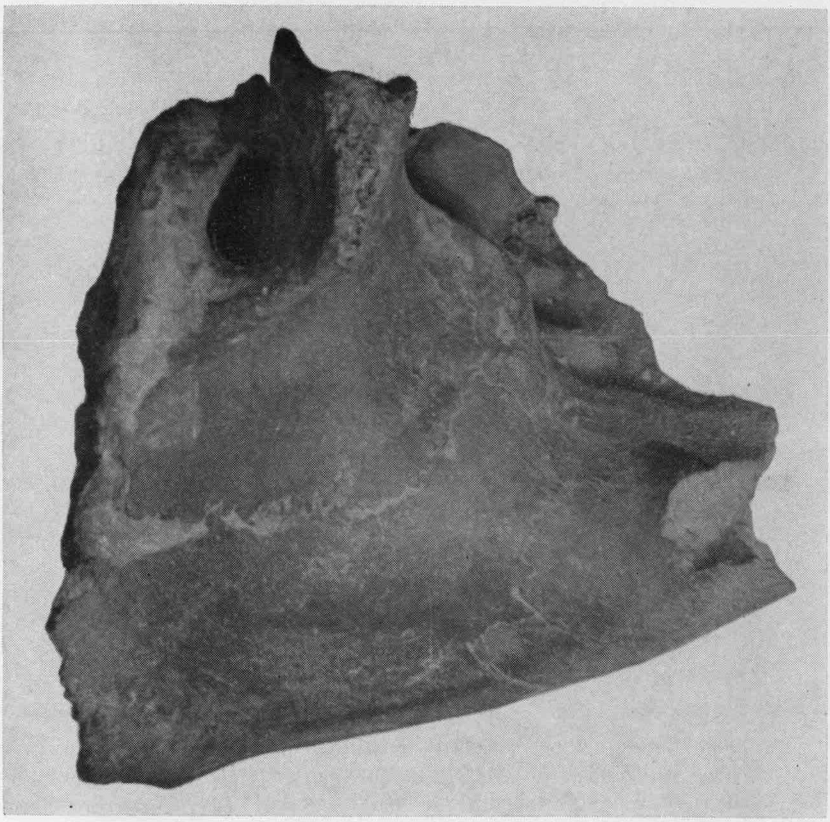

Fig. 15. UF 8979, rear part of skull of *Smilodon fatalis*, lacking occipitals, Ichetucknee River beds, left side view.

SABERTOOTH CAVE. USNM 11235, (cast). Various additional material described by Simpson (1929a).

MELBOURNE. USNM, no number, left P^4, described by Gazin (1950).

VERO. P^4 and a fragmentary saber, described and figured by Sellards (1916), and referred to *Trucifelis* (= *Smilodon*) *floridanus* by Hay (1919).

SEMINOLE FIELD. AMNH 23538, a fragmentary left M_1, described by Simpson (1929b).

OCALA. The type of *Smilodon floridanus*, a skull, was described by Leidy in 1889 from a limestone mine in this area and compared with Rancho La Brea material by Merriam and Stock (1932).

REMARKS: The left and right upper jaw fragments from the Ichetucknee River have perfectly preserved P^4s that show very little wear. They have no protocone, but the corresponding root is present and runs into the crown and forms a distinct medial style extending to the tip of the paracone. The prostyle is prominent. The size (table 21) is near the average for Rancho La Brea. The damaged walls for the alveoli of P^3 and the upper canine may also be seen, as well as the alveoli for the two roots of M^1. The lower rim of the orbit and the lower part of the large, oval infraorbital fossa are preserved and resemble the corresponding structures in the Rancho La Brea material. The preserved part of the palate shows a deep longitudinal corrugation.

UF 4114, a left mandible, has greatly worn cheek teeth. The third incisor is also much worn. The canine is broken near the base of the enamel. There is no trace of P_3. In shape this specimen is quite similar to the mandible from Rancho La Brea Merriam and Stock (1932) figured in their plate 4, figure 10. For measurements see table 22.

UF 4115 (fig. 14) is the right mandible of a young individual in which the fourth premolar is still in the process of emerging. It differs from most Rancho La Brea specimens by the presence of P_3; only the single root is preserved. Only fragments of the canine are preserved, but both P_4 and M_1 are in good shape, and unworn. As in UF 4114, there is no trace of the accessory anterior cuspule found in most Rancho La Brea M_1. The sizes of both lower jaws and their teeth are mostly within the Rancho La Brea range. Some mandibular measurements of UF 4115 are below those recorded for adult *Smilodon*, but this is presumably due to the youth of this individual.

The posterior part of a skull, UF 8979, may also be referred to *Smilodon*. This specimen is rather small in comparison with the Rancho La Brea form. In part this is evidently due to immaturity, for the sutures are still perfectly visible and all the occipital series of bones have been lost, the breakage following the suture lines. In front the skull is broken off behind the orbits, so that essentially only the braincase with the posterior roots of the zygomatic arches is preserved. The characters of this portion, including the position and size of the foramina, the development of the mastoid processes, the orientation of the glenoid fossa, and the shape of the postorbital processes, are of the smilodont type. The specimen is neither a *Felis* nor a *Dinobastis*.

A comparison between the measurements of UF 8979 and the series of juvenile skulls of *Smilodon* described by Merriam and Stock (table 23) shows that the width across the mastoid processes is well below the range for the California sample. A bivariate analysis of this variate together with the width across the postorbital constriction (fig. 16) suggests a real difference existed in this relationship between the Californian and Floridian forms.

The specimen from Bone Cave is similar to milk carnassials of *Smilodon* from Rancho La Brea figured and described by Merriam and Stock. There is a small prostyle; this is present in some Californian specimens, absent in others. The inner root does not carry a distinct cusp, and the morphology of this part of the tooth is diagnostic of *Smilodon*. The carnassial length of 21.6 mm is apparently much the same as in the Rancho La Brea teeth, though no data were given by Merriam and Stock. The tooth is quite unworn and appears to be of a very young individual. Part of the alveolus of the milk canine is visible in front; the diastema between it and D^3 is 7.0 mm. long. Behind the carnassial is a trace of the alveolus for one of the roots of D^4, and also part of the cavity that held the germ of P^4, still showing the impressions of the parastyle and paracone. The point of the latter had already pierced the palate.

The small size of the Arredondo I specimen (see tables 24-28) is presumably due in part to its age. Most measurements fall near the lower limits of the ranges recorded by Merriam and Stock from Rancho La Brea, and some measurements of the scapula, pelvis, and humerus are smaller than the smallest in the tar pit sample. When the Florida material is compared with the Rancho La Brea sample, a number of differences are apparent, which may be summarized as follows:

(1) Size. The Florida material varies in size from specimens distinctly smaller than anything recorded from Rancho La Brea (Santa Fe River Beds, Sabertooth Cave) to specimens at or slightly over the midpoint of the Rancho La Brea range (Reddick; Ichetucknee maxillaries and one of the Ichetucknee jaws). The majority fall in the lower half of the Rancho La Brea size range (Ocala, Ichetucknee skull and adult mandible, Arredondo, Melbourne, Seminole Field). Altogether this is good evidence that the Florida sabertooth averaged

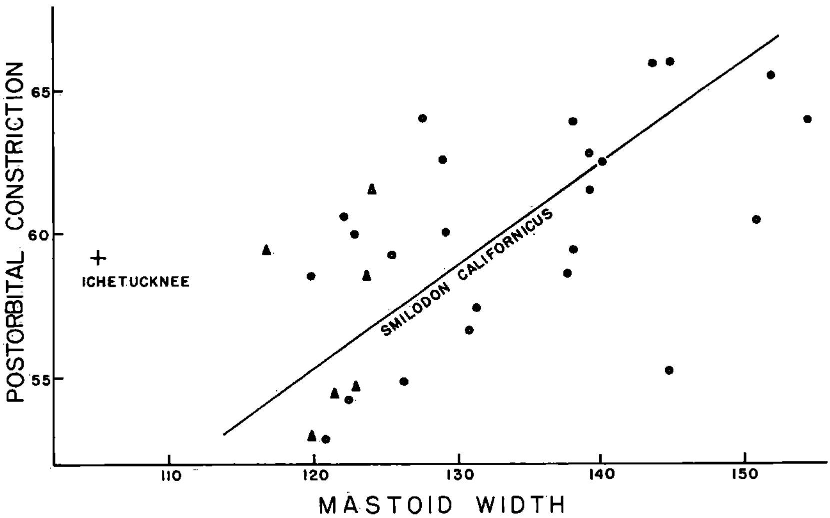

Fig. 16. Covariation between width across postorbital constriction (ordinate) and mastoid width (abscissa) in *Smilodon*. Dots, adult and triangles, juvenile individuals from Rancho La Brea, with major axis; cross, Ichetucknee specimen (fig. 15).

somewhat smaller than the Rancho La Brea form, although the ranges of the two overlapped. As the Smilodontini seems to have tended to increase in size with time, the Florida sabertooth material may illustrate the retention of a more primitive trait.

