NEW DATA ON THE RED WOLF IN ALABAMA

Because of uncertainty as to the systematic position of the native species of *Canis* in the southeastern United States, and the scarcity of specimens representing the original population there (Lawrence and Bossert, 1967; Paradiso and Nowak, 1972), a newly discovered skeleton of a wolf in Alabama has special significance. Goldman (1944:482–483) described the single previously reported specimen of a wolf from this state. That specimen was one of the only two known skulls of the easternmost subspecies of the red wolf, *Canis rufus floridanus*.

The new specimen (USNM 348063) was found and recovered by members of the Huntsville Grotto of the National Speleological Society in a series of trips into the Fern Cave System, between 26 April and 2 August 1969 (Myrick, 1969). The entrance to this recently discovered cave complex is in a mountainous area in Jackson County, Alabama, about 14 miles east of Huntsville. The remains were found in the upstream passage of the main lower level of what has been designated the New Fern area of this system. The several known routes, from the entrance to the location of the specimen, all involve lengthy horizontal movement and at least one vertical drop of between 72 and 200 feet. Because the remains were not at the base of one of the drops, and because none of the larger bones appeared damaged, it seems unlikely that the wolf reached its final position by any of the known routes. The animal probably came into the cave through a lower entrance that has since been obliterated. Considerable age is thus indicated for the remains, but they are not mineralized, and their remarkable state of preservation, including a thin layer of non-skeletal matter on some of the bones, suggests that the animal lived in Recent times. The fragmentary remains of two other carnivores, *Panthera onca* and *Arctodus simus* (identified by Clayton E. Ray), were discovered in the same passage of the cave, but in a much more deteriorated condition.

The bones of the wolf were found together on a rock ledge to the side of the main passage. The recovered elements include the complete skull, with all teeth (except the upper incisors, three lower incisors and the upper right P1); two scapulae; right humerus and radius; right and left femora; right and left tibiae; second and fifth left metacarpals; fifth left metatarsal; pelvis; baculum; and seven cervical, eight thoracic, six lumbar, and one coccygeal vertebrae, and the sacrum. Extensive wear on the teeth indicates that the animal was old, and it probably died naturally while using the cave as a retreat.

We have previously listed (Paradiso and Nowak, 1972) the cranial characters that distinguish the red wolf (*C. rufus*) from the gray wolf (*C. lupus*). The skull of the new specimen from Alabama closely resembles *rufus* in small size; narrowly spreading zygomata; relatively long, narrow rostrum; and large second upper molars. Because of wear, the dental characters of the specimen cannot be fully evaluated, but it appears to resemble *rufus* in having deep sculpturing on the medial part of the first upper molar.

The gray wolf subspecies that is morphologically nearest the red wolf, and also has the most nearly proximal geographic range, is *C. lupus lycaon* of the northeastern United States. In order to compare the Alabaman specimen, we measured 13 skulls of adult males of *lycaon* from the Upper Peninsula of Michigan. (There are no adequate series available from farther south.) The specimens are in the following collections: The Museum, Michigan State University, 4; University of Michigan Museum of Zoology, 5; National Museum of Natural History, 4. The same measurements were taken on a series of adult males of *rufus* collected before 1926, of which 11 are from Missouri, five are from Louisiana, and one is the previously reported Alabama skull. These specimens comprise all available skulls in good condition taken before 1926 in these states. All are in the National Museum of Natural History except one in the Museum of Comparative Zoology, Harvard University. The measurements on these series and the new specimen from Alabama are listed in Table 1.

In Fig. 1, the means of the series are compared with the measurements of the skull from Alabama in a ratio diagram. Here, in accordance with Simpson (1941), the data are con-

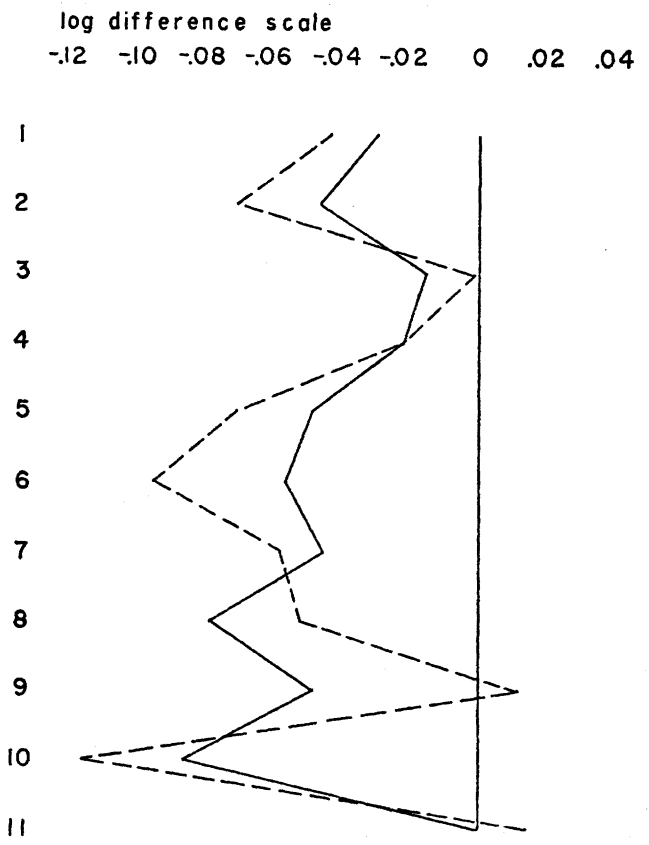

FIG. 1.—Ratio diagram of cranial measurements (numbers and data same as in Table 1) of the Alabama wolf and series of *Canis rufus* and *Canis lupus lycaon*. The logarithmic values of the means of *lycaon* are plotted on the vertical line under zero. The corresponding means of *rufus* and measurements of the Alabama specimen are plotted at a horizontal distance from the vertical line, representing the logarithmic difference between these values and the means of *lycaon*. The values of *rufus* are connected by solid lines, and those of the Alabama specimen by dashed lines.

