Journal of Herpetology, Vol. 20, No. 1, pp. 85–87, 1986

Dynamic Change of a Zone of Parapatry Between Two Species of *Pholidobolus* (Sauria: Gymnophthalmidae)

DAVID M. HILLIS[1] AND JOHN E. SIMMONS, *Museum of Natural History and Department of Systematics and Ecology, The University of Kansas, Lawrence, Kansas 66045, USA.*

Considerable attention has been focused recently on groups of closely-related species that are distributed parapatrically (for a recent review see Barton and Hewitt, 1980). Parapatrically distributed organisms usually meet at narrow hybrid zones, although in some cases hybridization may be rare or unobserved (Montanucci, 1973; Selander et al., 1974; Nevo et al., 1974; Caire and Zimmerman, 1975; Greenbaum and Baker, 1976; Hillis et al., 1983). These zones of sympatry often occur along ecotones and are generally considered to be relatively stable, especially if selection against hybridization is strong (Barton, 1979).

Montanucci's (1973) systematic review of lizards of the genus *Pholidobolus* revealed that the five species are distributed parapatrically in the Andes of Ecuador (Fig. 1). Areas of sympatry are extremely limited; overlap occurs only between the ranges of three species-pairs (Fig. 1): (1) *P. montium* and *P. affinis* in the upper end of the Latacunga Basin (Hoya del Río Cutuchi) in the vicinity of Mulaló; (2) *P. affinis* and *P. prefrontalis* at the edge of the Palmira Desert; and (3) *P. prefrontalis* and *P. macbrydei* on the east side of the Cuenca Valley (Hoya del Río Paute). All of these zones are in ecotonal situations.

In March 1984, we collected 43 specimens of *Pholidobolus* within the former zone of sympatry between *P. montium* and *P. affinis* near Mulaló, Cotopaxi Province, Ecuador. These two species can be easily distinguished by (1) the presence of a pair of prefrontals in *P. affinis* versus the absence of prefrontals in *P. montium*; (2) three supraoculars in *P. affinis* versus two supraoculars in *P. montium*; and (3) color pattern (see color photographs in Montanucci, 1973). In addition, the identities of all *Pholidobolus* reported herein were confirmed electrophoretically as part of another study (Hillis, ms.). All of the *Pholidobolus* that we collected in the former zone of sympatry between *P. affinis* and *P. montium* in 1984 were *P. montium*. In contrast, of the 70 specimens of *Pholidobolus* collected at this site from 1969–1972 and now in the Museum of Natural History at the University of Kansas, 87.1% were *P. affinis*, and only 12.9% were *P. montium*; this change is statistically highly significant ($P \ll 0.001$, $\chi^2 = 74.9$, df = 1). In addition, *P. montium* has extended its range at least as far south as Latacunga (Fig. 2). This is an extension of approximately 30 km to the south of the former zone of sympatry between *P. montium* and *P. affinis*. We could find no *P. affinis* north of a locality 3 km south of San Miguel de Salcedo in March 1984 (Fig. 2).

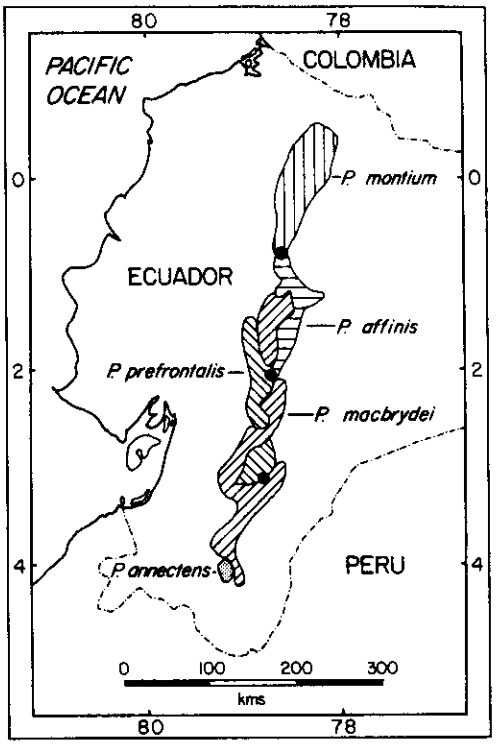

FIG. 1. Distributions of *Pholidobolus* as reported by Montanucci (1973). Black dots mark points of sympatry.

According to Montanucci (1973), both *P. affinis* and *P. montium* occur "... in localized, high-density populations associated with rock piles, stone walls, or agave fence rows." Populations in undisturbed páramo or subpáramo are relatively scattered; individuals in such settings are often found around clumps of bunch grass or agaves which serve as cover. Although some of the *P. montium* that we found near Mulaló in 1984 were under scattered rocks, many were found foraging in high grass.

Barton (1979) discussed possible movements of

[1] Present address: Department of Biology, P.O. Box 249118, University of Miami, Coral Gables, Florida 33124, USA.

