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The Genus *Conepatus* (Mammalia, Mustelidae): Variation Within a Population

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INTRODUCTION

The hog-nosed skunks (genus *Conepatus*) have one of the greatest geographic ranges of any genus of terrestrial mammal in the Western Hemisphere. They have been found as far north as southern Colorado in the United States of America (Hall and Kelson, 1959, pp. 940–941) and as far south as the Strait of Magellan in Argentina and Chile (Cabrera, "1957" [1958], pp. 265–271). In South America they are known from the Atlantic to the Pacific coast. From the range of this genus about 1000 specimens have been preserved, and since 1960 I have been examining and studying these with the intention of revising the taxonomy of the genus. The prime difficulty in revising the hog-nosed skunks has been to find a standard for the evaluation of differences found between specimens from widely separated localities, for until the present time, no large sample of these skunks with complete data, from a relatively restricted area, was available for an analysis of non-geographic variation. In 1962–1963, however, the American Museum-Uruguay Expedition made a special effort to obtain skunks, and the excellent collection thus made, when combined with additional material in the other museums, has permitted the present study.

The subspecies of hog-nosed skunk in Uruguay is *Conepatus chinga*

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suffocans, according to Cabrera ("1957" [1958], p. 267). In a later work, Kipp (1965) indicated that Uruguayan specimens should be called *Conepatus humboldti,* although she did not examine any specimens from Uruguay. As my study is the initial portion of a revision, I think it is not practical to belabor the taxonomic status of the specimens from Uruguay until the appropriate study of all representatives of the genus has been made.[1]

Acknowledgments

This study was supported by a grant from the National Science Foundation (No. G-11270, "A systematic revision of the skunks of the genera *Mephitis* and *Conepatus*") from 1960 to 1965. The large series on which most of this study is based was collected in the course of the American Museum-Uruguay Expedition, 1962–1963, which was supported by the United States Army Medical Research and Development Command (Grant No. DA-MD-49-193-63-G82-I, "Neotropical mammalogical and entomological investigations in relation to arthropod-borne diseases"). I am especially indebted to the staff of the Museo Nacional de Uruguay for their hearty cooperation and friendship while I studied at their institution. In particular I thank Srs. Miguel Klappenbach, Juan Cuello, and Braulio Orejas for help at the Museo in Montevideo, and Srs. Alfredo Ximenez and Alfredo Langguth for enthusiastic aid at the Museo and hearty cooperation and companionship in the field. In addition, I thank Sr. Isidoro Vejo of Montevideo for his friendship and hospitality in allowing us to camp and collect on his family's property in various parts of Uruguay, and I thank his son, Sr. Rodrigo Vejo, for similar assistance and for his participation in the field activities. I am grateful to Mr. Pablo Ford for providing me with pertinent information about Uruguay, and the assistance of the American Embassy in Montevideo and especially that of Mr. Edward Purcell, Cultural Attache, are gratefully acknowledged.

For the loan of specimens or permission to study specimens in their care, I am grateful to Dr. J. C. Moore and Mr. P. Hershkovitz, Field Museum of Natural History, Chicago; Dr. A. Willinck of the Instituto

[1] Data were gathered for this revision, and the research on the genus from 1960 until 1966 was done, with the intent of producing a monograph similar to that which I published for the genus *Spilogale* (Van Gelder, 1959). I regret the unfortunate necessity for fragmenting the monograph, for the resultant difficulty for future students of the genus, for the repetition that surely will follow, and for the lack of economy that will result. One result of the division of the monograph is my current inability to assign a definitive name to the hog-nosed skunks from Uruguay.

Miguel Lillo, Tucuman, Argentina; Dr. T. Haltenorth, Zoologische Staatssammlung, Munich, Germany; Mr. A. Ximenez, Museo Nacional de Uruguay, Montevideo; Dr. G. Corbett and Mr. J. E. Hill, British Museum (Natural History), London; and Drs. D. Johnson and C. Handley, Jr., United States National Museum, Smithsonian Institution, Washington.

Dr. D. Vincent Manson of the Department of Mineralogy of the American Museum of Natural History was especially helpful and cooperative in providing facilities for electronic computer analysis of some of these data, and I am deeply grateful to him for these services and for his enthusiastic cooperation. I am also grateful to Miss C. M. Cusson for her assistance in tabulating data and typing the manuscript. The Graphic Arts Department of the American Museum of Natural History prepared the drawings; and the Photography Division, the photographs.

MATERIALS AND METHODS

This study is based on examination of 103 museum specimens, all from Uruguay. For the purposes of this study, all the specimens from Uruguay are considered as a single population. The absence of any large sample from a single locality in collections has led to this grouping of specimens from a country with an area of about 72,000 square miles. From personal travels in the country and general ecological information, I judge that there is no physical barrier to gene-flow among the skunks. The low relief (sea level to about 1800 feet) and general ecology seem also to indicate that gene-flow among these animals can be continuous. As a further test of the statistical (if not biological) validity of this grouping, the specimens collected from specific localities where physical contact between the animals could readily occur have been compared with one another, and there are no significant differences (fig. 1). The low coefficients of variability for many measurements also indicate that a single population is being considered (table 8).

External Measurements

The external measurements (total length, length of tail, length of head and body, length of hind foot with claws, length of ear from notch) and weight were obtained from data recorded in the field from animals in the flesh by the collectors. In a few cases in which measurements of the length of the tail seemed to be obviously incorrect, they were altered in accordance with information derived by measuring the tail vertebrae of the skeletons of the specimens. However, when the

TABLE 1

Comparison of the Length of the Hind Foot of Specimens of *Conepatus* from Uruguay, Measured Two Different Ways

	Number	*Cum Unguis*			*Sine Unguis*		
		Average	Minimum	Maximum	Average	Minimum	Maximum
Adult males	15	71.1	61	78	64.1	55	70
Subadult males	7	68.7	63	72	62.0	55	68
Juvenile-subadult males	1	70	—	—	64	—	—
Adult females	24	63.8	55	71	57.4	50	64
Subadult females	8	63.0	57	69	57.2	52	62
Juvenile-subadult females	1	62	—	—	57	—	—

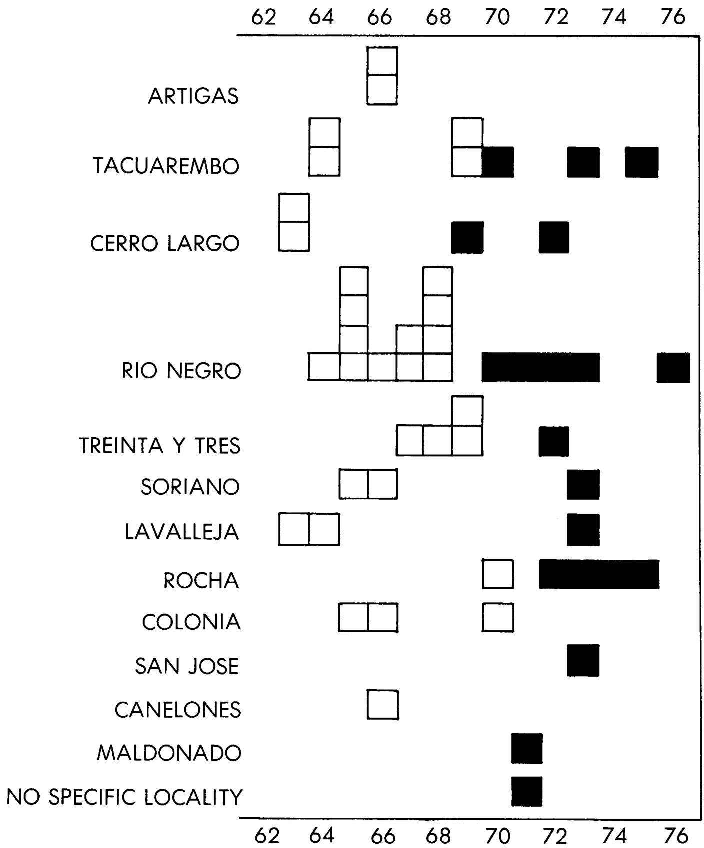
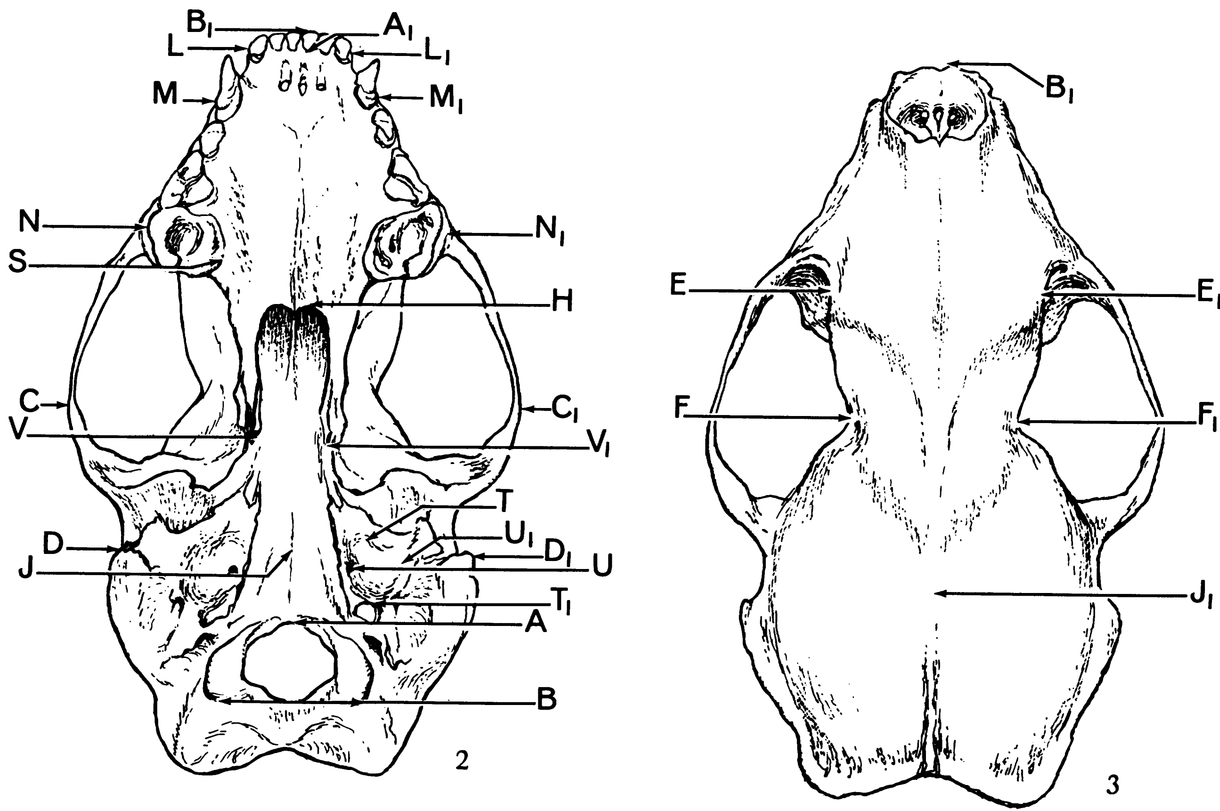


FIG. 1. Condylobasal length, in millimeters, of adult males (solid squares) and adult females (open squares) of *Conepatus* from different departments in Uruguay. See also figure 11.