(2) The relationship between mastoid width and interorbital width is somewhat different from that in the tar pit sample. The narrowness of the mastoid region in the Florida sabertooth is presumably also a primitive character.

(3) No accessory cuspule on M_1 is apparent, whereas at Rancho La Brea it is present in "nearly all cases" (Merriam and Stock, 1932). This cusp, which effects an elongation of the carnassial shear, is a late evolutionary innovation in *Smilodon,* so that its absence, too, is a primitive trait.

In all these respects, then, the Floridian form appears to be less advanced than the Californian. The differences may well be due to the greater average age of the Florida material, of which a fair proportion may be pre-Wisconsin, whereas the tar pit material appears to be Late Wisconsin.

The most recent revision of the North American *Smilodon* by Slaughter (1963) divides the genus into three successive species, as follows:

Smilodon gracilis (Cope). Yarmouth.

Smilodon fatalis (Leidy). Illinoian, Sangamon, and Early Wisconsin. This form includes as synonyms or subspecies a number of proposed species: *S. troglodytes* (Brown), *S. conardi* (Brown), *S. nebrascensis* (Matthew), and *S. trinitiensis* Slaughter.

Smilodon floridanus (Leidy). Late Wisconsin, approximately from the glacial maximum of some 18,000 B.P. This species may include *S. californicus* Bovard.

I regard Slaughter's scheme as valid in its main framework, and only subject to slight changes suggested by the present study of the Florida material. Slaughter's conclusions on the Florida sabertooth were based mainly on the Ichetucknee mandibles, which are likely to be Late Wisconsin in age. Much of the Florida material, including the type skull from Ocala and the specimens from Reddick I, Bone Cave, Arredondo I and II, and Sabertooth Cave, is apparently of pre-Wisconsin age and falls in the chronological range of *Smilodon fatalis* as defined by Slaughter. Furthermore, this material resembles *Smilodon fatalis* rather than *Smilodon californicus* in the characters discussed above. It seems necessary to conclude, therefore, that *Smilodon floridanus* is a synonym of *Smilodon fatalis*.

This procedure leaves only the Wisconsin forms of Ichetucknee, Melbourne, Vero, and Seminole Field for possible inclusion in *Smilodon californicus*, if that species is regarded as validly distinguishable from *Smilodon fatalis*. However in spite of their relatively recent age, these specimens are still less advanced than the Rancho La Brea form in all the four characters discussed above. They seem in fact to take an intermediate position between typical *Smilodon fatalis* and the progressive *Smilodon californicus*.

This is brought out rather clearly if average size indices are computed (table 29). Only dental material was used, to avoid the bias introduced by the juvenile skeletons in the Florida collection. The mean index for the Late Pleistocene Florida sabertooth is 98.1, intermediate between that for Rancho La Brea (100%) and that for Slaughter's material of *Smilodon fatalis* from Texas, Nebraska, and the Irvingtonian of California (95.7%). Unfortunately no index for the earlier Floridian form could be computed, as no appropriate dental material is available.

Table 29 shows the gradual size increase in the Smilodontini. Taken separately, the earliest representative of *Smilodon fatalis*, from Conard Fissure, has a mean index of 92.3, while the still earlier *Smilodon gracilis* from Port Kennedy Cave has a mean of 79.9 per cent. In comparison, the index for the P_4 from Santa Fe is 85 per cent, intermediate between *Smilodon gracilis* and early *Smilodon fatalis*. It is impossible at present to decide between these alternatives.

DISCUSSION AND CONCLUSIONS

Distribution

The distribution of the seven species of felids known from the Florida Pleistocene is indicated in figure 1. Table 30 shows the approximate number of individuals probably represented at each locality by the material reviewed in the present paper. In two instances, the available information was insufficient, and only presence has been recorded.

The material may be divided roughly into two successive faunas: an early fauna probably dating from the Illinoian and early Sangamon, and a late fauna mainly of Wisconsin date. The former group includes the material from Arredondo, Haile, Williston, Reddick, Kendrick, Ocala, Sabertooth Cave, Bone Cave, and probably part of the Santa Fe (the *Smilodon* specimen). The late fauna is represented by the fossils from Ichetucknee, Devil's Den, Sanford, Rock Springs, Seminole Field, Stickney Point, Melbourne, Merritt Island, Vero, Nocatee, and probably also the *Felis atrox* and *Felis onca* material from Santa Fe.

Table 31 lists the relative representation of the various species in the two successive faunas and in the total material by percentages based on absolute totals of 30 individuals in the early fauna and 49 in the late. Naturally, no direct conclusions on the relative abundance of two species are possible on the basis that Reddick I has yielded eight jaguars but only one ocelot. On the other hand, changes through time in the percentages present of any single species, or even of two ecologically closely similar species, may be valid indications of real population trends (Kurten, 1965).

All the large members of the genus *Felis* known from the later Pleistocene of North America ranged into Florida: *Felis atrox*, *Felis onca*, and *Felis concolor*. But *atrox* has so far been found only in the northern part of the state, and is conspicuously absent from the rich faunal assemblages of Reddick, Melbourne, and Seminole Field. Although negative evidence of this kind is unreliable, and future discoveries may reveal that the species did at some time range throughout the peninsula, I think it may be safely concluded that it was decidedly less common than the true jaguar; and it is unlikely that *Felis atrox* penetrated south of the present Suwannee and Santa Fe River basins.

The jaguar is the most common felid species, the total number of individuals is about 30 and represents 38 per cent of the grand total. It is also found at a greater number of sites (11) than any other felid except the bobcat. Jaguars reach their greatest abundance in broad-leafed forests. The absence of *Felis atrox* in the Peninsula may reflect ecological incompatibility with the true jaguar, or else indicate that this animal shunned the densely wooded areas *Felis onca* prefers.

The earlier fauna seems to represent the heyday in Florida of the jaguar, which here makes up one-half of the total in the fossil assemblage. A shrinking to one-third in the later fauna may indicate a gradual thinning out of the population that ultimately led to local extinction.

In contrast to the jaguar, the puma is rare in both faunas, but of course this does not necessarily indicate that it was actually less plentiful in life. Presumably the habits of the puma are less conducive to its fossilization than those of the jaguar, which seeks its prey along the streams and is a powerful swimmer. The puma percentage is low but constant, and the species survives today in Florida.

Next to the jaguar in abundance, the bobcat makes up one-third of the grand total. This species, which shows a marked increase in the late fauna, is still common in Florida.

Other small Felini are very rare as fossils, presumably because their habits do not readily predispose them for fossilization. That the ocelot has only been recorded from the early fauna and the jaguarundi only from the late does not necessarily imply that the two species alternated in this manner, although, of course, this is quite possible.

Finally, the sabertooth comes next to the jaguar in individual numbers in the early fauna; in the late fauna its percentage has shrunk to about one-half the previous value. This quite likely reflects a real population decline prior to the extinction of the species, as in the case of the jaguar. It is interesting to note that the population trend is consistent with the outcome in all the three cases where the data are sufficient for analysis. Both *Felis onca* and *Smilodon fatalis* show decreasing percentages in the late fauna, and are now extinct in Florida, whereas *Felis rufus* increased and survives. The same phenomenon was noted in a study of the Late Pleistocene and postglacial carnivora of Palestine (Kurten, 1965) where long-term population changes could be traced in numerous instances. It seems that many of the "sudden" extinctions at the end of the

Ice Age are in fact the result of population declines dating back well into the last glaciation or possibly even the last interglacial.

