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Skull Size of Two Insular and One Mainland Subspecies of *Odocoileus virginianus* from the Southeast

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ABSTRACT

We compared skull characteristics of white-tailed deer from the lower Florida Keys (O. *v. clavium*) with those of south Florida deer (*O.v. seminolus*) and deer from Blackbeard Island, Georgia (*O. v. nigribarbis*). Ranges of skull and tooth row length measurements showed no overlap between adult south Florida deer and the smaller Key deer. Overlap in ranges for most skull measurements between Key deer and Blackbeard Island deer suggest an influence of island habitat on both subspecies.

INTRODUCTION

Artiodactyls that inhabit islands generally are smaller than their mainland counterparts (Case, 1978; Lomolino, 1985). We know of few studies (Barbour and Allen, 1922; Dickson, 1955; McCain, 1970) that have compared skull morphology in insular and mainland populations of white-tailed deer (*Odocoileus virginianus*). We are aware of no studies that have compared skull morphology between white-tailed deer of different islands.

Maffei et al. (1988) described cranial and mandibular characteristics of the endangered Key deer (*O. v. clavium*) and recommended comparisons of these measurements among Key deer, other island populations, and mainland Florida white-tailed deer. These comparisons are of interest for determining patterns of morphological difference in island populations of white-tailed deer. Identification

of diagnostic measurements that differentiate deer of the Florida Keys from those of the mainland will enhance biologists' ability to identify skulls of questionable origin. This is of interest because Key deer are protected, and the population numbers 250-300 (U.S. Fish and Wildlife Service, 1985), whereas deer of south Florida are subjected to hunting.

METHODS

We measured cranial and dental characteristics of 38 white-tailed deer (*O. v. seminolus*) from south Florida (Broward, Dade, and Palm Beach counties) and 32 white-tailed deer (*O. v. nigribarbis*) from Blackbeard Island, Georgia (McIntosh County). All specimens were collected 1986-1988 and were assigned to age classes based on tooth eruption and wear (Severinghaus, 1949). Measurements of 383 skulls and 402 mandibles of Key deer (Cooperative Wildlife Research Laboratory Research Collection, see Maffei et al., 1988) also were analyzed.

South Florida deer collected for this study were isolated from Key deer by 60 km of open water and 70 km of land. Blackbeard Island deer occur on Sapelo and Blackbeard Islands, and immigration from the mainland is limited by a barrier (Johnson et al., 1974) of about 6.4 km of open water and salt marsh. Blackbeard Island lies about 530 km north of the south Florida collection area.

Of 20 skull measurements taken, 6 characterized length of crania (skull length, condylobasal length, auditobasal length, greatest length of nasal, greatest length of palate, and length from condylon to PM2); 7 characterized width of crania (zygomatic width, least width of nasals, width between paraoccipital processes, least interorbital width, width between frontojugal sutures, least width of palate, and width of orbit); and 7 characterized cheek-tooth row lengths (Upper and Lower PM2-M3, Upper and Lower PM2-M2, Upper and Lower PM2-M1, and Lower PM3-M3.

In addition to the 20 measurements, zygomatic width, PM2-M3, PM2-M2, PM2-M1, least width of nasals, width between paraoccipital processes, least interorbital width, width of skull between frontojugal sutures, least width of palate, width of orbit, condylobasal length, auditobasal length, greatest length of nasals, and greatest length of palate were expressed as a proportion of skull length. Nasal width/nasal length and palate width/palate length also were determined, for a total of 36 skull measurements.

Measurements ≤ 173 mm were taken with a dial caliper to 0.1 mm. Longer measurements were taken to the nearest mm on a measuring board. Measurements were taken on the right side when possible; partial series of measurements were obtained from damaged skulls and mandibles. Tooth row measurements were taken only if teeth were fully erupted.

Differences in means among ages and between sexes were identified for most cranial and mandibular characteristics of the Key deer (Maffei et al., 1988). To

avoid potential biases, we compared subspecies within each sex and age class. Because of small sample sizes within some age and sex classes, we compared ranges rather than means to identify differences. Tabular data are presented only for measurements showing no overlap in ranges.