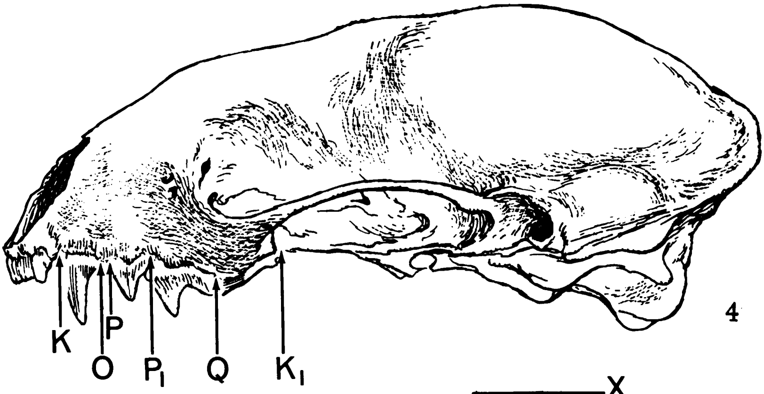
length of the tail is measured in the field, it is not truly a measurement of all the caudal vertebrae. The muscle mass and fat at the base of the tail preclude complete accuracy.

The length of the ear is usually taken from the notch, rarely from the crown. Unless otherwise indicated, reference to ear measurements implies the ear from the notch.

North American mammalogists generally measure the hind foot from the heel to the tip of the longest claw (*cum unguis, c. u.*), but non-North Americans usually take this measurement to the tip of the longest toe without the claw (*sine unguis, s. u.*). The field parties of the American Museum-Uruguay Expedition had personnel trained in both systems,



FIGS. 2, 3. Cranium of an adult female of *Conepatus* from Uruguay, showing points between which measurements were taken. 2. Ventral view. 3. Dorsal view.



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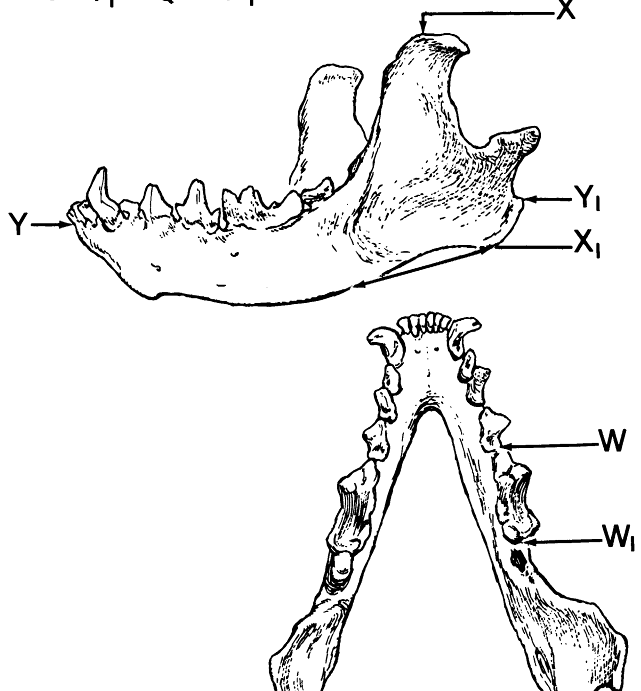

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FIGS. 4, 5. Adult female of *Conepatus* from Uruguay, showing points between which measurements were taken. 4. Lateral view of the cranium. 5. Lateral and dorsal views of the mandible. See text.

and both measurements were taken on all specimens. Roughly, the measurement *cum unguis* is about 6 mm. larger than that *sine unguis* (table 1).

The only data concerning weight are from the American Museum of Natural History series. All measurements that were listed in pounds have been converted to grams, although by so doing an untrue appearance of accuracy results. Many of the skunks were weighed on a spring scale to the nearest quarter of a pound, and thus the error in accuracy of data on the weight of these as expressed in grams may be 60 grams or even greater.

CRANIAL MEASUREMENTS

Thirty measurements were taken, if possible, on each of the skulls examined (figs. 2–5). The selection of the measurements taken was based on several considerations: dimensions that had been used to separate or otherwise distinguish taxa; measurements that had proved of value in taxonomic studies of other genera in the subfamily Mephitinae; measurements that seemed to reflect characters influenced by the age, sex, or geographic differences of specimens; measurements that might present objective data for dimensions expressed subjectively by other authors.

Each measurement was made with dial calipers to the nearest 0.1 mm. A few specimens were unknowingly measured twice, at an interval of several weeks, and the measurements of these have been used to indicate the amount of error that might be expected from variation in the investigator's technique or in a reading of the calipers. The names in parentheses are the designations of the measurements in the text and tables.

BASILAR LENGTH OF HENSEL (BASILAR): The least distance from the anteriormost border of the foramen magnum to the plane of the posterior margins of the first upper incisors. A to A_1 on figure 2. My error in taking this measurement was less than 1 per cent.

CONDYLOBASAL LENGTH (CONDYLOBASAL): The least distance from the plane of the posteriormost parts of the occipital condyles to the anteriormost portions of the premaxillae. B to B_1 on figures 2 and 3. My error in taking this measurement was less than 1 per cent.

ZYGOMATIC BREADTH (ZYGOMATIC): The greatest distance across the zygomatic arches measured perpendicular to the long axis of the cranium. C to C_1 on figure 2. My error in taking this measurement was less than 1 per cent.

MASTOID BREADTH (MASTOID): The distance across the tips of the mastoid processes perpendicular to the long axis of the cranium. D to D_1 on figure 2. My error in taking this measurement was less than 1 per cent.

INTERORBITAL BREADTH (INTERORBITAL): The least distance across the frontal bones at the level of the frontomaxillary sutures. E to E_1 on figure 3. My error in taking this measurement was about 1 per cent.

POSTORBITAL BREADTH (POSTORBITAL): The least distance across the frontal bones posterior to the postorbital projections. F to F_1 on figure 3. My error in taking this measurement was 1 per cent.

PALATILAR LENGTH (PALATILAR): The least distance from the indentation at the posterior of the palatine bones to the plane of the alveoli of the first upper incisors. H to A on figure 2. My error in taking this measurement was less than 1 per cent.

POSTPALATAL LENGTH (POSTPALATAL): The least distance from one of the indentations at the posterior of the palatine bones to the anteriormost border of the foramen magnum. H to A_1 on figure 2. My error in taking this measurement was less than 1 per cent.

HEIGHT OF CRANIUM (CRANIUM HEIGHT): The least distance perpendicular to the long axis of the skull between the junction of the basisphenoid and basioccipital bones and the dorsal surface of the parietal bones, exclusive of the sagittal crest. J to J_1 on figures 2 and 3. My error in taking this measurement was about 1 per cent.

LENGTH OF MAXILLARY TOOTH ROW (MAXILLARY TOOTH ROW): The least distance from the anterior surface of the canine at the alveolus to the posterior surface of the molar at the alveolus, in the plane of the tooth row. K to K_1 on figure 4. My error in taking this measurement was about 2 per cent.

WIDTH ACROSS INCISORS (WIDTH ACROSS INCISORS): The least distance from the labial surface of I^3 on one side to the labial surface of I^3 on the other side. L to L_1 on figure 2. My error in taking this measurement was less than 1 per cent.

WIDTH ACROSS CANINES (WIDTH ACROSS CANINES): The least distance from the labial surface of C on one side to the labial surface of C on the other side. M to M_1 on figure 2. My error in taking this measurement was about 1 per cent.

WIDTH ACROSS MOLARS (WIDTH ACROSS MOLARS): The least distance from the labial side of M^1 on one side to the labial side of M^1 on the other side. N to N^1 on figure 2. My error in taking this measurement was about 1 per cent.

DIAMETER OF CANINE (CANINE DIAMETER): The least distance from the anterior edge of C to the posterior edge of C at the alveolus, in the plane of the tooth row. K to O on figure 3. My error in taking this measurement was less than 2 per cent.

On some skulls in which the canines were missing, this measurement was taken of the alveolus. The two types of measurement, however, are not comparable, as the alveolus is larger than the canine at the alveolus. Table 2 indicates the differences.

Unless otherwise specified, diameter of the canine refers to measurements taken of the tooth, not of the alveolus.

TABLE 2
COMPARISON OF MEASUREMENTS (IN MILLIMETERS) OF THE DIAMETER OF THE CANINE AND THE ALVEOLUS OF THE CANINE

	N	Mean	2 S. E.	S. D.	Min.	Max.
Adult males						
With canine	18	4.57	0.11	0.24	4.2	5.1
Alveolus	4	5.38	—	—	5.2	5.5
Subadult males						
With canine	16	4.58	0.09	0.24	4.0	4.9
Alveolus	1	5.7	—	—	—	—
Adult females						
With canine	33	3.71	0.09	0.25	3.2	4.3
Alveolus	4	4.75	—	—	3.9	5.3
Subadult females						
With canine	13	3.78	0.11	0.19	3.5	4.2
Alveolus	2	4.2	—	—	4.2	4.2

LENGTH OF PM^2 (PM^2): The least distance from the anterior to the posterior of PM^2, taken at the alveolus in the plane of the tooth row. This tooth is not usually present in *Conepatus*, but the exceptions are noted.[1] Not illustrated.

LENGTH OF PM^3 (PM^3): The least distance from the anterior to the posterior of PM^3, taken at the alveolus from the labial side, in the plane of the tooth row. P to P_1 on figure 4. This tooth is frequently offset so that from the labial side, the posterior edge is hidden by PM^4. The measurement in these cases is, therefore, really from the anterior edge of PM^3 to the anterior edge of PM^4. My error in taking this measurement was nearly 5 per cent, and its magnitude is due, in part,

[1] The usual dental formula for the genus *Conepatus* is I^3_3, C^1_1, PM^2_3, M^1_2 = 32. However, a tooth anterior to PM^3, which may be an upper premolar (PM^2), is present in some individuals of this genus (it is characteristic of *Spilogale* and *Mephitis*). Unless otherwise stated, discussion concerning the first upper premolar refers to PM^3.

to the angling of this tooth out of the general plane of the tooth row in some specimens.