The geographic distribution of fossil felids in Florida (fig. 1) does not show any meaningful pattern except for *Felis atrox.*

Only two felid species reported from other parts of North America have not yet been found in Florida. The absence of *Felis canadensis* is explained as easily as the absence of the woolly mammoth, on climatic grounds. *Dinobastis serus* Cope, the scimitar-toothed cat of Texas is very rare as a fossil and in this case negative evidence is even less meaningful than in the case of *Felis atrox.*

Evolution in Size

The evolutionary record of the felids in Florida presents a number of interesting trends. Size decrease has been found in two instances, jaguar and bobcat. In one instance, that of the puma, the evidence indicates approximate stability in size. Finally, there is one case of size increase, the sabertooth. The trend in *Smilodon* has been suggested previously by other fossil sequences (see Kurten, 1963), but sequential evidence of size reduction during the Pleisto-

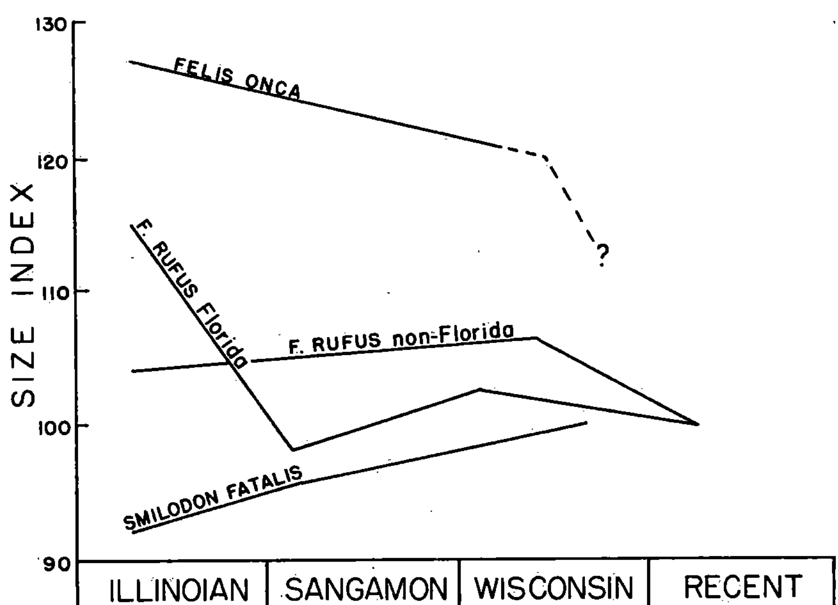

Fig. 17. Size changes in three species of Felidae, as labeled, during the Middle and Late Pleistocene.

cene in jaguar and bobcat has not been presented previously, although a postglacial dwarfing of *Felis onca* in North America has long been recognized (Simpson, 1941).

The size changes in *Felis onca, Felis rufus*, and *Smilodon fatalis*, not only in Florida but also in other areas, are summarized in figure 17. The size indices are based on comparison with recent or terminal forms of each species, which are given the value 100; only dental measurements have been used.

The jaguar data are based on the fossil material from Florida; for the bobcat two different curves have been constructed, one for Florida and the other for material from Conard Fissure (Illinoian) and the West (see table 18). Reddick and Haile are assumed to be Illinoian, and Sabertooth Cave Sangamon. Whether this correlation is exact or not does not influence the main contention, which is that changes in size were more extreme in Florida than on the mainland, and that at one time (Reddick-Haile) the Florida population was rather strongly differentiated from contemporary continental bobcat. Presumably this was due to geographic isolation.

The *Smilodon* sequence has been taken over directly from Table 29, beginning with the presumably Illinoian Conard Fissure. The typical *Smilodon fatalis* sample is given a "mean age" of approximately Sangamon, while the late Florida form and Rancho La Brea are dated as Wisconsin. The Floridian form is apparently less advanced than that of Rancho La Brea and has accordingly been given a somewhat earlier mean date; this is, frankly, morphological dating, and it is just as possible that a size cline existed between contemporaneous Californian and Floridian populations.

The factors responsible for size changes of this type are a difficult problem, and any discussion of them is necessarily rather tentative and speculative. For a more detailed study of an analogous case, see Kurtén (1965), where two important factors in short-term oscillation are noted: (1) Adjustment to climatic change, for instance in accordance with Bergmann's rule; and (2) compensation for impoverished environment by size reduction to keep up the density of the population, with a release-spring reversal if conditions again improve. This latter factor gains in probability when other data suggest an actual decrease in numbers, as in the case of the jaguar.

The bobcat, on the other hand, seems rather to have expanded in numbers as its size diminished, so that factor (2) does not seem to apply in its case. Another possibility might be put forward tentatively. If the aberrant Reddick type evolved in geographic isolation, it could simply have been swamped by the influx of the continental form when population contact was again established. The data suggest that this occurred in the early Sangamon before the complete flooding of the Suwannee Straits. Just why and how the Florida population was protected from foreign gene flow up until then is, of course, the next question to crop up, and here we can only plead ignorance.

For the sabertooth, finally, an entirely different solution is suggested: this seems to be but the last lap of a long-range adaptive change that had been going on since the earliest Pleistocene. The smilodont cats gradually evolved larger forms, beginning with the small Villafranchian *Megantereon* and culminating in monsters such as the Rancho La Brea sabertooth and the even larger Pampean species *Smilodon neogaeus.*

TABLE 1. MEASUREMENTS OF SKULL, DENTITION AND MANDIBLE OF *Felis atrox*

	Santa Fe FDT 124	Ichetucknee UF 9076	Rancho La Brea Range**
Skull			
Prosthion to basion length	——	350	269 -404.7
Condylobasal length	——	370	290 -424.3
Prosthion to inion length	——	404	310.3-467.5
Length of palate in midline	——	180	143 -212
Postglenoid length (to condyles)	——	100	80 -112.5
Length of nasals	——	94	79.2-114
Width of nasal opening	——	61.3	a47 - 73
Rostral width at canines	——	117	98 -141.4
Interorbital width	——	86.5	68.8-106.6
Width across postorbital processes	——	126	99 -132
Width at postorbital constriction	——	73	71 - 89
Bizygomatic width	——	251	a203 -304.3
Width across upper carnassials	——	144	110 -147.8
Width of bulla	——	32.8	21.1- 35.9
Mastoid width	——	146	122.8-173.6
Width across condyles	——	74.4	58.4- 78.6
Dentition			
I^3, breadth	——	11.3	9.4- 12.8
C^1, length	——	33.9	25.2- 36.8
C^1, width	——	25.0	18.0- 25.7
P^2, length of alveolus	——	9.2	7.3- 11.4
P^3, length	——	30.4	23.9- 30.6
P^3, breadth	——	16.4	12.0- 16.2
P^4, length	——	43.7	a35 - 45.0
P^4, breadth	——	21.7	18.3- 22.9
P^4, length of paracone	——	17.3	12.4- 17.0
P^4, length of metastyle	——	17.7	13.9- 16.5
C^1-P^4, inclusive	——	131	101.2-139.4
C_1, length	——	32	21.8- 30.4
C_1, breadth	——	21.5	15.1-a22.0
P_3, length	——	20.6	17.0- 21.6
P_3, breadth	——	11.3	8.9- 13.2
P_4, length	——	30.8	25.8- 32.3
P_4, breadth	——	15.6	12.0- 16.9
P_4, length of protoconid	——	14.9	11.9- 15.0
M_1, length	30	33.4	26.9- 33.9
M_1, breadth	16.0	17.2	13.0- 17.5
P_3-M_1, inclusive	——	82.8	68.3- 89.0
C_1-M_1, inclusive	——	149	116.4-156.7

(continued)

TABLE 1 (continued)

	Santa Fe FDT 124	Ichetucknee UF 9076	Rancho La Brea Range**
Mandible			
Length, symphysis to condyle	——	276	206 -318
Symphysis, anterior length	——	90	67.2- 99.3
Ramus depth at diastema	——	56.4	38.9- 60.7
Depth behind M_1	——	63.8	46.0- 67.1
Thickness below M_1	——	26.0	20.0- 36.9
Height, angle to condyle	——	56.0	42.0- 66.4
Height, angle to coronoid process	——	133.5	96.3-150
Condyle, transverse breadth	——	65.5	a44.5- 74.9
Condyle, greatest depth	——	25.8	18.4- 27.2

* In 18 skulls and 16 mandibles, after Merriam and Stock (1932).

TABLE 2. MEASUREMENTS OF UPPER DENTITION IN *Felis onca*

	C^1		P^3		P^4				
	L	B	L	B	L	Ba	Bbl	Lp	Lm
Recent, ISM 1068	15.6	12.7	14.6	7.7	24.5	12.8	9.5	9.1	10.1
Santa Fe, FDT 487	—	—	—	—	30.5	16.2	11.5	12.5	12.4
Haile II B, UF 3004	—	—	19.5	10.4	28.6	15.5	11.0	11.4	12.4
Reddick, GSF V-5695	—	—	—	—	35	17.3	12.6	12.9	—
Reddick, UF 2858	22.0	19.2	21.5	—	—	—	—	—	—
Reddick, UF 2858	20.2	16.7	—	—	—	—	—	—	—
Reddick, UF 8875	23.0	20.3	—	—	—	—	—	—	—
Reddick, UF 8876	—	16.5	—	—	—	—	—	—	—
Reddick, UF 8877	—	—	20.5	12.0	—	—	—	—	—
Vero, USNM 11411*	—	—	—	—	33.4	18.7	12.5	12.5	13.1
Melbourne, USNM	—	—	—	12.2	33.0	—	11.8	12.8	—
Melbourne, USNM	—	—	—	—	29.6	—	11.9	11.8	11.8
Seminole Field, AMNH 23539	—	—	19.3	9.2	—	—	—	—	—
Niobrara River, USNM 125**	—	—	—	10.5	33.2	16.7	11.6	12.9	13.3
Core Hole Cave, UTBEG 40673-48	22	18.3	21.8	11.3	29.5	16.5	12.5	12.0	—
Craighead Caverns, AMNH 32635	19.5	16.3	19.6	10.0	—	—	—	—	—

* Type of *Felis veronis*.
** Type of *Felis augustus*.

