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

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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; Selanders et al., 1974; Nevo et al., 1974; Caire and Zimmermann, 1975; Greenbaum and Baker, 1976; Hillis et al., 1985). 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 Rio Cutuchi) in the vicinity of Mulál; (2) P. affinis and P. prefrontalis at the edge of the Palmito Desert; and (3) P. prefrontalis and P. macbrydei on the east side of the Cuenca Valley (Hoya del Rio 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 Muláló, 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 supracoculars in P. affinis versus two supracoculars 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 this 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, 39.5% were P. affinis, and only 12.0% were P. montium; this change is statistically highly significant ($P < 0.001$, $x^2 = 74.9$, 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).

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 Muláló in 1984 were under scattered rocks, many were found foraging in high grass.

Barton (1979) discussed possible movements of
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 Mulal, 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 ectonal 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.

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Literature Cited

The Identity of the Crocodile of Lago de Yojoa, Honduras

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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. Neil (1971) and Smith and Smith (1977) suggested, however, that the crocodile might be C. moreletii. Neil (1971) stated that the identity of these crocodiles "as acu-
tus 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 Neil'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 Neil (1971), Lago de Yojoa is not isolated from a large river but is, in fact, virtually encircled by tributaries of the Rio Ulúa, including the Rio Humuya. The Rio 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 Rio Jatique, which eventually empties into the Rio Ulúa. . . ." (Monroe, 1968). That is, an avenue of dispersal exists between the Rio 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. Neil (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. Neil (1971) noted that the 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