LENGTH OF PM^4 (PM^4): The least distance from the anterior edge to the posterior edge of PM^4, at the alveolus, in the plane of the tooth row. P_1 to Q on figure 4. My error in taking this measurement was about 1 per cent.

LENGTH OF MOLAR (MOLAR LENGTH): The least distance from the anterior edge to the posterior edge of M^1, at the alveolus, in the plane of the labial edge of the tooth. Q to K_1 on figure 4. My error in taking this measurement was 7 per cent. See comments for Width of Molar.

WIDTH OF MOLAR (MOLAR WIDTH): The greatest distance from the lingual side to the labial side of M^1 taken parallel to the plane of the labial edge of the tooth. S to N on figure 2. My error in taking this measurement was 8 per cent.

The measurements of the length and width of the upper molar are extremely difficult to take with a high degree of duplication. In part the difficulty is a result of differential wear of the tooth, so that the greatest measurement in either length or width may not always be between the same parts of the tooth, even on two animals of equivalent age. Oldfield Thomas seemingly was unable to standardize his taking of this measurement, for in his various descriptions he omitted it (1903, p. 462), recorded it as "length of upper molar on outer side" (1905, p. 586), recorded length and breadth "at right angles to the axis of the skull" (1921, p. 222), recorded it as "inner antero-posterior diameter of m^1" (1927, p. 200) and "greatest diameter" (*ibid.,* p. 203), "greatest diameter taken in an oblique line from the antero-external to the postero-internal corner" (for length), and at right angles to this "from the antero-internal convexity to the little concavity on the posterior border" (1902, p. 127), and diagonally (1919, p. 491).

In particular, the width measurement is subject to greater error (as much as 20%) and excessive taxonomic importance probably should not be given to these measurements or comparisons of molar measurements in the literature.

LENGTH OF BULLA (BULLA LENGTH): The least distance, anteroposteriorly, between the anterior of the entotympanic exclusive of the styliform process to the posterior swollen portion at the level of the stylomastoid foramen, in the plane of the bulla. T to T_1 on figure 2. My error in taking this measurement was about 5 per cent. See comments for Width of Bulla.

WIDTH OF BULLA (BULLA WIDTH): The greatest width of the entotympanic, measured at right angles to the plane of the bulla, from the carotid foramen to the ectotympanic. U to U_1 on figure 2. My error in taking this measurement was about 9 per cent.

The measurements of the bulla were originally designed to obtain quantitative data on the swollen portion of the entotympanic. Because precise points for measuring on the bulla are not evident, these measurements are of dubious taxonomic validity, and, in any case, do not necessarily record the degree of inflation of the bulla.

LENGTH OF ANTERIOR PALATINE FORAMEN (FORAMEN LENGTH): The greatest distance from the anterior to the posterior edge of the anterior palatine foramen (foramen incisiva) measured from the ventral surface of the premaxilla. Not illustrated. My error in taking this measurement was 10 per cent. See comments under Width of Anterior Palatine Foramen.

WIDTH OF ANTERIOR PALATINE FORAMEN (FORAMEN WIDTH): The greatest diameter of the anterior palatine foramen (foramen incisiva) perpendicular to the long axis of the skull measured from the ventral surface of the premaxilla. Not illustrated. My error in taking this measurement was 34 per cent.

At the outset of this study, variation in the size of the anterior palatine foramina was noticed, and these measurements were taken to see if this variation could be equated with age, sex, or geographic variation. Because the edges of the foramen do not lie in a single plane (the anterior portion may be at right angles to the posterior edge), great error in taking these measurements resulted. Further, the small dimensions involved, especially of the foramen width, results in a greater proportional error if even 0.1 mm. is involved. The least error possible is 0.1 mm., and this variance would mean an error of about 10 per cent.

At the level of the posterior edges of the anterior palatine foramina, the genus *Conepatus* has a smaller foramen on the midline of the palate. This foramen has been called foramen palatinum medius and median anterior palatine foramen (Story, 1951, pp. 487, 511) as well as the foramen intermaxillare (Imaizumi, 1965). It is characteristic of the genus and is not present in *Mephitis* or *Spilogale*. The presence of this foramen was recorded, but its size was not measured.

WIDTH OF INTERPTERYGOID FOSSA (FOSSA WIDTH): The greatest distance across the tips of the hamuli of the internal pterygoid bones, measured perpendicularly to the long axis of the skull. V to V_1 on figure 2. My error in taking this measurement was about 1 per cent.

LENGTH OF LOWER CARNASSIAL (CARNASSIAL LENGTH): The least distance from the anterior to the posterior edge of the lower carnassial,

M_1, at the alveolus, taken in the plane of the mandibular tooth row. W to W_1 on figure 5. My error in taking this measurement was less than 2 per cent.

HEIGHT OF CORONOID (CORONOID HEIGHT): The greatest distance from the dorsalmost point of the coronoid process of the mandible perpendicular to the line formed between the ventral portion of the ramus and the ventral portion of the angular process. X to X_1 on figure 5. My error in taking this measurement was less than 2 per cent.

LENGTH OF MANDIBLE (MANDIBLE LENGTH): The greatest distance between the mandibular symphysis at the alveoli of the first incisors to the posteriormost portion of the angular process, in the plane of the ramus. Y to Y_1 on figure 5. My error in taking this measurement was about 1 per cent.

PLANE OF PALATE RELATIVE TO PLANE OF MOLARS (PALATE-MOLAR RELATIONSHIP): For each specimen the relationship between the anteriormost margins of the posterior edge of the palatine bones and the plane of the posteriormost portions of the upper molars was recorded: long (palate extends posterior to plane of molars), even (palate ends even with plane of molars), short (palate ends anterior to plane of molars).

SHAPE OF PALATE (PALATE SHAPE): For each specimen the shape of the posterior borders of the palatine bones was recorded: spined (having a posterior palatine spinous process), smooth (lacking a posterior palatine spinous process and not indented anteriorly), notched (having a medial indentation at the junctions of the posterior edge of the palatine bones).

ANALYSIS

SEX RATIOS

The sex was recorded from the field labels or, if unrecorded, was determined for the specimen by an examination of the skin, or an analysis of the skull, or both (see p. 25, Secondary Sexual Variation). In a trial of accuracy, I correctly determined the sex of 49 of 50 specimens of all age classes for which the sex was known when these were given to me as animals of unknown sex.

Of 93 specimens for which sex was recorded in the field or for which it has been determined from an examination of the skull or skin, 55 are females and 38 are males. This variation from an expected 1:1 sex ratio is significant at a .10 to .05 level ($X^2 = 3.108$). For the seven juveniles and juvenile-subadults (five males, two females) the deviation

TABLE 3

Months of Collection of Specimens of *Conepatus* from Uruguay Arranged by Sex and Age Groups

Age and Sex	Jan.	Feb.	Mar.	Apr.	May	Oct.	Nov.	Dec.	Totals
Juvenile and juvenile-subadult									
Males	1	1	0	0	0	0	0	3	5
Females	0	0	0	0	0	0	0	2	2
Subadult and subadult-young									
Males	5	3	2	2	0	0	0	0	12
Females	4	1	2	3	4	0	0	0	14
Young-adult and adult									
Males	3	3	3	1	4	1	2	1	18
Females	17	2	4	3	0	0	0	9	35
Age not known									
Males	2	0	1	0	0	1	1	0	5
Females	0	0	1	0	1	0	0	0	2
Totals	32	10	13	9	9	2	3	15	93

from a 1:1 sex ratio is not significant (P=.30–.20), nor is it significant for the 12 male and 14 female subadults and subadult-young adults (P=.70–.50). For the 53 young adults and adults, however, of which 18 are males and 35 are females, the deviation from 1:1 is significant at the 2 per cent level ($X^2=5.452$).

Further analysis of the sex ratios by month indicates that 22 per cent of the adult males and young males were obtained in the months of December and January, whereas 74 per cent of the females of the same age groups were collected in these months. Skunks have been collected during only eight months of the year, and the deviation from the expected 25 per cent of the specimens for males in midsummer is insignificant, but is highly significant for females (P=.01). Ordinarily a larger number of male carnivores in collections is expected, because they are usually larger, generally have a larger range, and may be more readily attracted to traps by certain baits. In the related genus *Spilogale,* I found an over-all sex ratio, of nearly 2000 specimens, to be preponderantly males, with a significant ratio of 1.5:1 (Van Gelder, 1959, pp. 241–242).

Until more knowledge concerning the life history of *Conepatus* is obtained, explanation of the deviation from a 1:1 ratio in the months of December and January is speculative. However, it is these months that the females have young in their care (table 3), and perhaps the replenishment of the metabolic demands of parental care leads females to wander farther at these times so that they are more likely to be trapped or shot.

Months of Collections

There are no specimens of *Conepatus* from Uruguay collected in June, July, August, and September in collections. This absence does not necessarily reflect a decrease in numbers of specimens or their unavailability. Of the 103 specimens on which this study is based, 94 (91%) were obtained by two field parties: the Field Museum of Natural History in 1926–1927 (Sanborn, 1929, p. 148), and the American Museum of Natural History in 1962–1963, neither of which collected in Uruguay during the months of June to September. Of the remaining nine specimens, the month of collection is recorded for only four of them.

Aging

Each specimen for which a skull was available was assigned to an age class. Initially, three major categories were established:

Juvenile: Permanent dentition not fully erupted, most sutures of the skull open.

Subadult: Permanent dentition fully erupted, but basisphenoid-basioccipital suture, at least, open.

Adult: Permanent dentition fully erupted, basisphenoid-basioccipital suture fused and obliterated.

Within and between the age classes, further subdivisions were made:

Juvenile-Subadult: Permanent dentition fully erupted except the upper canines which are almost fully erupted. The teeth of these specimens generally show no wear, except possibly some on the incisors.

Subadult-Young Adults: Incisors, premolars, and molars may show some wear, especially the first (as opposed to no wear on the premolars and molars of subadults). The suture of the malar-temporal suture of the zygomatic arch is fused, although not in every case obliterated. The frontoparietal suture is not open and is usually obliterated, as are the parietotemporal and the sagittal sutures. In subadults, these sutures are generally in a state of lesser fusion.

Young Adult: Most of the cranial sutures are obliterated, but the basisphenoid-basioccipital suture line is clearly evident and is not obliterated as it is in adults. The nasal-maxillary sutures, although fused, are not obliterated, and the same is true of the malar-temporal suture of the zygomatic arch.