TABLE 3. MEASUREMENTS OF LOWER DENTITION IN *Felis onca*

	C_1		P_3		P_4			M_1	
	L	B	L	B	L	B	Lp	L	B
Recent, ISM 1068	16.3	11.7	13.4	7.2	19.2	9.8	8.2	18.0	9.5
Santa Fe, FDT 483	21.8	16.9	—	—	—	—	—	—	—
Santa Fe, FDT 484	20.6	15.4	—	—	—	—	—	—	—
Santa Fe, FDT 490	—	—	14.3	7.8	21.8	10.5	10.7	22.6	—
Reddick, FGS V-5695	—	—	—	—	23.2	11.8	11.2	—	—
Reddick, UF 3003	—	—	16.8	9.0	21.8	11.3	—	22.5	11.6
Reddick, UF 8879	—	—	—	—	21.3	10.6	10.9	22.3	11.4
Reddick, UF 8878	—	—	—	—	23.0	12.0	11.1	—	—
Melbourne, USNM 11470	18.7	14.4	16.1	8.3	21.0	11	10.1	20.7	11.1
Melbourne, USNM —	—	—	—	—	19	—	10.2	21.8	11.0
Seminole Field, AMNH 23540	—	—	—	—	—	10.8	10.5	—	—

TABLE 4. MEASUREMENTS OF MILK TEETH AND MANDIBLE IN JUVENILE *Felis onca*

			Seminole Field	
	Reddick UF 2565	Haile VII UF 8455	AMNH 23536	AMNH 23537
D^3, length	—	—	—	19.7
D^3, length of paracone	—	—	—	6.3
D^3, length of metastyle	—	—	—	8.3
DC_1, length	—	10.8	—	—
DC_1, breadth	—	4.5	—	—
D_3, length	12.7	13.3	—	—
D_3, breadth	5.3	5.5	—	—
D_3, length of protoconid	5.7	6.1	—	—
D_4, length	16.1	17.0	18.4	—
D_4, breadth	6.4	6.5	6.2	—
D_4, length of trigonid	13.3	13.9	15.2	—
D_3-D_4, inclusive	27.4	30	—	—
DC_1-D_4, inclusive	—	56	—	—
Ramus length, DC to condyle	—	118	—	—
Diastema, length	—	9.5	—	—
Depth at diastema	—	30.1	—	—
Depth behind D_4	—	27.4	—	—
Height, angle to condyle	—	26.1	—	—
Condyle, transverse breadth	—	30.6	—	—
Condyle, greatest depth	—	12.2	—	—

TABLE 5. MEASUREMENTS OF HIND PART OF SKULL IN *Felis onca* AND *Felis atrox*

	Felis onca			
	Fossil FGS V-5696	Recent		*Felis atrox*
		ISM 1068	Range*	Range**
Mastoid width	130	90	85.2-116.6	122.8-173.6
Condylar width	60.8	43.1	42.6- 50.7	58.4- 78.6
Bulla, width	29	23.6	21.8- 27.8	21.1- 35.9
Postglenoid length	70	53	52 - 66.6	80 -112.5
Braincase width	a108	73	-	-
Occipital height	90	68.5	-	-

* In 12 specimens, after Merriam and Stock.
** In 18 specimens, after Merriam and Stock.

TABLE 6. MEASUREMENTS OF MANDIBLE IN *Felis onca*

	Recent ISM 1068	Santa Fe FDT 490	Reddick UF 3003	Melbourne USNM 11470	Craig-head * AMNH 32633
P_3-M_1, inclusive	48.9	58	59	56.5	66
C_1-M_1, inclusive	80.0	—	108	95.0	106
Length, symphysis to condyle	147	—	e200	a173	203
Symphysis, anterior length	45.9	—	64.0	—	—
Depth at diastema	29.7	38.2	43.6	35.0	44.5
Depth behind M_1	31.1	38.5	44.4	37.2	43.5
Thickness below M_1	11.8	16.6	21.3	16.0	17.5

* See Simpson, 1941.

TABLE 7. MEASUREMENTS OF ARM BONES IN *Felis onca* AND *Felis atrox*

	Felis onca						
				Haile VII			*Felis atrox*
	Recent ISM 1068	Devil's Den UF 8980	Reddick FGS V-5690	UF 3463	UF 8981	UF 9122	Range*
Humerus							
Length	196	249	—	275	—	—	328 -409
Proximal transverse	40.5	56	—	64	—	—	78.7-100.2
Proximal anteroposterior	52	71	—	81	—	—	99.1-123.4
Shaft, transverse	17.4	23.3	—	26.4	—	—	33.0- 41.4
Distal transverse	50.0	69	77	78	—	—	85.7-111.3
Distal min. anteropost.	15.1	21.3	24.4	23.2	—	—	29.5- 36.0
Radius							
Length	166	—	231	240	230	242	317 -411
Proximal long diameter	22.0	—	35.8	38.4	35.5	36.3	a44 - 58.1
Proximal short diameter	15.6	—	26.6	26.1	—	23.9	a33 - 47.2
Shaft, width	13.8	—	27.6	25.7	28	27.5	33.4- 45.6
Shaft, thickness	10.4	—	18.2	16.7	17	16.8	20.7- 27.5
Distal long diameter	35.2	—	53.5	—	51	52	61.5- 77.6
Ulna							
Length	204	—	—	299	—	—	384 -438
Olecranon posterior width	18.7	—	—	27.0	—	—	35.4- 47.7
Sigmoid notch, width	27.1	—	—	41.5	—	—	48.0- 69.7
Dorsal margin to coronoid	32.4	—	—	51.6	—	—	68.5- 87.8
Shaft anteroposterior**	19.5	—	—	32.8	—	—	42.5- 57.7
Shaft transverse**	11.2	—	—	18.7	—	—	20.7- 25.0

* In 10 humeri, 10 radii, and 7 ulnae, after Merriam and Stock.
** Measured at proximal end of tendon scar.

TABLE 8. MEASUREMENTS OF CARPAL BONES IN *Felis onca* AND *Felis atrox*

	Felis onca			*Felis atrox*
	Recent	Reddick		
	ISM 1068	FGS V-5690	UF 8593	Range *
Scapho-lunar				
Anteroposterior diameter	22.4	32.2	32.4	37.2-50.7
Transverse diameter	25.0	38.6	40.3	50.7-61.7
Radial facet, anteroposterior	14.9	23.9	23.5	-
Unciform				
Anteroposterior diameter	15.4	24.1	—	29.4-38.3
Transverse diameter	11.8	19.8	—	22.8-28.8
Dorsoplantar diameter	16.5	25.8	—	26.2-33.3
Pisiform				
Length	23.6	33.2	—	40.7-52.4
Proximal long diameter	13.7	19.0	—	25.1-31.4
Distal boss, long diameter	13.0	19.7	—	21.0-26.1
Distal boss, short diameter	7.2	11.9	—	17.5-20.2

* In 3 specimens of the scapho-lunar and 6 each of unciform and pisiform, after Merriam and Stock.

TABLE 9. MEASUREMENTS OF ASTRAGALUS IN *Felis concolor*, *Felis onca* AND *Felis atrox*

	Length	Breadth	Neck breadth	Head breadth
Felis concolor				
Recent, USNM 172688	36.0	34.6	16.8	22.3
Reddick, UF 8895	36.3	35.1	18.3	22.5
Felis onca				
Recent, ISM 1068	32.1	31.8	15.0	17.3
Reddick, UF 8889	44.8	44.6	22.8	27.6
Reddick, UF 8889	49.0	47.7	23.1	28.6
Reddick, UF 8890	50.0	—	23.5	—
Haile VII, UF 8958	50.3	50.0	22.6	29.8
Haile VII, UF 9124	48.7	—	24.2	28.0
Felis atrox *				
Minimum	58.7	51.8	26.3	35.1
Maximum	74.1	66.0	35.4	43.0

* Range in 10 specimens, after Merriam and Stock.

TABLE 10. MEASUREMENTS OF CALCANEUS IN *Felis onca* AND *Felis atrox*

	Length	Breadth	Breadth of cuboid facet
Felis onca			
Recent, ISM 1068	60.0	26.3	16.2
Kendrick, UF 8891	89.5	34.6	24.2
*Felis atrox**			
Minimum	109.0	41.5	26.0
Maximum	142.0	56.0	37.8

* Range in 10 specimens, after Merriam and Stock.