verted to logarithmic values in order to permit evaluation of the proportions of all measurements relative to one another. The new specimen closely resembles *rufus*, except that the frontal shield and jugals are large, but even the dimensions of these two parts of the skull fall within the range of variation of the measurements on the skulls of the red wolf. In the specimen collected earlier in Alabama, the jugals are also relatively deep and the frontal shield is broad. Goldman (1944:482) considered these two features to be characteristic of *floridanus*.

Postcranial skeletons of wolves are not well represented in museum collections. We have, however, measurements of the limb bones of three *C. lupus lycaon* from Minnesota (all in the American Museum of Natural History). The only available postcranial elements of the red wolf are from specimens collected in Brazoria County, Texas, in 1942–1944 (all in the National Museum of Natural History). In Table 2, the lengths of four limb bones

TABLE 1.—*Cranial measurements (in millimeters) of the newly discovered wolf from Alabama, and series of adult male* Canis rufus *and* Canis lupus lycaon. *For the series, the first number of each entry is the mean, the second and third numbers (in parentheses) are the extremes, and the fourth number is the sample size.*

Measurement	Alabama skull	*C. rufus*	*C. lupus lycaon*
1. Greatest length of skull	228.0	235.6(218.0–250.0)17	252.1(234.0–274.0)13
2. Zygomatic width	115.0	121.6(114.0–130.0)17	135.4(121.0–148.0)13
3. Width of braincase at level of parietotemporal sutures	64.1	62.0(59.6– 65.0)17	64.2(59.8– 69.0)13
4. Alveolar length of upper toothrow from P1 to M2	79.5	79.4(74.2– 84.0)17	83.5(77.5– 89.7)13
5. Maximum crown width across upper cheekteeth	66.0	69.8(63.7– 75.3)17	78.2(72.8– 83.0)13
6. Minimum width between alveoli of upper P1	24.0	26.3(22.3– 27.7)17	29.9(27.0– 33.6)13
7. Width across maxillae at outer edges of alveoli of canines	39.0	40.1(35.7– 43.8)17	44.7(41.6– 50.6)13
8. Maximum width across postorbital processes of frontal shield	58.9	55.3(49.5– 64.0)17	66.6(57.1– 74.5)13
9. Minimum depth of jugal at right angle to main axis of bone	18.3	15.9(13.5– 18.4)17	17.8(16.3– 20.0)13
10. Maximum anteroposterior width of upper canine at base of enamel	11.2	12.0(10.5– 13.7)16	14.7(12.1– 15.3)11
11. Maximum transverse crown diameter of upper M2	14.4	13.9(12.7– 15.6)16	13.9(11.8– 15.1)13

from these series are compared with measurements of the new specimen; the latter is closer to *rufus* in all measurements than to *lupus*.

There has been uncertainty as to whether the red wolf is (1) a species, (2) conspecific with either the coyote (*C. latrans*) or the gray wolf (*C. lupus*), or (3) a hybrid between *C. latrans* and *C. lupus*. Whatever the case, the original population of *Canis* in the southeastern states has vanished from almost its entire range and has been replaced in part by the coyote or by a hybrid swarm of red wolf × coyote. This replacement appears directly attributable to the white man, who nearly extirpated the red wolf and who also broke down ecological barriers, thus permitting *latrans* to extend its range eastward and probably to interbreed with surviving *rufus*. It is not known with certainty which specimens collected in the Southeast represent the original population in its pure form, and which show influence from *latrans*. It might be argued that the small size and narrowly proportioned skulls of the specimens now believed to represent the species *rufus*, actually indicate the introduction of genes from the species *latrans* into the species *lupus*. The discovery, however, of a new specimen of a wolf that lived long before the disruption of the environment by man, and far from the range of the coyote, but which demonstrates the same morphological characters as the twentieth century population known as *rufus*, indicates that *rufus* was not derived from introduction of genes from *latrans* into *lupus* populations.

TABLE 2.—*Measurements (in millimeters) of the greatest lengths of four specified limb bones in the wolf from Alabama and in three specimens each of* Canis rufus *and* Canis lupus lycaon.

	Humerus	Radius	Femur	Tibia
Alabama specimen	195.0	196.8	211.0	221.8
Range of *rufus*	176.5–196.3	190.6–200.2	199.8–207.5	205.8–216.3
Range of *lycaon*	216.0–227.0	218.0–228.0	231.0–246.0	240.0–254.0

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IMPORTANCE OF GREEN VEGETATION FOR REPRODUCTION IN THE KANGAROO RAT, *DIPODOMYS MERRIAMI MERRIAMI*

Several studies suggest that environmental factors, especially rainfall and subsequent green vegetation, initiate reproduction in desert rodents. Reynolds (Ecol. Monogr., 28:111–127, 1958; J. Mamm., 41:48–58, 1960) and Chew and Butterworth (J. Mamm., 45:203–225, 1964) suggested that a correlation exists between the onset of reproductive cycles in *D. merriami* and the seasonal growth of green vegetation, especially desert annuals. Seasonal weight changes were also recorded by Chew and Butterworth, and they speculated that green plant food might promote the physical condition (weight increase, vigor) necessary for reproduction.