Only one of the specimens from Uruguay is younger than juvenile-

TABLE 4
MEASUREMENTS (IN MILLIMETERS) OF SPECIMENS OF *Conepatus* FROM URUGUAY

Measurement	*N*	Mean	S. E.	S. D.	Min.	Max.
Adult males						
Total length	16	549.25	6.06	23.46	510	575
Tail	16	171.81	4.36	16.88	146	212
Head and body	16	377.44	7.72	29.89	325	420
Hind foot	16	71.06	1.26	4.88	61	78
Ear	16	28.00	0.74	2.88	22	35
Weight	13	2242.46	117.60	407.38	1587	2951
Basilar	19	63.25	0.34	1.45	60.8	66.0
Condylobasal	19	72.72	0.41	1.74	69.6	76.1
Zygomatic	19	47.13	0.43	1.84	44.0	51.4
Mastoid	19	39.15	0.29	1.22	36.1	41.0
Interorbital	20	23.09	0.23	0.98	20.9	25.0
Postorbital	19	17.18	0.33	1.38	14.0	19.0
Palatilar	20	29.15	0.23	0.99	27.5	30.9
Postpalatal	19	34.51	0.35	1.49	32.1	37.4
Cranium height	18	25.42	0.23	0.93	23.8	27.1
Maxillary tooth row	20	23.02	0.18	0.78	21.4	24.2
Width across incisors	21	10.63	0.10	0.46	9.9	11.5
Width across canines	20	18.83	0.18	0.79	16.8	20.0
Width across molars	20	28.33	0.25	1.10	26.3	30.5
Diameter of canine	18	4.57	0.06	0.24	4.2	5.1
PM^3	21	3.13	0.07	0.30	2.5	3.8
PM^4	21	6.87	0.10	0.45	6.0	7.7
Molar length	21	6.30	0.13	0.57	5.1	7.5
Molar width	21	8.10	0.15	0.67	5.9	9.0
Bulla length	19	8.05	0.18	0.77	6.3	9.2
Bulla width	19	5.72	0.17	0.71	4.7	6.7
Foramen length	19	2.52	0.10	0.42	1.8	3.4
Foramen width	19	0.97	0.04	0.16	0.7	1.3
Fossa width	19	7.35	0.10	0.43	6.0	8.3
Carnassial length	20	8.58	0.11	0.49	7.8	9.4
Coronoid height	19	23.38	0.27	1.16	21.7	25.8
Mandible length	19	46.57	0.27	1.14	44.9	49.7
Subadult males						
Total length	12	487.33	8.82	29.50	425	540
Tail	12	170.17	6.52	21.64	125	194
Head and body	12	317.17	6.21	20.58	290	365
Hind foot	12	68.42	1.24	4.10	60	74
Ear	9	25.22	1.10	3.11	21	31
Weight	8	1464.38	212.05	561.08	253	1927
Basilar	12	62.25	0.87	2.90	57.7	66.1
Condylobasal	13	70.48	0.85	2.93	66.4	74.8
Zygomatic	10	42.06	0.38	1.14	40.6	44.1
Mastoid	14	37.38	0.48	1.71	34.8	40.5

TABLE 4—(*Continued*)

Measurement	*N*	Mean	S. E.	S. D.	Min.	Max.
Interorbital	14	22.11	0.36	1.31	20.1	24.6
Postorbital	14	19.62	0.40	1.45	17.1	21.7
Palatilar	14	28.79	0.30	1.07	26.8	30.2
Postpalatal	12	33.69	0.69	2.30	30.3	37.5
Cranium height	14	25.15	0.29	1.05	23.0	27.1
Maxillary tooth row	14	22.31	0.20	0.71	20.8	23.5
Width across incisors	14	10.58	0.15	0.56	9.8	11.6
Width across canines	14	18.30	0.20	0.74	17.3	20.0
Width across molars	14	28.74	0.35	1.26	27.3	32.3
Diameter of canine	16	4.58	0.04	0.24	4.0	4.9
PM^3	15	3.18	0.11	0.43	2.1	3.8
PM^4	15	7.09	0.11	0.36	6.5	7.9
Molar length	15	6.35	0.10	0.63	5.1	7.3
Molar width	15	7.97	0.17	0.49	7.0	8.9
Bulla length	14	8.35	0.13	0.62	7.2	9.1
Bulla width	14	5.40	0.12	0.42	4.9	6.2
Foramen length	14	2.79	0.17	0.62	1.6	3.7
Foramen width	14	0.98	0.07	0.25	0.5	1.4
Fossa width	10	6.82	0.24	0.73	5.4	7.9
Carnassial length	15	8.95	0.16	0.61	8.1	10.3
Coronoid height	14	21.71	0.50	1.81	18.8	25.2
Mandible length	14	43.75	0.91	3.30	36.7	48.4
Juvenile males						
Total length	2	447.5	—	—	430	465
Tail	2	156.5	—	—	153	160
Head and body	2	291.0	—	—	277	305
Hind foot	2	65.0	—	—	60	70
Ear	2	24.0	—	—	23	25
Weight	1	907.0	—	—	—	—
Basilar	4	52.13	0.68	1.36	50.3	53.5
Condylobasal	4	60.30	0.58	1.15	58.8	61.6
Zygomatic	4	38.13	0.47	0.94	36.9	39.0
Mastoid	5	35.30	0.86	1.91	32.0	37.0
Interorbital	4	20.23	0.21	0.41	19.7	20.7
Postorbital	5	19.88	0.17	0.38	19.4	20.3
Palatilar	4	24.73	0.18	0.36	24.4	25.2
Postpalatal	4	27.60	0.48	0.97	26.2	28.4
Cranium height	5	23.58	0.32	0.72	22.5	24.4
Maxillary tooth row	4	20.72	0.48	0.96	19.5	21.8
Width across incisors	4	10.15	0.03	0.06	10.1	10.2
Width across canines	4	15.88	0.59	1.19	14.8	17.3
Width across molars	4	27.92	0.19	0.38	27.5	28.4
Diameter of canine	5	3.72	0.34	0.77	2.8	4.7
PM^3	5	2.56	0.12	0.26	2.3	3.0
PM^4	5	7.22	0.17	0.39	6.7	7.8

TABLE 4—(*Continued*)

Measurement	*N*	Mean	S. E.	S. D.	Min.	Max.
Molar length	5	6.38	0.21	0.47	5.9	7.0
Molar width	5	8.14	0.26	0.59	7.3	8.7
Bulla length	5	7.66	0.26	0.59	7.3	8.7
Bulla width	5	5.98	0.43	0.97	4.7	7.3
Foramen length	4	2.60	0.27	0.55	2.0	3.2
Foramen width	4	1.15	0.13	0.26	0.8	1.4
Fossa width	4	6.20	0.24	0.48	5.7	6.7
Carnassial length	5	9.00	0.16	0.35	8.6	9.4
Coronoid height	5	18.56	0.51	1.14	16.7	19.5
Mandible length	5	38.34	1.31	2.94	35.1	41.0
Adult females						
Total length	29	507.38	4.59	24.27	445	560
Tail	29	170.00	3.52	18.60	133	200
Head and body	29	337.72	4.54	24.05	290	396
Hind foot	29	64.07	0.64	3.39	55	71
Ear	24	25.83	0.42	1.99	21	29
Weight	24	1532.17	57.46	275.59	1125	2041
Basilar	33	58.20	0.38	2.12	54.9	64.8
Condylobasal	34	66.97	0.40	2.30	63.4	73.5
Zygomatic	31	43.55	0.22	1.21	40.2	45.2
Mastoid	34	36.65	0.22	1.28	33.8	39.5
Interorbital	34	21.82	0.14	0.82	20.5	23.5
Postorbital	36	17.11	0.24	1.40	14.2	20.0
Palatilar	37	26.71	0.18	1.09	24.7	30.1
Postpalatal	32	31.67	0.26	1.45	28.5	34.9
Cranium height	34	24.22	0.13	0.73	22.7	25.6
Maxillary tooth row	37	21.72	0.17	1.01	18.1	23.5
Width across incisors	36	10.15	0.12	0.72	8.3	11.3
Width across canines	36	16.67	0.18	1.04	14.7	19.1
Width across molars	37	27.73	0.20	1.21	25.6	31.5
Diameter of canine	33	3.71	0.04	0.25	3.2	4.3
PM^3	36	3.06	0.05	0.30	2.5	3.6
PM^4	36	6.70	0.07	0.42	6.1	7.7
Molar length	36	5.94	0.12	0.72	2.7	7.1
Molar width	35	7.95	0.11	0.63	6.8	9.3
Bulla length	38	8.03	0.12	0.71	6.7	9.6
Bulla width	38	5.47	0.09	0.55	4.4	6.7
Foramen length	36	2.20	0.08	0.49	0.9	3.3
Foramen width	36	0.98	0.05	0.32	0.3	1.8
Fossa width	29	7.33	0.12	0.63	6.2	8.5
Carnassial length	36	8.47	0.07	0.42	7.5	9.3
Coronoid height	35	21.50	0.19	1.11	19.3	24.0
Mandible length	35	42.60	0.29	1.69	38.8	45.4
Subadult females						
Total length	13	469.46	8.10	28.07	410	510
Tail	14	169.21	4.90	17.65	130	190

TABLE 4—(*Continued*)

Measurement	*N*	Mean	S. E.	S. D.	Min.	Max.
Head and body	13	299.54	6.20	21.16	256	330
Hind foot	14	63.50	0.90	3.23	57	69
Ear	11	25.82	0.85	2.68	23	31
Weight	10	1344.40	124.94	374.82	907	2118
Basilar	10	58.14	0.63	1.89	55.7	61.5
Condylobasal	10	66.27	0.73	2.20	62.2	69.1
Zygomatic	9	40.46	0.47	1.34	38.7	42.5
Mastoid	11	35.65	0.39	1.25	33.0	37.3
Interorbital	13	21.14	0.24	0.85	19.5	22.4
Postorbital	14	19.65	0.21	0.77	17.6	20.6
Palatilar	14	27.04	0.28	1.01	25.8	28.9
Postpalatal	10	30.96	0.44	1.33	28.9	32.8
Cranium height	14	24.65	0.29	1.06	21.7	26.2
Maxillary tooth row	14	20.99	0.24	0.90	19.6	22.1
Width across incisors	13	10.25	0.13	0.45	9.5	10.9
Width across canines	13	16.40	0.22	0.75	14.6	17.5
Width across molars	13	27.31	0.33	1.16	25.6	28.8
Diameter of canine	13	3.78	0.05	0.19	3.5	4.2
PM^3	15	2.87	0.12	0.44	1.8	3.5
PM^4	14	6.74	0.12	0.44	6.2	7.7
Molar length	15	6.09	0.14	0.52	5.2	7.3
Molar width	15	7.83	0.13	0.49	7.0	8.6
Bulla length	14	7.93	0.32	1.15	6.1	10.3
Bulla width	14	5.66	0.20	0.73	4.4	7.2
Foramen length	13	2.32	0.12	0.43	1.6	3.0
Foramen width	13	1.02	0.07	0.23	0.6	1.4
Fossa width	11	6.95	0.18	0.58	5.9	7.7
Carnassial length	15	8.75	0.08	0.29	8.3	9.4
Coronoid height	14	21.06	0.37	1.33	17.9	22.7
Mandible length	14	42.10	0.44	1.57	39.7	44.1
Juvenile females						
Total length	1	410	—	—	—	—
Tail	1	162	—	—	—	—
Head and body	1	248	—	—	—	—
Hind foot	1	62	—	—	—	—
Ear	1	25	—	—	—	—
Weight	1	680	—	—	—	—
Basilar	1	50.0	—	—	—	—
Condylobasal	1	58.1	—	—	—	—
Zygomatic	2	37.95	—	—	36.6	39.3
Mastoid	2	34.80	—	—	34.2	35.4
Interorbital	2	20.75	—	—	20.3	21.2
Postorbital	2	19.80	—	—	19.7	19.9
Palatilar	2	24.55	—	—	24.1	25.0
Postpalatal	1	27.0	—	—	—	—