RESULTS AND DISCUSSION

Key deer skulls were shorter than those of south Florida white-tailed deer; ranges of 4 length measurements showed no overlap in males and females ≥ 1 year of age (Table 1). Female fawns were not compared, but measurement ranges for male fawns of Key deer overlapped those of male fawns from south Florida.

No overlap in ranges of lower PM2-M3 and lower PM3-M3 was evident for Key deer and south Florida male and female deer aged ≥ 1 year (Table 2). In addition, no overlap occurred for upper PM2-M3, upper and lower PM2-M2, and upper PM2-M1 in specimens aged ≥ 2 years. These findings concur with those of previous studies (Barbour and Allen, 1922; Dickson, 1955; McCain, 1970; Maffei et al. 1988) which identified short cheek-tooth row length as an important characteristic that distinguishes Key deer from mainland deer.

The six skull measurements showing no overlap between yearling and older deer of the Florida Keys and mainland may aid in resolving questions regarding the origin of a given skull. If the skull is from a deer ≥ 2 years of age, four more measurements (for a total of ten) may be used in determining if the skull is from an endangered Key deer or a legally harvested deer from mainland Florida.

For all measurements, upper portions of ranges in Key deer overlapped with lower portions of ranges in Blackbeard Island deer, with the exception of auditobasal length in females ≥ 1 year old (Table 3). Therefore, based on comparisons of ranges, most Key deer skulls are not distinguishable from those of deer from Blackbeard Island.

Results from this study suggest an influence of island habitat on morphology of white-tailed deer. Skulls of Key deer were more similar in size to skulls of deer from another island (Blackbeard) population located 700 km north than to those of a mainland Florida population located within 200 km of the Key deer. Similar environmental constraints of food, fresh water, and space on coastal islands may be responsible.

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Table 1. Non-overlapping ranges of cranial measurements (in mm) from deer of the Florida Keys and adjacent mainland.

Measurement		Key deer				South Florida deer			
Sex	age (years)	$\bar{x}$	n	SE	range	$\bar{x}$	n	SE	range
Skull Length									
M	1-2	217	18	2.8	192-235	259	7	1.8	251-266
M	2-3	224	23	1.9	208-247	279	3	1.2	277-281
F	1-2	201	22	2.1	171-215	255	12	2.2	245-271
F	2-3	216	14	1.9	201-227	266	5	6.2	246-284
F	3-4	224	8	2.3	216-232	260	3	6.1	249-270
F	4-5	228	9	2.4	219-239	259	2	7.5	251-266
Condylobasal Length									
M	1-2	201	17	4.7	141-224	248	7	1.5	242-253
M	2-3	212	22	1.8	199-231	268	3	2.2	264-271
F	1-2	191	20	2.2	164-205	243	12	2.1	233-259
F	2-3	205	13	1.7	191-215	255	4	6.3	239-268
F	3-4	212	8	1.6	206-219	250	3	2.2	246-253
F	4-5	216	9	1.8	209-225	253	2	6.0	247-259
Auditobasal Length									
M	1-2	188	16	2.5	171-207	224	7	1.8	214-230
M	2-3	192	23	1.7	175-207	245	3	2.5	242-250
F	1-2	173	18	2.3	145-188	221	12	2.0	211-235
F	2-3	185	13	2.1	177-201	230	5	4.9	214-243
F	3-4	192	8	1.5	183-196	228	3	4.4	220-235
F	4-5	195	9	1.8	186-204	229	2	6.0	223-235
Palate Length									
M	1-2	131	14	2.2	112-143	163	5	3.2	155-173
M	2-3	136	22	1.2	125-146	173	3	2.0	170-177
F	1-2	120	16	1.9	102-131	160	11	1.5	152-168
F	2-3	132	12	1.2	123-139	166	5	3.7	157-178
F	3-4	135	8	0.9	132-139	168	3	4.1	161-175
F	4-5	139	9	1.2	136-147	169	2	5.5	163-174

Table 2. Non-overlapping ranges of cheek-tooth row measurements (in mm) from deer of the Florida Keys and adjacent mainland.