TABLE 11. MEASUREMENTS OF ECTOCUNEIFORM IN *Felis onca* AND *Felis atrox*

	Length	Depth	MT-facet breadth
Felis onca			
Recent, ISM 1068	23.5	11.7	13.0
Reddick, FGS V-5690	36.2	16.7	19.8
Haile VII, UF 9125	—	17.6	20.6
*Felis atrox**			
Minimum	43.8	23.0	25.0
Maximum	55.2	28.2	33.8

* Range in 4 specimens, after Merriam and Stock.

TABLE 12. MEASUREMENTS OF NAVICULAR IN *Felis onca* AND *Felis atrox*

	Length	Breadth
Felis onca		
Recent, ISM 1068	23.9	17.6
Reddick, FGS V-5690	38.3	31
Reddick, UF 8888	40.3	35.7
Reddick, UF 8897	38.0	32.7
*Felis atrox**		
Minimum	43.0	32.6
Maximum	52.7	39.7

* Range in 10 specimens, after Merriam and Stock.

TABLE 13. MEASUREMENTS OF METAPODIALS IN *Felis onca*

		Length	Proximal width	Proximal depth	Shaft width	Distal width
Metacarpals						
Recent, ISM 1068	MC I	24.1	—	—	8.2	11.0
Recent, ISM 1068	MC II	55.9	12.4	16.1	7.7	13.0
Recent, ISM 1068	MC III	63.2	16.2	14.3	8.8	14.2
Recent, ISM 1068	MC IV	61.0	11.6	14.8	8.0	13.0
Recent, ISM 1068	MC V	48.9	12.8	13.8	7.5	12.3
Reddick, GSF V-5690, Series	MC I	36.5	—	—	14.0	17.3
Reddick, GSF V-5690, Series	MC II	80	17.5	25.3	13.0	19.7
Reddick, GSF V-5690, Series	MC III	90	23.1	23.5	14.5	21.8
Reddick, GSF V-5690, Series	MC IV	87	17.7	22.0	12.7	19.6
Reddick, GSF V-5690, Series	MC IV	89.5	17.4	22.5	—	20
Reddick, UF 8899	MC III	90	—	—	12.5	18.5
Haile VII, UF 9126	MC IV	84.5	16.4	19.5	12.0	18.5
Arredondo II, UF 1717	MC V	e63	17.0	19.3	11.6	—
Metatarsals						
Recent, ISM 684205	MT II	68.0	11.4	16.1	7.6	12.4
Recent, ISM 684205	MT III	76.0	14.9	20.1	9.6	14.0
Recent, ISM 684205	MT IV	76.4	—	17.4	8.7	13.2
Recent, ISM 684205	MT V	69.0	15.2	—	7.1	11.6
Reddick, GSF V-5690	MT II	93	16.0	25.0	13.2	19.2
Reddick, GSF V-5690	MT II	—	14.8	23.0	12.0	—
Reddick, GSF V-5690	MT IV	107	—	22.3	14.0	19.5
Reddick, GSF V-5690	MT V	—	—	—	11.4	—
Reddick, UF 2446	MT IV	—	—	21.8	a14.0	—
Reddick, UF 2446	MT V	—	22.8	—	11.8	—

TABLE 14. MEASUREMENTS OF TEETH IN **Felis concolor**

	Seminole Field			
	AMNH 23541	AMNH —	AMNH 23540	Recent Range *
P^4, length	21.4	—	—	21.0-25.3
P^4, breadth	11.1	—	—	10.7-13.2
P^4, blade width	8.2	—	—	-
P^4, length of paracone	9.2	—	—	8.4- 9.8
P^4, length of metastyle	8.3	—	—	8.4-10.3
P_4, length	—	—	—	14.6-17.5
P_4, breadth	—	8.0	8.6	8.1- 9.0
P_4, length of protoconid	—	8.0	7.4	7.3- 8.7

* In 12 specimens, after Merriam and Stock.

TABLE 15. MEASUREMENTS OF UPPER DENTITION IN *Felis rufus*

	C^s		P^3		P^4				
	L	B	L	B	L	Ba	Bbl	Lp	Lm
Reddick, UF 3246*	(8.9)	(7.3)	10.0	5.3	16.8	8.0	5.3	7.0	6.3
Sabertooth Cave, AMNH 23405	(6.3)	—	8.9	4.5	13.2	6.7	5.0	5.6	5.6
Seminole Field, AMNH	—	—	10.4	6.0	13.0	6.1	4.9	5.7	5.3
Melbourne, USNM 11479	—	—	—	—	15.0	6.8	5.0	6.3	6.0
Melbourne, MCZ 17781	—	—	—	—	14.0	—	a5.2	—	—
Port Kennedy Cave, ANSP 54	a7.9	—	8.3	a4.0	13.8	6.3	4.7	5.8	5.6
Port Kennedy Cave, ANSP 54	—	—	8.2	4.3	—	—	—	—	—
Port Kennedy Cave, ANSP 54	7.3	5.3	8.7	3.8	14.3	—	—	—	—
Port Kennedy Cave, ANSP 54	—	—	8.7	3.8	14.3	—	—	—	—
Conard Fissure, AMNH 11801	a7.1	a5.4	9.1	4.6	—	—	—	—	—
Conard Fissure, AMNH 11802**	—	—	8.5	4.7	14.1	6.1	—	5.7	5.5

* Type, *Felis rufus koakudsi*, new subspecies.
** Type, *Lynx compressus* Brown.

TABLE 16. COMPARATIVE STATISTICS FOR UPPER DENTITION AND SKULL IN SAMPLES OF *Felis rufus* AND *Felis canadensis*

	N	Range	Mean	S.D.
P^3, length				
Felis canadensis, recent*	13	10.0-11.5	10.68±0.11	0.40
Felis rufus, recent, Florida	16	7.7- 9.8	8.99±0.15	0.61
Late Pleistocene, Florida	2	8.9-10.4	9.65	—
Port Kennedy & Conard	6	8.2- 9.1	8.58±0.13	0.33
Reddick	1	-	10.0	—
P^3, width				
Felis canadensis, recent	13	4.8- 5.4	5.05±0.05	0.17
Felis rufus, recent, Florida	16	4.3- 5.4	4.85±0.08	0.32
Late Pleistocene, Florida	2	4.5- 6.0	5.25	—
Port Kennedy & Conard	6	3.8- 4.7	4.20±0.16	0.39
Reddick	1	-	5.3	—
P^4, length				
Felis canadensis, recent	13	15.4-17.1	16.21±0.13	0.46
Felis rufus, recent, Florida	16	13.1-15.2	13.96±0.18	0.72
Late Pleistocene, Florida	4	13.0-15.0	13.8 ±0.6	1.2
Port Kennedy & Conard	4	13.8-14.3	14.12±0.12	0.24
Reddick	1	-	16.8	—
P^4, width				
Felis canadensis, recent	13	7.2- 8.0	7.62±0.07	0.26
Felis rufus, recent, Florida	16	5.7- 7.2	6.51±0.11	0.43
Late Pleistocene, Florida	3	6.1- 6.8	6.53±0.22	—
Port Kennedy & Conard	2	6.1- 6.3	6.2	—
Reddick	1	-	8.0	—
P^4, paracone length				
Felis canadensis, recent	13	5.9- 6.8	6.24±0.07	0.25
Felis rufus, recent, Florida	16	5.5- 6.6	6.01±0.07	0.27
Late Pleistocene, Florida	3	5.6- 6.3	5.87±0.22	—
Port Kennedy & Conard	2	5.7- 5.8	5.75	—
Reddick	1	-	7.0	—
Index 100 LP^3/LP^4				
Felis canadensis, recent	13	63 -68	65.8 ±0.4	1.5
Felis rufus, recent, Florida	16	57 -73	64.6 ±1.0	3.8
Late Pleistocene, Florida	1	-	67	—
Port Kennedy & Conard	2	60 -60	60	—
Reddick	1	-	60	—
Interorbital width				
Felis canadensis, recent	13	26.8-31.6	28.4 ±0.3	1.2
Felis rufus, recent, Florida	16	17.5-25.0	22.0 ±0.5	1.9
Reddick	1	-	a27	—

(continued)

TABLE 16 (continued)

	N	Range	Mean	S.D.
Width of postorbital constriction				
Felis canadensis, recent	13	37.7-42.0	39.6 ±0.4	1.5
Felis rufus, recent, Florida	16	24.7-42	37.9 ±0.5	1.9
Reddick	1	-	a38	—
Depth of zygoma below orbit				
Felis rufus, recent, Florida	14	11.5-14.6	12.71±0.25	0.93
Reddick	1	-	15.2	—

* Data on *Felis canadensis* from Merriam and Stock (1932).