TABLE 4—(*Continued*)

Measurement	*N*	Mean	S. E.	S. D.	Min.	Max.
Cranium height	2	24.20	–	–	24.0	24.4
Maxillary tooth row	2	20.15	–	–	20.0	20.3
Width across incisors	2	10.50	–	–	10.0	11.0
Width across canines	2	15.45	–	–	15.0	15.9
Width across molars	2	27.25	–	–	27.0	27.5
Diameter of canine	1	3.7	–	–	–	–
PM^3	2	2.50	–	–	2.4	2.6
PM^4	2	7.05	–	–	6.7	7.4
Molar length	2	5.80	–	–	5.6	6.0
Molar width	2	7.40	–	–	7.1	7.7
Bulla length	2	7.70	–	–	6.7	8.7
Bulla width	2	5.15	–	–	5.0	5.3
Foramen length	2	2.00	–	–	1.9	2.1
Foramen width	2	0.85	–	–	0.8	0.9
Fossa width	2	5.95	–	–	5.7	6.2
Carnassial length	2	8.45	–	–	8.1	8.8
Coronoid height	2	18.45	–	–	18.3	18.6
Mandible length	2	38.65	–	–	38.5	38.8

subadult, and data about deciduous dentition are lacking (p. 25). An adult female (F.M.N.H. No. 29284) has, on the left side, PM^2 measuring 1.1 mm. in anteroposterior alveolar diameter, and this could be a persistent milk tooth. A juvenile-subadult female (F.M.N.H. No. 29286), with canines almost fully erupted, has a tooth in the same position (anterior to PM^3), measuring 0.9 mm., which may be a persistent milk tooth. However, in view of the lack of information about deciduous dentition in *Conepatus,* one could also assume that these premolars represent a vestigial PM^2.

The incisors appear to be the first permanent teeth to be fully erupted in *Conepatus,* and the upper canines the last. The upper molars are generally fully erupted when the canines are not completely erupted.

Tooth wear is not necessarily a criterion of age, although there are no specimens aged younger than adult that have any teeth that could be considered well worn. The incisors are usually the first teeth to show wear, followed by the carnassials and last molars.

The frontoparietal, parietotemporal, and sagittal sutures all fuse at about the same time, and in all young adults and subadult-young adults these sutures are obliterated. The frontonasal and frontomaxillary sutures have also disappeared by these ages.

The zygomatic suture seems to be the next to fuse and become obliterated, and the suture along the lambdoidal crests also fuses at about this time, although it may be visible for some time after fusing. The nasomaxillary sutures fuse at about the same time as the basisphenoid-basioccipital suture, or a little later, although the evidence of the suture at the anterior ends of the nasals may persist even in old adults.

In all specimens classified as adults for which skeletons are available, the epiphyses of the femur and humerus are fused and generally are obliterated. In all subadult-young adults and younger animals, the epiphyses are open or (rarely) fused but clearly evident. The vertebral edge of the scapula in adults is ridged and smooth; in subadult-young adults and younger animals it is clearly marked by rough, developing bone.

Too few young adults were available for study to enable me to make conclusive remarks about this age group, except that the basisphenoid-basioccipital suture is fused but evident, but presumably the other age characteristics would be further advanced than in the subadult-young adult group.

Age Variation

The characters used to determine age are discussed above. For the purposes of analysis, young adults were grouped with adults, subadults and subadult-young adults were considered one group, and all the youngest specimens are juvenile-subadults, except the two specimens dealt with separately at the end of this section. The sample size for the figures in table 5 may be determined from table 4. Of the external measurements, the length of the tail, that of the hind foot, and that of the ear seem to reach adult size first; the weight and the length of the head and body, last.

Most of the measurements of the teeth are of adult size or larger in subadults and juvenile-subadults. The teeth, when fully erupted, do not increase in size with age but, in fact, decrease in size because of wear. In juvenile-subadults, the canine is not fully erupted. Another exception is PM^3 in juvenile-subadults, which is fully erupted but is about 18 per cent smaller than in adults. In part this difference may be the result of error in measurement (see p. 10).

One cranial measurement that decreases with age is the postorbital breadth. It averages about 15 per cent smaller in adults compared with that of either of the other age groups, and is a true constriction, not just a proportional one. The cranial measurements of subadults may nearly equal those of some adults, as is apparent from tables 4 and 5. However, some mean differences as small as 2 per cent (e.g., mastoid

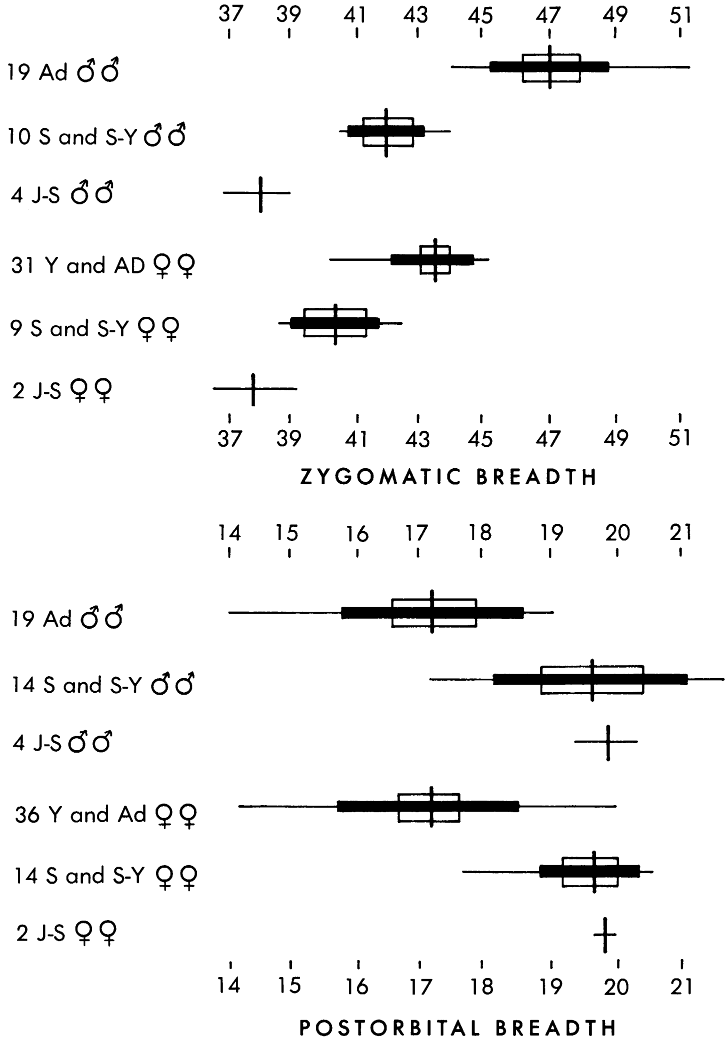

FIG. 6. Statistical presentation of zygomatic breadth and postorbital breadth of Uruguayan *Conepatus* by sex and age categories. Vertical line, mean; horizontal line, range; horizontal solid bar, one standard deviation of the mean; horizontal open bar, two standard errors of the mean.

breadth of males) are statistically significant at the 95 per cent level.

The width across the zygomatic arches is a character that increases in size with age (fig. 6). Age classes of males and of females can be distinguished with a high degree of reliability on this character alone, and

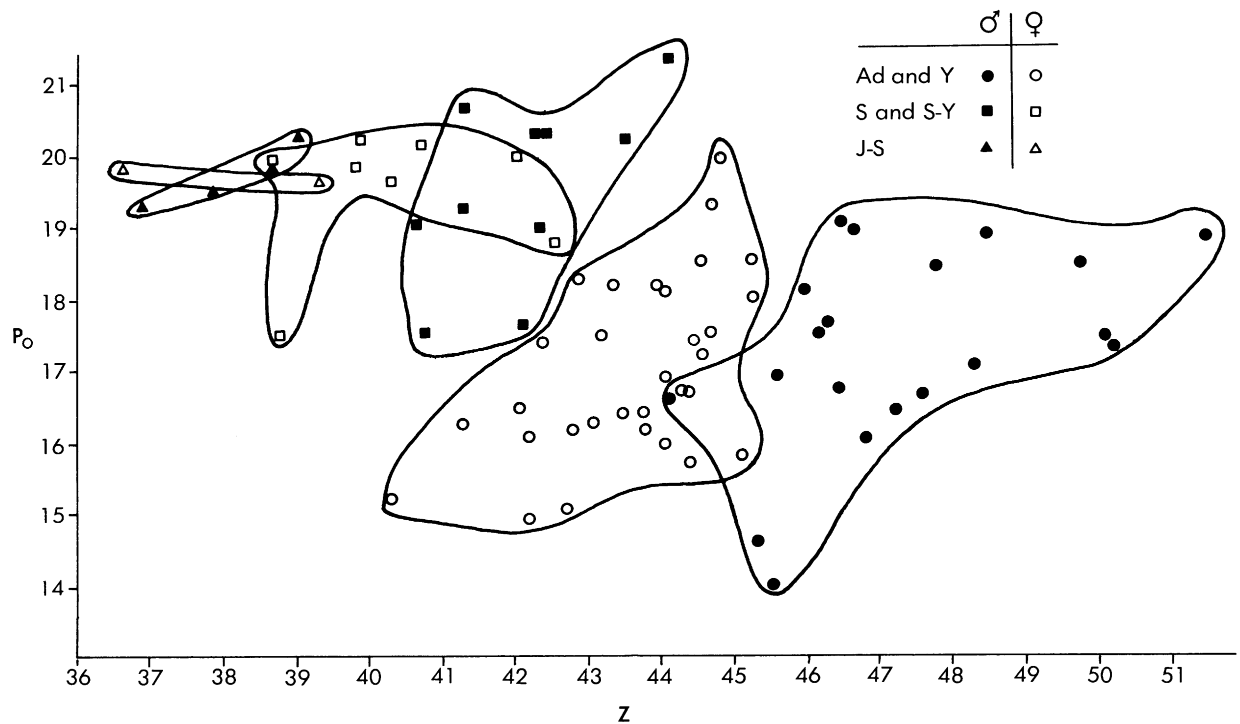

FIG. 7. Measurements, in millimeters, of the postorbital breadth (vertical) and the zygomatic breadth (horizontal) of Uruguayan *Conepatus* plotted by sex and age groups.