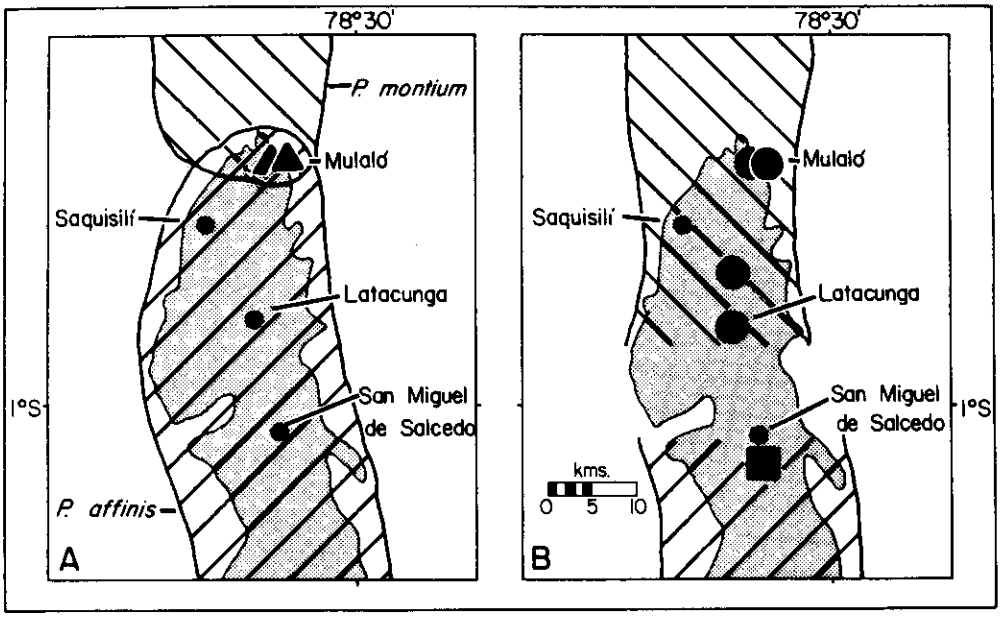

FIG. 2 Zone of contact between *P. montium* and *P. affinis* in the upper Latacunga Valley. The stippled area represents elevations below 3000 m. A. Ranges of the two species in 1971, as interpreted by Montanucci (1973). The triangles represent localities where both species were collected sympatrically. B. Ranges of the two species in 1984. The large dots represent localities where only *P. montium* was collected; the square represents a locality where only *P. affinis* was found.

hybrid zones and noted that such zones could change if one species is selectively advantageous or if the population density of a species on one side of the zone is low. Such movements are expected to be quite slow in species with low vagility (such as small, secretive lizards like *Pholidobolus*) unless the selection in favor of one species in very high. The rapid movement of the contact zone between *P. montium* and *P. affinis* (at least 30 km in 12 or fewer years) has been accompanied by dramatic human-induced habitat change. In 1972, when one of us (JES) visited the collection site near Mulaló, it consisted of a large field (approximately 50 hectares) with numerous agaves and many lava rocks. At that time, *Pholidobolus* were found throughout the field under rocks. When we visited the site in 1984, this field had been cleared of rocks, intensively irrigated, and planted; *Pholidobolus* were restricted to non-planted areas around the periphery of the field. These changes were widespread over much of the upper Latacunga Valley, thereby providing a more mesic environment than previously existed. Montanucci (1973) considered *P. montium* to be more mesically-adapted than *P. affinis*; as a result, the recent habitat changes apparently have allowed *P. montium* to move into the former range of *P. affinis* and to displace the latter species.

Movement of most hybrid zones, if it occurs at all, occurs at too slow a rate to be studied practically in the field. The situation reported here is novel, and apparently was brought about by rapid and drastic habitat modification in an ecotonal situation. If the movement of the contact zone between *P. montium* and *P. affinis* continues, this situation may provide an invaluable natural laboratory for studying the interactions of parapatrically distributed organisms.

Acknowledgments.—Our field work on *Pholidobolus* in Ecuador was ancillary to research on marsupial frogs supported by a grant (DEB 8219388) from the National Science Foundation (William E. Duellman, principal investigator). An NSF fellowship in support of DMH is also gratefully acknowledged. Collecting permits were issued by Sergio Figueroa of the Programa Nacional Forestal, Ministerio de Agricultura y Ganaderia. We thank William E. Duellman, Darrel Frost, Richard L. Mayden, and Richard R. Montanucci for reviewing the manuscript. We also thank Eugenia del Pino and the Cristóbal Galarza family for assistance and hospitality during our stay in Ecuador.

LITERATURE CITED

BARTON, N. H. 1979. The dynamics of hybrid zones. Heredity 43:341–359.

———, AND G. M. HEWITT. 1980. Hybrid zones and speciation. *In* W. R. Atchley and D. S. Woodruff (eds.), Essays on Evolution and Speciation in Honour of M. J. D. White. Pp. 109–145. Cambridge Univ. Press.

CAIRE, W., AND E. G. ZIMMERMAN. 1975. Chromosomal and morphological variation and circular overlap in the deer mouse, *Peromyscus maniculatus*, in Texas and Oklahoma. Syst. Zool. 24:89–95.