TABLE 18. COMPARATIVE STATISTICS FOR LOWER DENTITION IN SAMPLES OF *Felis rufus*

	N	Range	Mean	S.D.
P_3, length				
Recent, Florida	11	5.9- 7.8	6.98±0.16	0.53
Late Pleistocene, Florida	7	6.7- 8.4	7.59±0.25	0.67
Late Pleistocene, N.M., Calif.	8	6.9- 8.7	7.50±0.22	0.62
Port Kennedy & Conard	5	7.2- 8.4	8.00±0.21	0.47
P_4, length				
Recent, Florida	11	7.6-10.3	9.11±0.25	0.82
Late Pleistocene, Florida	10	8.1-10.4	9.20±0.26	0.83
Late Pleistocene, N.M., Calif.	8	8.8-11.4	9.68±0.30	0.86
Port Kennedy & Conard	6	8.6-11.1	9.92±0.39	0.95
M_1, length				
Recent, Florida	11	9.7-12.1	10.68±0.20	0.66
Late Pleistocene, Florida	8	9.2-11.0	10.38±0.23	0.66
Late Pleistocene, N.M., Calif.	10	10.2-12.7	11.69±0.25	0.78
Port Kennedy & Conard	7	9.6-12.5	11.50±0.46	1.22
P_3-M_1 inclusive, length				
Recent, Florida	11	23.9-28.1	26.3 ±0.3	1.2
Late Pleistocene, Florida	4	24.7-28.2	26.5 ±0.8	1.6
Late Pleistocene, N.M., Calif.	6	26.3-31.3	28.6 ±0.8	1.9
Port Kennedy & Conard	4	26.5-31.6	29.5 ±1.1	2.1
Index, 100 LM_1/LP_3				
Recent, Florida	11	136 - 178	153.6 ±3.5	11.8
Late Pleistocene, Florida	3	125 - 152	140 ±8	—
Late Pleistocene, N.M., Calif.	8	146 - 174	154.5 ±3.6	10.2
Port Kennedy & Conard	5	146 - 155	151.8 ±1.6	3.6
Sabertooth Cave	1	-	139	—
Haile VIII	1	-	166	—

TABLE 17. MEASUREMENTS OF LOWER DENTITION AND MANDIBLE IN *Felis rufus*

	LC_1	LP_3	LP_4	LM_1	P_3M_1 incl.	$C-M_1$ incl.	D behind M_1	D at diast.
Haile VIII, UF 3103	6.7	7.4	10.0	12.3	28.1	41.0	14.3	12.6
Sabertooth Cave, AMNH 23405	6.3	7.2	9.2	10.0	25.4	38.1	13.0	12.4
Ichetucknee, UF 9257	6.7	7.1	9.0	10.8	25.5	41.5	15.3	14.8
Melbourne, USNM 12948	—	—	8.4	10.8	27.5	42.4	15.8	13.4
Melbourne, USNM 11205	—	—	—	10.2	—	—	—	—
Melbourne, USNM —	—	—	8.7	10.9	—	—	—	12.7
Nocatee (cast)	—	6.7	8.3	9.6	24.7	—	14.0	12.8
Seminole Field, AMNH 23533	—	—	8.1	9.2	—	—	14	—
Seminole Field, AMNH 23534	—	8.4	9.5	10.5	28.2	—	17.0	15.5
Seminole Field, AMNH 23535	—	—	—	11.0	—	—	14.5	—
Seminole Field, AMNH —	—	8.2	10.4	—	—	—	—	a14.0
Seminole Field, AMNH —	—	7.1	9.6	—	—	—	—	13.6
Seminole Field, AMNH —	—	7.4	9.6	—	—	—	—	15.2
Seminole Field, AMNH —	—	8.2	10.4	—	—	—	—	a15.0
Port Kennedy Cave, ANSP 56*	—	8.4	10.8	12.3	31.6	—	—	15.9
Port Kennedy Cave, ANSP 56	—	8.3	11.1	12.5	—	—	—	—
Port Kennedy Cave, ANSP 55	—	8.1	9.7	12.5	30.1	—	—	—
Port Kennedy Cave, ANSP 53**	5.7	—	8.6	10.2	—	—	a15	12.0
Port Kennedy Cave, ANSP —**	—	—	—	9.6	—	—	—	—
Conard Fissure, AMNH 11800	—	8.0	10.1	12.4	29.8	—	16.1	15.4
Conard Fissure, AMNH 11803	5.8	7.2	9.2	11.0	26.5	—	15.1	12.2

* Type, *Lynx calcaratus* Cope.
** *Felis eyra* in Cope (1899).

TABLE 19. MEASUREMENTS OF HUMERUS IN *Felis rufus*

	Arredondo UF 1716	Recent, UF Nos. 4543	6422	7645	6379	1757	6655	5831
Length	—	149	148	146	140	136	130	129
Shaft, transverse at middle	10.3*	10.7	10.0	9.8	9.0	9.6	8.7	8.6
Distal transverse	28.8	27.8	26.9	27.8	26.7	26.0	24.2	23.5
Bar over entepicondylar foramen, width	7.5	5.7	6.1	5.5	5.6	4.7	5.2	5.1

* Somewhat compressed; original width probably slightly greater.

TABLE 20. MEASUREMENTS OF FEMUR IN *Felis pardalis* AND *Felis rufus*

	Haile	*F. pardalis*	*F. rufus*					
	8960	4644	4543	——	6379	1757	6655	5831
Length	—	167	173	170	166	154	151	148
Proximal transverse	40.8	34.0	30.8	32.1	28.1	28.5	26.9	25.3
Head diameter	18.1	14.9	14.6	14.4	12.4	13.2	12.9	11.9
Neck, depth	16.5	16.2	11.9	12.7	10.0	11.0	10.2	11.0
Shaft, long diameter*	17.5	14.9	14.5	14.3	13.3	13.0	11.7	11.7
Shaft, short diameter*	12.0	12.2	10.1	9.8	8.9	10.2	9.5	8.3

* Measured about one-third from the proximal end of the femur.

TABLE 21. MEASUREMENTS OF UPPER DENTITION IN *Smilodon*

	C^s			P^4			
	L	B	H	L	B	Lp	Lm
Ichetucknee, UF 3470	—	—	—	41.1	16.0	13.2	16.3
Melbourne, USNM —	—	—	—	35.7	—	11.5	15.2
Sabertooth Cace, USNM 11235 cast	32.5	17.5	121	—	—	—	—
Hardin Co., AMNH 10395*	—	—	—	33.2	15.9	11.3	13.3
Medio Creek, USNM 20750	—	a19.5	—	a37.0	15.2	12.1	15
Rancho La Brea, maximum**	—	—	—	46.0	19.9	14.2	16.9
Rancho La Brea, minimum	—	—	—	33.4	14.2	11.1	11.5

* Type, *Trucifelis fatalis* Leidy.
** Range for 28 specimens from Rancho La Brea, after Merriam and Stock.

TABLE 22. MEASUREMENTS OF LOWER DENTITION AND MANDIBLE IN *Smilodon*

	Santa Fe	Ichetucknee		Seminole	Rancho La Brea
	FDT 488	UF 4114	UF 4115	AMNH 23538	Range *
C_1, length at enamel base	—	14.4	—	—	13.0- 16.6
C_1, breadth at enamel base	—	9.8	—	—	9.7- 12.2
P_4, length	22.2	25.0	27	—	22.5- 27.7
P_4, breadth	9.5	10.8	12.8	—	10.5- 14.6
P_4, protoconid length	11.7	—	12.5	—	9.0- 12.1
M_1, length	—	27.5	30.0	—	25.0- 32.1
M_1, breadth	—	12.9	14.5	13.0	12.4- 17.6
M_1, protoconid length	—	—	15.7	—	12.8- 18.0
P_1-M_1, inclusive	—	51	56	—	48.3- 60.9
C_1-M_1, inclusive	—	128	114	—	113.5-147.8
Diastema C_1-P_4, length	—	60	41	—	46.3- 72.6
Length, symphysis to condyle	—	197	171	—	178.3-230
Least depth at diastema	—	30.4	29.6	—	27.3- 40.4
Depth behind M_1	—	38.4	34.2	—	36.0- 45.6
Thickness below M_1	—	21.1	19.0	—	18.7- 25.0
Height, angle to condyle	—	30.4	31	—	30.7- 40.0
Height, angle to coronoid	—	67.3	55.5	—	58.0- 76.3
Condyle, transverse breadth	—	44.6	—	—	38.7- 55.9
Condyle, greatest depth	—	17.7	—	—	15.8- 20.7

* In 25 specimens, after Merriam and Stock.