TABLE 5
PER CENT OF ADULT SIZE ATTAINED BY SUBADULTS AND JUVENILE-SUBADULTS OF *Conepatus*

	Subadult		Juvenile-Subadult	
	Males	Females	Males	Females
Total length	88.7[a]	92.5[a]	81.5[a]	80.8
Tail	99.0	99.5	91.1	95.3
Head and body	84.0[a]	88.7[a]	77.1[a]	73.4
Hind foot	96.3[b]	99.1	91.5	96.8
Ear	90.1	100.0	85.7	96.8
Weight	65.3[a]	87.7	40.4[a]	44.4
Basilar	98.4	99.9	82.4[a]	85.9
Condylobasal	96.9[c]	99.0	82.9[a]	86.8
Zygomatic	89.2[a]	92.9[a]	80.9[a]	87.1
Mastoid	98.0[a]	97.3[c]	90.2[a]	95.0
Interorbital	95.8[c]	96.9[a]	87.6[a]	95.1
Postorbital	114.2[a]	114.8[a]	115.7[a]	115.7
Palatilar	98.8	101.2	81.7[a]	91.9
Postpalatal	97.6	97.8	80.0[a]	82.6
Cranium height	98.9	101.8	92.8[a]	99.9
Maxillary tooth row	96.9[c]	96.6[c]	90.0[a]	92.8
Width across incisors	99.5	101.0	95.5	103.4
Width across canines	97.2	98.4	84.3[a]	92.6
Width across molars	101.4	98.5	98.6	98.3
Canine diameter	100.2	101.9	81.4[a]	99.7
PM^3	101.6	94.1	81.8[a]	82.0
PM^4	103.2[b]	100.6	105.1	105.2
Molar length	100.8	102.5	101.3	97.6
Molar width	98.4	98.5	100.5	93.1
Bulla length	103.7	98.8	95.2	95.9
Bulla width	94.4	103.5	104.5	94.1
Foramen length	110.7	105.5	103.2	90.9
Foramen width	101.0	104.1	123.7	86.7
Fossa width	92.8[b]	94.8	84.4[a]	81.2
Carnassial length	104.3	103.3[c]	104.9	99.8
Coronoid height	92.9[a]	98.0	79.4[a]	85.8
Mandible length	93.9[a]	98.8	82.3[a]	90.7

[a] P = $<$ .01.
[b] P = $<$ .05.
[c] P = $<$ .02.

when it is combined with another age-character such as postorbital breadth (figs. 6 and 7), there is complete distinction.

There is overlap in the measurements of all characters when adults are compared with subadults (table 4). Significant differences (95% level), when groups are analyzed by age and sex, exist in all external and skull measurements except tail, length of bulla, width of bulla, width of foramen, length of molar, and width of molar.

On January 12, 1963, two very young skunks were extricated from a den 6 kilometers north-northwest of Belen. These are presumed to be the offspring of a lactating female trapped at the den on January 9. Both the young are females and the "weight of each about 1½ hours after being given a little milk was 199 . . . and 190 [grams] . . . Both have the eyes open and can stand, but have difficulty walking. Make a cat-like mew and other squeaks—but no bird-like chirps" (Van Gelder, field notes, January 12, 1963). The measurements and weights of these skunks were 236-60-33 (*s. u.*)-34 (*c. u.*)-14 mm.; 212.8 grams; 235-61-34 (*s. u.*)-37 (*c. u.*)-15 mm.; 213.6 grams on January 13. Unfortunately, only one of these animals, which died a few days later, was preserved. The total length was 46 per cent of the average size of adult females; the tail, 36 per cent; the head and body, 52 per cent; the hind foot, 57 per cent; the ear, 56 per cent; and the weight, 14 per cent, of the respective average measurements of adult females. The tail must grow very rapidly from the time skunks are the size of these nestlings to the time they are juvenile-subadults, when it is of about adult size.

The skull, extracted from the specimen in alcohol, has all sutures open. There is no evidence of milk dentition, but permanent dentition is just starting to erupt. The measurements and per cent of adult female size are in table 6. It is evident that most of the measurements in the sagittal plane are about five-eighths of those of an adult. The width measurements are less consistent, and the postorbital breadth closely approximates that of an adult. As indicated above, this measurement reflects age and is one that decreases with age after subadult size is reached. Actually, postorbital breadth in the one nestling is 15 per cent smaller than that in juvenile-subadults, and 14 per cent smaller than that in subadults.

Secondary Sexual Variation

Differences not attributable to age or individual variation are evident in some measurements of hog-nosed skunks when comparison between the sexes is made. Males of *Conepatus* are usually larger than females in body measurements, much heavier in weight, have a larger skull that is heavier-boned, more robust, and that may more commonly have a distinct sagittal crest, and have larger canine teeth. Table 7 gives the per cent of average adult male size attained by adult females.

Adult males are about 30 per cent heavier than adult females in *Conepatus,* and this is the greatest difference between the sexes in any

TABLE 6

Cranial Measurements and Per Cent of Adult Size of a Nursing Female of *Conepatus*

	Measurement	Per Cent of Adult Female Size
Basilar	36.0	62
Condylobasal	41.2	62
Zygomatic	27.4	63
Mastoid	22.2	61
Interorbital	16.6	76
Postorbital	16.9	99
Palatilar	16.5	62
Postpalatal	19.5	62
Cranium height	18.9	78
Maxillary tooth row	16.2	75
Width across incisors	7.9	78
Width across canines	11.1	67
Width across molars	22.2	80
Bulla length	6.8	85
Bulla width	4.6	84
Fossa width	4.2	57
Coronoid height	12.2	57
Mandible length	27.7	65

of the characters studied. There is an average difference of 700 grams, and the heaviest male weighed 910 grams more than the heaviest female. All but one of the females were without embryos, although some were lactating. The one female with four embryos (see p. 18) weighed 2041 grams and was one of two females with this weight, the heaviest recorded for this sex in Uruguay. The other did not have embryos. The great difference in adult weight between the sexes is also true in the genus *Spilogale,* in which I found a 40 per cent difference between the sexes in adults (Van Gelder, 1959, p. 344). The least difference between the sexes in external measurements is in the length of the tail, for which the mean measurements are less than 2 mm. different. In length of head and body and hind foot the males are about 10 per cent larger. Significantly different means (at the 95% level of confidence) between adult males and adult females exist in all external measurements except the tail (P=.2–.3) and ear (P=.4–.5).

The skulls of male *Conepatus* average larger than those of females in almost all the measurements taken (tables 4 and 7). Significant differences in the mean at the 95 per cent level of confidence are indicated in table 4. It is noteworthy that the 10 measurements most commonly used in the taxonomy of mustelids (the first 10 cranial measurements)

TABLE 7

PER CENT OF AVERAGE SIZE OF MALES OF *Conepatus* ATTAINED BY FEMALES

Measurement	Adults	Subadults	Juvenile- Subadults
Total length	92.4[a]	96.3	91.6
Tail	98.9	99.4	103.5
Head and body	89.5[a]	94.4	85.2
Hind foot	90.2[a]	92.8	95.5
Ear	92.3	102.4	104.2
Weight	68.3[a]	91.8	75.0
Basilar	92.0[a]	93.8	96.9
Condylobasal	92.1[a]	94.0	96.4
Zygomatic	92.4[a]	96.2	99.5
Mastoid	93.6[a]	95.4	98.6
Interorbital	94.5[a]	95.6	102.6
Postorbital	99.6	100.2	99.6
Palatilar	91.6[a]	93.9	103.1
Postpalatal	91.8[a]	91.9	97.8
Cranium height	95.3[a]	98.0	102.6
Maxillary tooth row	94.4	94.1	97.2
Width across incisors	95.5[a]	96.9	103.4
Width across canines	88.5[a]	89.6	97.3
Width across molars	97.9	95.0	97.6
Diameter of canine	80.2[a]	82.5	99.5[b]
PM^3	97.4	90.3	97.7
PM^4	97.5	95.1	97.6
Molar length	94.3[a]	95.9	90.9
Molar width	98.1	98.2	90.9
Bulla length	99.8	95.0	100.5
Bulla width	94.8	104.8	86.1
Foramen length	87.3[a]	83.2	76.9
Foramen width	101.0	104.1	70.8
Fossa width	99.7	101.9	96.0
Carnassial length	98.7	97.8	93.9
Coronoid height	92.0[a]	97.0	99.4
Mandible length	91.5[a]	96.2	100.8

[a] $P = < .05$.
[b] The tooth is not fully erupted.

are, with the exception of postorbital breadth, ones that vary significantly depending upon the sex of the animal. Seven of these are also characters that show relatively low individual variation (see p. 28). For the significance of postorbital breadth measurements, see page 21.

The greatest difference between the sexes in cranial measurements is the diameter of the canines. As can readily be seen from tables 2, 4, and 7, there is almost complete separability, and about a 20 per cent difference in the means. Utilizing this character alone, one could sex skulls with a high level of accuracy. The larger size of canine teeth in the males also influences the measurement of the width of the cranium across the canines, the second most distinguishing measurement influenced by the sex of the specimens.

Significant sexual differences in the size of teeth seems limited primarily to the canine and to the length of the upper molar in adults. The molar often shows considerable wear in very old specimens, and the differences between the means of males and those of females may be influenced by this factor, even though all animals in the sample were regarded as having reached adult size. There is a highly significant difference between the sexes in the length of the anterior palatine foramen. As mentioned above (p. 12), this measurement is difficult to take accurately and highly variable, and I do not believe that it can be used to distinguish the sexes.

The differences between the sexes are less evident in animals younger than adult, which, in part, probably reflects the decreased influence of sexual hormones in animals not yet sexually mature. The diameter of the canine and the width across the canines appear to be characters that are as different sexually in subadults as in adults. The same is true of the length of the anterior palatine foramina, although I still doubt the utility of this measurement in distinguishing the sexes. Further remarks on sexual differences in relation to age are on page 34.