Measurement		Key deer				South Florida deer			
Sex	age (years)	$\bar{x}$	n	SE	range	$\bar{x}$	n	SE	range
Lower PM2-M3									
M	1-2	71.4	15	0.8	64.7-75.5	81.4	4	1.4	79.3-85.4
M	2-3	70.7	18	0.5	66.2-74.0	82.0	3	2.1	78.3-85.4
F	1-2	70.3	5	0.6	68.8-71.8	80.0	8	1.1	75.4-84.5
F	2-3	70.6	17	0.5	67.8-73.5	81.5	4	1.2	78.3-83.9
F	3-4	69.5	12	0.8	66.0-74.2	80.9	3	1.9	77.7-84.2
F	4-5	69.5	11	0.5	67.7-71.8	77.3	2	2.9	74.4-80.2
Lower PM3-M3									
M	1-2	64.8	17	0.6	59.0-68.3	73.9	4	1.3	71.8-77.6
M	2-3	63.0	27	0.6	54.2-68.3	73.6	3	1.8	70.0-76.0
F	1-2	63.7	22	0.6	61.8-66.7	72.3	9	0.9	68.8-75.7
F	2-3	63.6	22	0.4	60.3-66.8	73.1	5	0.9	70.9-75.5
F	3-4	62.4	14	0.6	58.2-67.2	72.8	3	1.6	70.0-75.5
F	4-5	62.0	15	0.7	53.2-64.2	69.5	2	3.3	66.2-72.8
Upper PM2-M3									
M	2-3	62.6	27	0.4	56.7-65.9	80.0	3	1.6	76.9-82.5
F	1-2	61.8	6	0.7	59.8-64.5	75.5	5	1.2	70.6-80.2
F	2-3	62.0	19	0.4	59.1-64.2	76.6	5	0.9	74.1-79.3
F	3-4	61.5	14	0.5	58.2-65.4	76.3	2	0.6	75.8-76.9
F	4-5	60.8	14	0.4	56.7-62.5	72.5	2	4.4	68.1-76.9
Upper PM2-M2									
M	2-3	51.3	28	0.3	47.1-55.3	65.5	3	1.4	63.0-67.9
F	1-2	52.8	33	0.4	48.7-56.9	62.1	8	0.9	58.1-66.0
F	2-3	51.0	20	0.3	47.7-53.1	62.7	5	1.1	60.3-65.6
F	3-4	50.6	14	0.4	47.5-54.5	62.6	2	1.4	61.2-64.1
F	4-5	49.6	14	0.4	46.6-52.0	58.8	2	3.7	55.2-62.5
Lower PM2-M2									
M	2-3	54.8	19	0.5	50.6-58.0	63.5	3	1.6	60.4-65.8
F	2-3	54.4	17	0.3	52.6-56.3	62.3	4	0.9	60.2-65.9
F	3-4	52.9	12	0.7	48.7-57.0	61.4	3	2.4	57.6-65.9
F	4-5	52.7	11	0.4	50.7-55.2	58.5	2	2.8	55.7-61.3
Upper PM2-M1									
M	2-3	39.5	28	0.3	36.1-42.6	50.7	3	1.2	49.0-53.0
F	1-2	40.5	20	0.3	37.2-44.2	48.0	8	0.8	45.0-51.1
F	2-3	38.9	20	0.3	36.4-42.4	48.1	5	1.2	45.0-51.2
F	3-4	38.8	14	0.4	35.2-41.2	48.0	2	1.2	46.8-49.2
F	4-5	38.2	14	0.4	35.6-40.8	45.1	2	2.7	42.4-47.8

Table 3. Non-overlapping ranges of auditobasal length (in mm) from female deer of the Florida Keys and Blackbeard Island, Georgia.

	Key deer				Blackbeard Island deer			
age (years)	$\bar{x}$	n	SE	range	$\bar{x}$	n	SE	range
1-2	173	18	2.3	145-188	203	3	10.1	191-223
2-3	185	13	2.1	177-201	218	1		218-218
3-4	192	8	1.5	183-196	213	3	4.1	206-220
4-5	195	9	1.8	186-204	222	4	2.9	216-230