TABLE 23. MEASUREMENTS OF HIND PART OF SKULL IN SUBADULT *Smilodon*

	Postorbital Constriction	Mastoid Width	Braincase Width
Ichetucknee, UF 8979	59.1	105	86.7
Rancho La Brea, 2001-3*	54.5	121.5	—
Rancho La Brea, 2001-6	54.8	122.9	—
Rancho La Brea, 2001-7	58.6	123.7	—
Rancho La Brea, 2001-8	63.2	124	—
Rancho La Brea, 2001-9	59.5	116.7	—
Rancho La Brea, 2001-10	53	120	—

* All Rancho La Brea measurements after Merriam and Stock.

TABLE 24. MEASUREMENTS OF VERTEBRAE AND SACRUM OF *Smilodon*

	Arredondo UF 2562	Rancho La Brea Range *
T 4, length**	a35	-
T 5, length	33	-
T 6, length	a35	-
T 7, length	a32	-
T 8, length	32	-
T 9, length	a33	-
T 10, length	a32	-
T 11, length	a34	31.8- 41.4
T 11, depth of centrum	23.7	25.6- 32.2
T 11, greatest width	68.5	58.4- 85.6
T 11, spine length from anterior notch	65.6	41.0- 87.7
T 12, length	a36	33.3- 42.6
T 13, length	a38	38.3- 47.5
L 1, length	40.0	-
L 2, length	41.2	-
L 3, length	45.2	-
L 4, length	47.7	-
L 6, length	47.3	-
L 7, length	a44	36.7- 54.3
Sacrum, length of centra	100	-
Sacrum, greatest length	126	110.9-145.9
Sacrum, greatest anterior width	93	77.0-111.5
Sacrum, depth of anterior centrum	24.0	23.0- 33.9

* After Merriam and Stock.
** Central length throughout.

TABLE 25. MEASUREMENTS OF SCAPULA AND PELVIS OF *Smilodon*

	Arredondo UF 2562	Rancho La Brea Range *
Scapula		
Length along axis of spine	255	266 -358
Distal depth	73.0	67.0- 87.1
Distal transverse	43.5	40.8- 57.9
Medial glenoid border to spine top	78	70.1- 96.6
Depth of neck	58.1	55.1- 76.4
Pelvis		
Length	a300	a283 -368
Depth of ilium	70	73.8- 94
Acetabulum diameter	45.5	44.3- 54.8
Depth of obturator foramen	44.3	45.0- 57.4

* In 10 specimens, after Merriam and Stock.

TABLE 26. MEASUREMENTS OF LONG BONES OF *Smilodon*

	Arredondo UF 2562	Rancho La Brea Range *
Humerus		
Length	307	309 -385
Proximal transverse	67.8	75.4- 92.4
Proximal anteroposterior	94.6	92.0-118.2
Shaft width at middle	29.0	32.2- 41.7
Distal width	96.9	98.7-128.3
Distal, minimum anteroposterior	29.1	27.5- 36.0
Radius		
Length	e240 **	235 -295
Proximal, long diameter	42.8	41.3- 55.5
Proximal, short diameter	33.2	32.2- 44.0
Shaft width at middle	26.5	26.0- 38.8
Shaft thickness at middle	18.5	16.5- 24.6
Ulna		
Length	e310 **	287 -372
Olecranon, posterior width	37.0	33.6- 48.8
Greater sigmoid notch, width	46.7	41.5- 60.2
Dorsal margin to coronoid process	63.2	57.3- 78.8
Shaft anteroposterior at tendon scar	32.0	30.0- 47.6
Shaft width at tendon scar	21.4	19.8- 29.9
Femur		
Length	334	317 -408
Proximal transverse	86.0	82.7-108.8
Head diameter	40.5	39.1- 50.7
Shaft width at middle	30.5	30.1- 40.4
Shaft anteroposterior at middle	28.0	26.8- 35.4
Distal transverse	71.5	65.2- 90.2
Distal anteroposterior	66.5	63.9- 80.3
Tibia		
Length	252	239 -305
Proximal transverse	77.4	72.5- 90.4
Shaft width at middle	24.5	25.1- 33.0
Distal transverse	51.7	45.0- 63.3

* In 10 specimens of each bone, after Merriam and Stock.

** The distal epiphyses have been lost in radius and ulna, both sides. Without epiphyses, the measurements are: Radius, 215; Ulna, 278.

TABLE 27. MEASUREMENTS OF TARSAL BONES IN *Smilodon*

	Reddick FGS V-5690	Arredondo UF 2562	Rancho La Brea Range
Astragalus			
Length	—	50.0	44.6- 61.2
Breadth	—	48.6	46.0- 61.2
Neck, transverse	—	27.4	23.3- 29.5
Head, transverse	—	31.7	29.0- 36.2
Calcaneus			
Length	—	94.0	79.4-106.8
Width	—	42.5	40.4- 50.8
Cuboid facet, transverse (incl. navicular facet)	—	34.7	32.7- 44.2
Outer face, depth	—	37.7	36.3- 48.9
Ectocuneiform			
Length	40.1	—	33.1- 48.9
Depth	15.6	—	12.8- 19.1
Breadth of MT-facet	23.3	—	22.0- 29.7

TABLE 28. MEASUREMENTS OF METAPODIALS IN *Smilodon*

		Length	Proximal width	Proximal depth	Shaft width	Distal width
Metacarpals						
MC-III	Reddick, UF 2537	100	26	24.6	17.4	25.6
	Rancho La Brea, minimum*	83	24.2	22.8	14.6	22.4
	Rancho La Brea, maximum	110	30.7	29.2	20.0	29.4
MC IV	Reddick, UF 2537	93	23.2	23.8	14.0	22.4
	Rancho La Brea, minimum	79	18.9	20.6	12.3	19.6
	Rancho La Brea, maximum	107	26.6	27.4	16.0	24.6
MC V	Reddick, UF 2537	76	22.0	25.8	14.8	22.0
	Rancho La Brea, minimum	62	20.1	23.3	12.9	19.6
	Rancho La Brea, maximum	87	28.8	32.2	17.9	26.6
Metatarsals						
MT II	Reddick, FGS V-5690	85	14.9	26.5	14.0	21.2
	Reddick, UF 2537	85	16.2	28.7	14.4	21.7
	Arredondo, UF 2562	80	13.7	27.5	12.2	19.3
	Rancho La Brea, minimum	74	14.6	26.2	13.1	19.9
	Rancho La Brea, maximum	96	17.0	31.7	16.0	23.7
MT III	Reddick, UF 2537	99	25.0	31.6	17.4	24.6
	Arredondo, UF 2562	95	24.5	31.1	17.0	23.2
	Rancho La Brea, minimum	86	24.9	29.7	15.8	22.7
	Rancho La Brea, maximum	113	27.4	36.4	18.2	26.7
MT IV	Reddick, FGS V-5690	101	—	28.0	15.6	21.5
	Arredondo, UF 2562	96	—	26.3	14.1	20.2
	Rancho La Brea, minimum	84	16.1	25.8	13.0	18.5
	Rancho La Brea, maximum	114	19.9	30.9	17.0	25.2
MT V	Arredondo, UF 2562	78	—	24.5	12.1	17.1
	Rancho La Brea, minimum	71	—	24.4	10.5	17.1
	Rancho La Brea, maximum	95	—	28.6	13.8	21.6

* Rancho La Brea measurements after Merriam and Stock, representing ranges in about 1400 specimens.

TABLE 29. SIZE INDICES FOR SAMPLES OF *Smilodon*, BASED ON LENGTHS AND WIDTHS OF P^4, C_1, P_4, AND M_1. STANDARD OF COMPARISON (100%), MEANS FOR RANCHO LA BREA. N (EXCEPT FOR STANDARD), NUMBER OF ORIGINAL MEASUREMENTS CONVERTED INTO INDICES.

	N	Range	Mean
Rancho La Brea*	—	83-124	100.0
Florida, Late Pleistocene	14	89-109	98.1
Smilodon fatalis, various**	36	83-117	95.7
Conard Fissure	9	85-103	92.3
Santa Fe River Beds	2	80-90	85.0
Port Kennedy Cave	20	70-90	79.9

* Data from Merriam and Stock.