Individual Variation

Variability not attributable to age, sex, geographic or ecologic distribution is regarded as individual variation. Of the measurements taken in the field, weight is the most highly variable. This is to be expected because it is affected by numerous factors, including whether or not the stomach, bladder, and intestines are full, dehydration, pregnancy in females, and the general body condition of the animal, as well as errors in reading the scale (see p. 8). The coefficient of variation of body weight is significantly different from that of most of the other external measurements and cranial measurements (table 8). The least variable external measurements are total length, length of head and body, and length of hind foot. The measurements of the ear and of the length of the tail are quite variable. As was true of *Spilogale* (Van Gelder, 1959, p. 239) for the following four characters, the tail is the most variable external character, the head and body are the next most variable, and the hind foot and total length are the least variable.

TABLE 8

COEFFICIENT OF VARIATION AND TWO STANDARD ERRORS OF COEFFICIENT OF VARIATION OF ADULT AND SUBADULT MALES AND FEMALES OF *Conepatus* FROM URUGUAY

	Adult Males	Subadult Males	Adult Females	Subadult Females
Total length	4.27±1.51	6.05± 2.46	4.78±1.26	5.98± 2.34
Tail	9.82±3.46	12.72± 5.20	10.94±2.88	10.43± 3.94
Head and body	7.91±2.78	6.49± 2.64	7.12±1.86	7.06± 2.76
Hind foot	6.86±2.42	5.99± 2.44	5.29±1.38	5.09± 1.92
Ear	10.26±3.62	12.36± 5.84	7.70±2.22	10.38± 4.47
Weight	18.16±7.12	38.32±19.16	17.99±5.20	28.88±12.92
Basilar	2.28±0.74	4.65± 1.90	3.64±0.90	3.25± 1.46
Condylobasal	2.39±0.78	4.16± 1.64	3.43±0.82	3.32± 1.48
Zygomatic	3.90±1.26	2.70± 1.20	2.78±0.70	3.31± 1.56
Mastoid	3.11±1.02	4.58± 1.74	3.49±0.82	3.51± 1.50
Interorbital	4.23±1.34	5.92± 2.24	3.76±0.92	4.02± 1.58
Postorbital	8.01±2.60	7.39± 2.80	8.18±1.92	3.92± 1.48
Palatilar	3.39±1.08	3.71± 1.40	4.08±0.94	3.74± 1.42
Postpalatal	4.29±1.40	6.83± 2.78	4.58±1.14	4.30± 1.92
Cranium height	3.66±1.22	4.17± 1.58	3.01±0.72	4.30± 1.62
Maxillary tooth row	3.38±1.08	3.16± 1.20	4.65±1.08	4.29± 1.62
Width across incisors	4.29±1.32	5.25± 1.98	7.09±1.68	4.39± 1.72
Width across canines	4.22±1.34	4.02± 1.52	6.24±1.46	4.57± 1.80
Width across molars	3.89±1.24	4.38± 1.66	4.36±1.01	4.25± 1.66
Diameter of canine	5.14±1.71	5.25± 1.57	6.77±1.67	5.11± 2.00
PM^3	9.64±2.98	13.46± 4.92	9.84±2.32	15.33± 5.60
PM^4	6.58±2.04	5.03± 1.84	6.27±1.48	6.53± 2.46
Molar length	9.13±2.82	9.86± 3.60	12.12±2.86	8.54± 3.12
Molar width	8.25±2.54	6.17± 2.26	7.92±1.90	6.26± 2.28
Bulla length	9.57±3.10	7.42± 2.80	8.84±2.02	14.50± 5.48
Bulla width	12.48±4.06	7.79± 2.94	10.05±2.30	12.90± 4.88
Foramen length	16.56±5.38	22.08± 8.34	22.27±5.24	18.53± 7.26
Foramen width	16.16±5.24	26.03± 9.48	32.65±7.70	22.55± 8.84
Fossa width	5.83±1.90	8.59± 3.84	8.59±2.26	8.35± 3.56
Carnassial length	5.71±1.80	6.77± 2.48	4.96±1.16	3.31± 1.20
Coronoid height	4.98±1.62	8.34± 3.16	5.16±1.24	6.32± 2.38
Mandible length	2.78±0.90	7.54± 2.86	3.97±0.94	3.23± 1.21

Of the cranial measurements, the least variable (coefficient of variation less than 5) in samples analyzed by age and sex are basilar, condylobasal, zygomatic, mastoid, palatilar, cranium height, maxillary tooth row, and width across molars. The next least variable group, all having coefficients of variation of seven or lower, are interorbital, postpalatal, width across incisors, width across canines, canine diameter, PM^4, lower carnassial, and length of mandible. Somewhat more variable (coeffi-

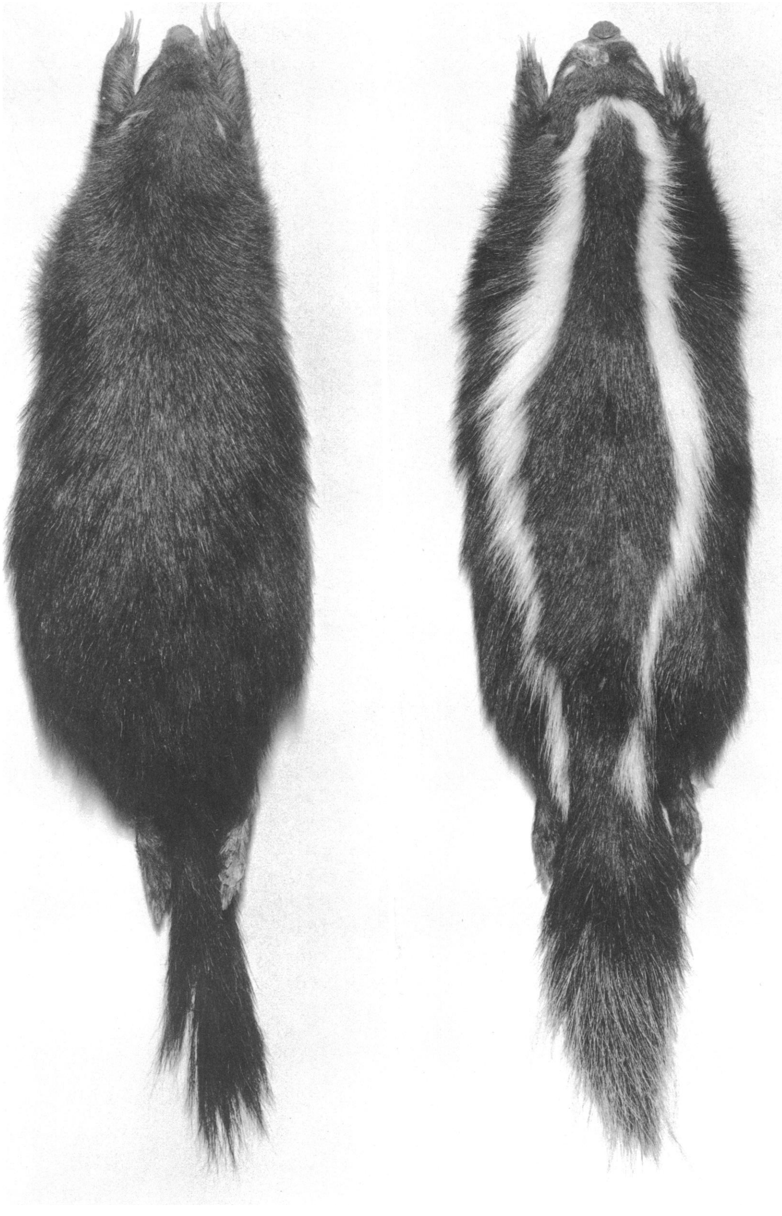

FIG. 8. Extremes of variation in color pattern among 65 specimens of *Conepatus* from Uruguay.

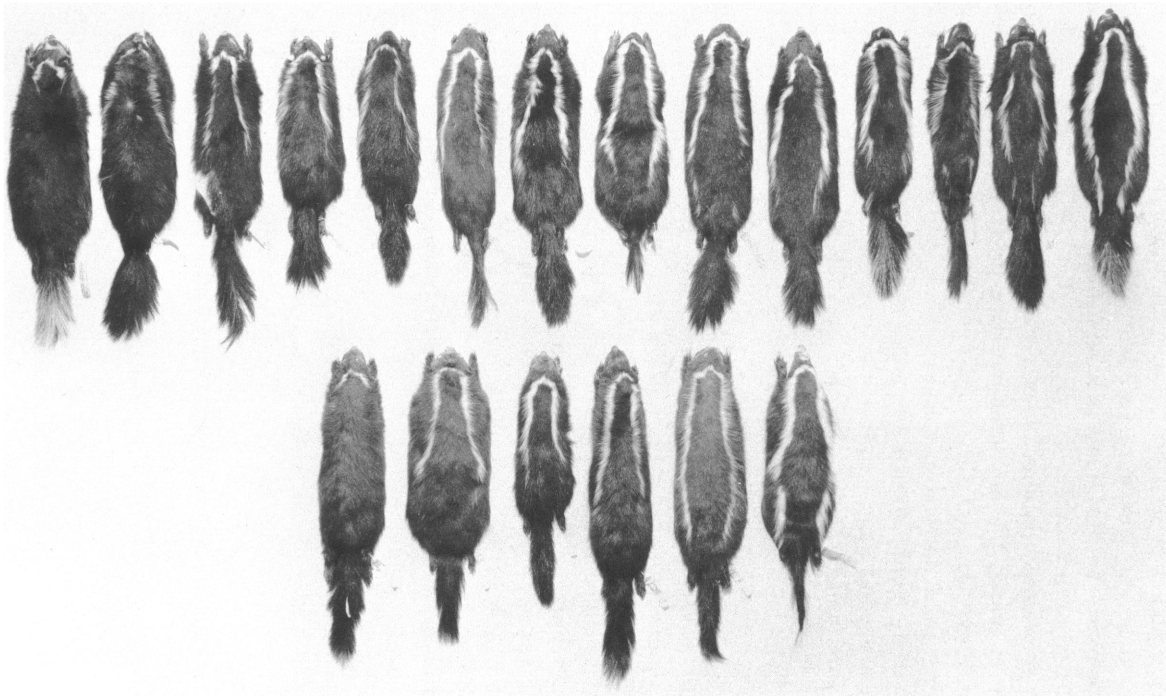

FIG. 9. Variation in color pattern within a single population of *Conepatus* from Arroyo Negro, 15 kilometers south of Paysandú, Department of Río Negro, Uruguay. All were captured between December 26, 1962, and January 7, 1963. *Upper row:* Females. *Lower row:* Males.

cient of variation 9 or less) are postorbital, molar width, fossa width, and coronoid height. The most variable characters (coefficient of variation 10 or more) are PM^3, molar length, bulla length and width, and foramen length and width.