GREENBAUM, I. F., AND R. J. BAKER. 1976. Evolutionary relationships in *Macrotus* (Mammalia: Chiroptera): biochemical variation and karyology. Syst. Zool. 25:15–25.

HILLIS, D. M., J. S. FROST, AND D. A. WRIGHT. 1983. Phylogeny and biography of the *Rana pipiens* complex: a biochemical evaluation. Syst. Zool. 32:132–143.

MONTANUCCI, R. R. 1973. Systematics and evolution of the Andean lizard genus *Pholidobolus* (Sauria: Teiidae). Misc. Pubs. Univ. Kansas Mus. Nat. Hist. 59:1–52.

NEVO, E., Y. J. KIM, C. R. SHAW, AND C. S. THAELER. 1974. Genetic variation, selection, and speciation in *Thomomys talpoides* pocket gophers. Evolution 28:1–23.

SELANDER, R. K., D. W. KAUFMAN, R. J. BAKER, AND S. L. WILLIAMS. 1974. Genic and chromosomal differentiation in pocket gophers of the *Geomys bursarius* group. Evolution 28:557–564.

Accepted: 20 September 1984.

Journal of Herpetology, Vol. 20, No. 1, pp. 87–88, 1986

The Identity of the Crocodile of Lago de Yojoa, Honduras

LARRY DAVID WILSON, *Department of Biology, Miami-Dade Community College, South Campus, Miami, Florida 33176, USA.*

JAMES R. MCCRANIE, *10770 S.W. 164th Street, Miami, Florida 33157, USA.*

KENNETH L. WILLIAMS, *Department of Biology and Microbiology, Northwestern State University of Louisiana, Natchitoches, Louisiana 71497, USA.*

The specific identity of the crocodile in Lago de Yojoa, in west-central Honduras, has been disputed in recent years. Meyer and Wilson (1973) used the name *Crocodylus acutus* for the lake population, represented by two juvenile specimens from Agua Azul, Depto. Cortés (AMNH 70570–71). Agua Azul is a motel and campground on the eastern shore of Lago de Yojoa. Neill (1971) and Smith and Smith (1977) suggested, however, that the crocodile might be *C. moreletii*. Neill (1971) stated that the identity of these crocodiles "as *acutus* has been assumed in the literature, although no specimen [had] been examined. The elevation of Yojoa, and its isolation from a large river, render it an unlikely locality for the American crocodile." Smith and Smith (1977) implied that they agreed with Neill's assessment.

Lago de Yojoa is the largest lake in Honduras. Honduran Highway 1 from Tegucigalpa to San Pedro Sula passes for several kilometers along its eastern shore. The lake is about 29 km long from north to south and 8 km wide from east to west (longest dimensions in each case) and the elevation of the lake surface is 625 m (Monroe, 1968). It forms part of the borders of the departments of Cortés, Santa Bárbara, and Comayagua. It lies in a basin between the high peaks of Cerro Santa Bárbara (2835 m elevation) and Cerro Azul (2104 m) and is bounded on the south by a transverse range of mountains between Taulabé and Siguatepeque. Contrary to the statement of Neill (1971), Lago de Yojoa is not isolated from a large river but is, in fact, virtually encircled by tributaries of the Río Ulúa, including the Río Humuya. The Río Ulúa and its tributaries drain much of north-central Honduras, giving this river the status of one of the major Caribbean versant rivers in Central America. Lago de Yojoa "is drained naturally at the southern end by the Río Jatique, which eventually empties into the Río Ulúa. . . ." (Monroe, 1968). Thus, an avenue of dispersal exists between the Río Ulúa and its crocodile populations (Meyer and Wilson, 1973) and those of Lago de Yojoa.

At the suggestion of Mario R. Espinal, we stopped at one of the numerous restaurants along the eastern shore of Lago de Yojoa, where he had seen a skull of a large crocodile on display. The skull measures 650 mm from the tip of the snout to the posterior end of the mandible. A sign indicated that the crocodile had been 18 feet (ca. 548 cm) in total length. Neill (1971) gave data on head length vs. total length for a *C. acutus* from Lantana, Florida that died in captivity at 14 feet (ca. 427 cm) with a head length of 28.5 inches (ca. 724 mm). The head length/total length ratio of this animal was 0.170. Based on the total length of the skull of the Lago de Yojoa specimen (650 mm) and using the ratio computed above, the total length of the Honduran specimen would have been about 384 cm. Neill (1971) noted that a specimen of *C. acutus* killed at Arch Creek in North Miami, Dade Co., Florida, measuring 15 feet, 2 inches (ca. 462 cm) in length, was probably near the maximum total length of the species.

Crocodylus moreletii is a much smaller crocodilian, with adults rarely reaching 250 cm in total length (Brazaitis, 1973; Smith and Smith, 1977). On estimated total length alone, the Lago de Yojoa crocodilian is a *C. acutus*.

We borrowed the two AMNH specimens in order to reestablish their identity. It is obvious upon first glance that the specimens are *C. acutus*. The narrow skull possessed by these two specimens is diagnostic of the species (Schmidt, 1942). Upon