** Based on measurements recorded under this name by Slaughter (1963, table 1), except for Conard Fissure specimen.

TABLE 30. DISTRIBUTION OF PLEISTOCENE FELIDAE IN FLORIDA

	Felis atrox	*Felis onca*	*Felis concolor*	*Felis rufus*	*Felis pardalis*	*Felis yaguarundi*	*Smilodon fatalis*
Ichetucknee River	1	—	—	1	—	—	3
Santa Fe River	1	5	—	—	—	—	1
Arredondo	—	1	—	1	—	—	1
Haile I	—	—	—	—	1	—	—
Haile II B	—	1	—	—	—	—	—
Haile VII A	—	4	—	—	—	—	—
Haile VIII	—	—	—	1	—	—	—
Williston	—	—	—	X	—	—	—
Devil's Den	—	1	—	—	—	—	—
Reddick	—	8	1	1	1	—	1
Kendrick	—	1	—	—	—	—	—
Ocala	—	—	—	—	—	—	1
Sabertooth Cave	—	—	—	1	—	—	2
Bone Cave	—	—	—	—	—	—	1
Sanford	—	—	—	X	—	—	—
Rock Springs	—	—	—	—	—	1	—
Seminole Field	—	3	2	8	—	—	1
Stickney Point	—	1	—	—	—	—	—
Melbourne	—	4	1	5	—	1	1
Merritt Island	—	—	—	—	—	1	—
Vero	—	1	—	4	—	—	1
Nocatee	—	—	—	1	—	—	—

* Denotes presence in unknown numbers, - absence. Figures indicate approximate number of individuals represented by fossils reviewed here.

TABLE 31. RELATIVE REPRESENTATION (BY PERCENTAGES) OF FELID SPECIES IN PLEISTOCENE FAUNAS OF FLORIDA

	Early fauna	Late fauna	Total
Felis atrox	0 %	4 %	2.5 %
Felis onca	50	31	38
Felis concolor	3	6	5
Felis rufus	17	41	32
Felis pardalis	7	0	2.5
Felis yagouaroundi	0	6	4
Smilodon fatalis	23	12	16

LITERATURE CITED

Arata, Andrew A.

1961. Meadow vole (*Microtus pennsylvanicus*) from the Quaternary of Florida. Quart. Jour. Florida Acad. Sci., 24: 117-121.

Auffenberg, W.

1958. Fossil Turtles of the Genus *Terrapene* in Florida. Bull. Florida State Mus., 3: 53-92.

1963. The Fossil Snakes of Florida. Tulane Studies Zool., 10: 131-216.

Bader, Robert S.

1957. Two Pleistocene Mammalian Faunas from Alachua County, Florida. Bull. Florida State Mus., 2: 53-75.

Brodkorb, Pierce

1953. Pleistocene birds from Haile, Florida. Wilson Bull., 65: 49-50.

1957. New Passerine Birds from the Pleistocene of Reddick, Florida. Jour. Paleont., 31: 129-138.

1959. The Pleistocene Avifauna of Arredondo, Florida. Bull. Florida State Mus., 4: 269-291.

Brown, B.

1908. The Conard Fissure, a Pleistocene bone deposit in northern Arkansas; with descriptions of two new genera and twenty new species of mammals. Am. Mus. Nat. Hist. Mem., 9: 155-208.

Cope, E. D.

1899. Vertebrate remains from the Port Kennedy bone deposit. Proc. Acad. Nat. Sci. Philadelphia, 1896: 378-394.

Gazin, C. L.

1950. Annotated list of fossil Mammalia associated with human remains at Melbourne, Florida. Washington Acad. Sci. Jour., 40: 397-404.

Gut, H. J.

1938. Hitherto unrecorded vertebrate fossil localities in southcentral Florida. Florida Acad. Sci. Proc. 3: 50-53.

Gut, H. J., and C. E. Ray

1963. The Pleistocene vertebrate fauna of Reddick, Florida. Quart. Jour. Florida Acad. Sci., 26: 315-328.

Holman, J. Alan

1959. Birds and Mammals from the Pleistocene of Williston, Florida. Bull. Florida State Mus., 5: 1-24.

Hay, O. P.

1917. Vertebrate mostly from stratum No. 3, at Vero, Florida together with descriptions of New species. Rep. Fla. Geol. Surv., 9: 43-68.

1919. Descriptions of some mammalian and fish remains from Florida of probably Pleistocene age. U. S. Nat. Mus. Proc., 56: 103-112.

Hooijer, D. A.

1950. The study of subspecific advance in the Quaternary. Evolution, 4: 360-361.

Kurten, Bjorn

1958. The bears and hyenas of the interglacials. Quaternaria, 4: 69-81.

1963. Notes on some Pleistocene mammal migrations from the Palaearctic to the Nearctic. Eiszeitalter und Gegenwart, 14: 96-103.

1965. The carnivora of the Palestine caves. Acta Zool. Fennica, 107: 1-74.

Kurten, Bjorn., and R. Rausch

1959. Biometric comparisons between North American and European mammals. Acta Arctica, 11: 1-44.

Leidy, J.

1889. Description of some mammalian remains from a rock crevice in Florida. Wagner Free Inst. Sci. Trans., 2: 13-17.

McCrady, E., H. T. Kirby-Smith, and H. Templeton

1951. New finds of Pleistocene Jaguar skeletons from Tennessee caves. U. S. Nat. Mus. Proc., 101: 497-511.

Merriam, J. C., and Chester Stock

1932. The Felidae of Rancho La Brea. Pub. Carnegie Inst. Wash., 422: 1-232.

Ray, E.

1958. Additions to the Pleistocene mammalian fauna of Melbourne, Florida. Harvard Mus. Comp. Sool. Bull.

Ray, C. E., S. J. Olsen, and H. J. Gut

1963. Three mammals new to the Pleistocene fauna of Florida, and a reconsideration of five earlier records. Jour. Mamm., 44: 373-395.

Simpson, G. G.

1928. Pleistocene mammals from a cave in Citrus County, Florida. Am. Mus. Novitates, 422: 1-19.

1929a. The extinct land mammals of Florida. Florida Geol. Surv. 20th Ann. Rept.: 229-279.

1929b. Pleistocene mammalian fauna of the Seminole Field, Pinellas County, Florida. Am. Mus. Nat. Hist. Bull., 56: 561-599.

1930. Additions to the Pleistocene of Florida. Am. Mus. Novitates, 406: 1-19.

1941. Large Pleistocene Felines of North America. Am. Mus. Nat. Hist. Novitates, 1136: 1-27.

Slaughter, Bob H.

1960. A new species of *Smilodon* from a Late Pleistocene Alluvial Terrace Deposit of the Trinity River. Jour. Paleo., 34(3): 486-492.

1963. Some observations concerning the Genus *Smilodon*, with special reference to *Smilodon fatalis*. Texas Jour. Sci., 15(1): 68-81.

Weigel,

1962. Fossil vertebrates of Vero, Florida Special Publication No. 10, Florida Geological Survey, p. 1-59.

Contributions to the BULLETIN OF THE FLORIDA STATE MUSEUM may be in any field of biology. Manuscripts dealing with natural history or systematic problems involving the southeastern United States or the Caribbean area are solicited especially.

Manuscripts should be of medium length—50 to 200 pages. Examination for suitability is made by an Editorial Board.

The BULLETIN is distributed worldwide through institutional subscriptions and exchanges only. It is considered the responsibility of the author to distribute his paper to all interested individuals. To aid in this, fifty copies are furnished the author without cost.

PREPARATION OF MANUSCRIPT

Highly recommended as a guide is the volume:

Conference of Biological Editors, Committee on Form and Style. 1960. Style manual for biological journals. Amer. Inst. Biol. Sci., Washington. 92 p.

Manuscripts should be typewritten with double spacing throughout, with ample margins, and on only one side of the paper. The author should keep a copy; the original and a carbon must be submitted. Tables and legends of figures should be typed on sheets separate from the text. Several legends or tables may be placed on a single sheet.

Illustrations, including maps and photographs, should be referred to as "figures." All illustrations are reduced to a maximum of 4-1/4 by 7-1/8 inches. Size scales, wherever they are necessary, should be incorporated into the figure.

References to literature should conform with the bibliographic style used in recent numbers of the BULLETIN. Spell out in full the titles of non-English serials and places of publication.

Footnote material should be kept to a minimum. However, provide copy for a footnote detailing the title, affiliations, and address of the author (see recent numbers of the BULLETIN).

Manuscripts must be accompanied by a synopsis—a brief and factual summary (not a mere description) of the contents and conclusions, which points out the presence of any new information and indicates its relevance. In it list all new organisms described and give their ranges; indicate all taxonomic changes proposed. The synopsis, written in full sentences, should be concise, but completely intelligible in itself without references to the paper, thereby enabling the busy reader to decide more surely than he can from the title alone whether the paper merits his reading. The synopsis will be published with the paper. It does not replace the usual conclusions or summary sections. It may also serve as copy for the abstracting services.

Manuscripts and all editorial matters should be addressed to:

Managing Editor of the BULLETIN
Florida State Museum
Seagle Building
Gainesville, Florida