In part, the high variability of some characters is a result of my own variability in taking the measurements (see p. 8), but not entirely. As I mention above, some of these measurements were selected originally because they were noticeably variable. There are differences in coefficient of variation, not statistically significant for most characters, between the sexes and age groups. These are discussed in the sections on Age Variation and Secondary Sexual Variation (see pp. 21, 25).

Color Pattern

All the specimens of *Conepatus* from Uruguay are blackish or brownish black, with a varying amount of white hair. Of the 65 skins from Uruguay in the American Museum, 30 are dull or brownish, and 35 are shiny and blackish. The brownish coloration is mostly worn, possibly stained or bleached pelage. The tips of the hairs of these specimens are generally broken off, and the pelage is coarser and duller than that of most of the specimens that have been categorized as blackish. The hairs of the tail of the brownish specimens are, in general, sparser, shorter, and coarser. When the adult specimens were arranged by sex, locality, and date of capture, no consistent correlation with blackish or brownish coloration was evident. Similarly subadults exhibit both a shiny black and a dull brownish appearance. No definitive comments about a seasonal molt seem warranted from the material available.

The white stripes of the Uruguay skunks vary in length from ones that extend the entire length of the body and onto the base of the tail to no stripes at all and only a few white hairs in the head region (fig. 8). The width of a stripe varies from about 15 mm. to the width of a single hair. The length of the white hairs often makes the stripe appear wider by an overlying of the adjacent black hairs by the white hairs, so that the width of the white stripes appears to be about 25 mm., although the actual zone of follicles producing these hairs may be half that width.

Each specimen was categorized in one of five stripe classes:

Long: Stripes extending the full length of the body and onto the base of the tail.

Three-Quarters: Stripes extending from the crown to the hips.

One-Half: Stripes extending from the crown to the middorsal region.

One-Quarter: Stripes extending from the crown to the shoulder.

None: Short; stripes absent to short stripes no longer than 30 mm.

The majority of Uruguay specimens had stripes half, or longer than half, of the length of the body. About one-quarter of the specimens had stripes shorter than one-half of the length of the body (fig. 10).

Asymmetry was evident in the length of the stripes in many specimens, but the difference between one side and the other was in no case greater than one stripe-length class.

The majority of Uruguay skunks have a tail that appears totally black. Of the 65 skins at the American Museum, only eight have more than a half dozen scattered white hairs in the tail. There appears to be no correlation between the amount of white in the tail and the length

FIG. 10. Histogram showing the extent of white markings on Uruguayan *Conepatus*. The vertical scale is the number of specimens. The horizontal scale is the length of the white markings. See text.

of the body stripes. The eight specimens classified as having white on the tail have a sufficient amount of white to be seen at a distance of 10 feet. Those with only a few scattered white hairs appear to have totally black tails at this distance. Unlike some specimens of *Conepatus* from other parts of the range of the genus which have bicolored hair (white base, black tip) in the tail, the Uruguay specimens have unicolored hair—either completely white or completely black.

A whorl of hair on the nape has sometimes been used as a taxonomic character in studies of *Conepatus*. In Uruguay this seems to be a variable character, and in a series of 20 specimens from Arroyo Negro, it is present in one of six males and in three of 14 females.

SUMMARY AND DISCUSSION

One hundred three specimens of the genus *Conepatus* from Uruguay have been analyzed for age, sex, and individual variation of both skins and skulls.

Sexual dimorphism in the cranial measurements is sufficiently great to

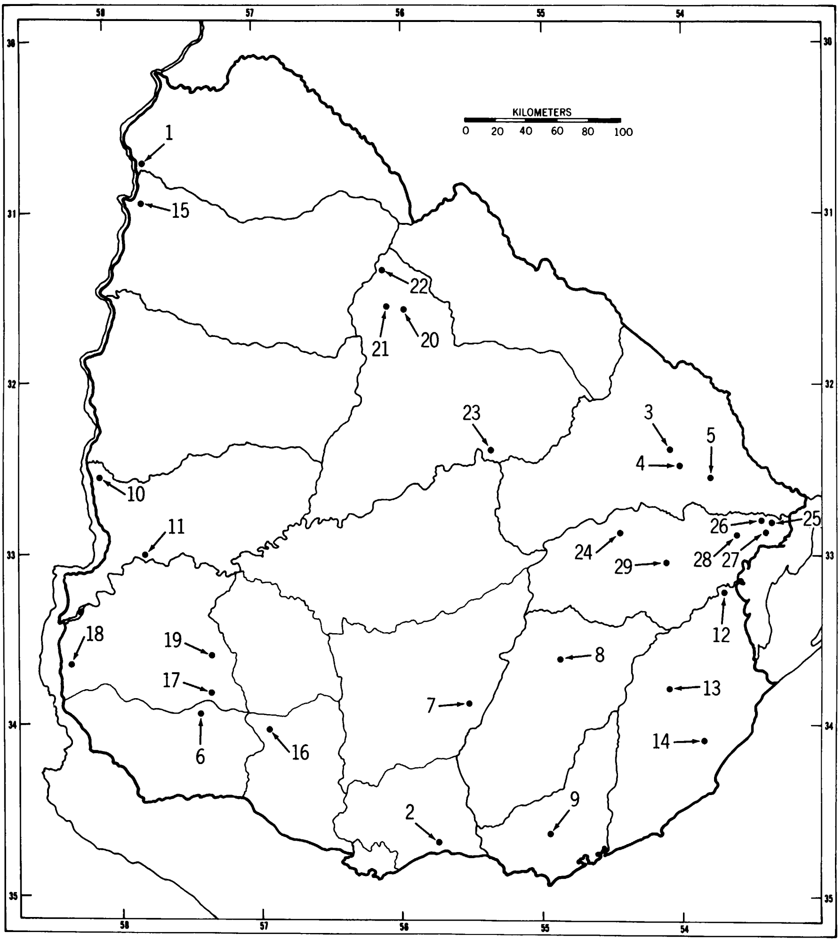

FIG. 11. Map of Uruguay, showing the localities from which specimens have been examined. See text.

preclude consideration of both sexes as a single unit in systematic studies. Similarly, there are significant differences between age groups of the same sex great enough to indicate that taxonomic comparisons must be made between animals of comparable age. Individual variation in cranial dimensions is sufficiently low (coefficient of variation less than 5) in about 10 measurements to suggest that these will be most useful taxonomic criteria.

An analysis of color pattern indicates considerable individual variation but no sex or age differences. From the material available, no conclusions about molt or seasonal variation could be made.

Kipp (1965) is the only other person who has investigated variation in this genus in detail. Her sample consisted of 84 specimens, of which only 26 were skins with associated skulls. The total sample was drawn from an area larger than 600,000 square miles, with varied topography and climate. Although she called specimens adult, subadult, and juvenile, Kipp did not present data for age criteria, and some of the questions she raised indicate that she did not refine her age categories sufficiently. Her comments (pp. 218–219) on postorbital breadth and zygomatic breadth seem to indicate that she did not recognize these as age characters. In drawing her taxonomic conclusions, she relied almost entirely on characters of the skins. Her placement of Uruguayan material (Kipp, 1965, map p. 226) in the group of skunks having bicolored hair in the tail is not correct.

This paper presents the basic analyses that will permit a more objective evaluation of characters used in the classification of the genus *Conepatus*.

SPECIMENS EXAMINED

One hundred three specimens were examined, from the localities in Uruguay that are listed below. The numbers in italics refer to the localities on the map (fig. 11). The initials of the institutions in the collections of which the specimens are contained are:

A.M.N.H., the American Museum of Natural History
B.M., British Museum (Natural History), London
F.M.N.H., Field Museum of Natural History, Chicago
I.M.L., Instituto Miguel Lillo, Tucuman, Argentina
M.N.U., Museo Nacional de Uruguay, Montevideo
U.S.N.M., United States National Museum, Smithsonian Institution, Washington, D. C.
Z.S., Zoologische Staatssammlung, Munich, Germany

LOCALITIES

Artigas: 6 kilometers north-northwest of Belén, 5 (A.M.N.H.), *1. Canelones:* Balnearis Jaureguiberry, 1 (M.N.U.), *2. Cerro Largo:* 6 kilometers southeast of Melo, 2 (A.M.N.H.), *3;* Sierra de Vas, Rio Tacuarí, 1 (A.M.N.H.); Sierra de Vas, Rio Tacuarí, about 20 kilometers southeast of Melo, 1 (A.M.N.H.), *4;* 20 kilometers northwest of Paso del Dragón, 1 (A.M.N.H.), *5. Colonia:* 10 kilometers south of La Lata, 4 (F.M.N.H.), *6;* Estancia Los Alpes, 10 miles south of La Lata, 1 (B.M.), *6. Florida:* Arroyo Milan, Reboledo, 1 (M.N.U.), *7. Lavalleja:* 12 kilometers west-southwest of Zapicán, 5 (A.M.N.H.), *8. Maldonado:* North of San Carlos, 1 (F.M.N.H.), *9. Río Negro:* Arroyo Negro, 15 kilometers south of Paysandú, 22 (A.M.N.H.), *10;* Paso Correntino, 1 (F.M.-

N.H.), *11. Rocha:* Cebollatí, 1 (M.N.U.), *12;* 22 kilometers southeast of Lascano, 11 (A.M.N.H.), *13;* 15 kilometers north of San Vicente de Castillos, 2 (F.M.N.H.), *14. Salto:* Espinillar, 1 (M.N.U.), *15. San José:* Sierra Mahoma, 1 (M.N.U.), *16. Soriano:* 3 kilometers east of Cardona, 1 (A.M.N.H.), *17;* southwest of Dolores, 1 (F.M.N.H.); 15 miles southwest of Dolores, 6 (F.M.N.H.), *18;* Santa Elina, Drabble, 1 (M.N.U.), *19;* "Soriano," 2 (B.M.). *Tacuarembó:* About 10 kilometers north of Tacuarembó, 2 (A.M.N.H.), *20;* 10 kilometers north of Tacuarembó, 1 (A.M.N.H.); about 15 kilometers northwest of Tacuarembó, 1 (A.M.N.H.), *21;* 40 kilometers northwest of Tacuarembó, 5 (A.M.-N.H.), *22;* Río Negro, waters 7 kilometers above the bar of Tacuarembó, 1 (M.N.U.), *23. Treinta y Tres:* Quebrada de los Cuervos, 8 (F.M.N.H.), *24;* 10 kilometers west of mouth of Río Tacuarí, 3 (A.M.N.H.), *25;* 15 kilometers northwest of mouth of Río Tacuarí, 1 (A.M.N.H.), *26;* 16 kilometers south-southwest of Río Tacuarí, 4 (A.M.N.H.), *21;* 80 kilometers northeast of Treinta y Tres, 1 (A.M.N.H.), *28;* 13 kilometers west-southwest of Vergara, 1 (A.M.N.H.), *29. No exact locality:* 2 (I.M.L.).

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