NOTES ON THE MICROHABITATS OF THE PHILIPPINE DISCOGLOSSID FROG BARBOURULA BUSUANGENSIS

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The microhabitats of the Philippine discoglossid frog Barbourula busuangensis in permanent mountain streams in northern Palawan are described. The water temperatures of these streams were about 25° C or lower. The juveniles were found in quiet, shallow pools, under rocks and among rotting leaves; the adults, under large boulders and inside crevices of rock-walls. The microhabits of adults were all directly above water. Several species of anuran amphibians were associated with Barbourula.

The discoglossid frog Barbourula busuangensis from the Philippines was described as a new genus and species from Busuanga Island, north of Palawan Island, by Taylor and Noble in 1924. The type was the only known specimen. In the sixty years since that time there have been few additional collections of this frog; and no data has been published on its natural history other than that of Myers (1943), who noted that specimens collected by Albert Herre, also on Busuanga Island in 1940, were taken from pools in two mountain streams at an elevation of 200 plus meters. They were first seen as floating with only the eyes and nostrils above the surface of the water. When disturbed they swam to the bottom and hid under stones. This collection by Dr. Herre was the second record for the species.

The third record, also from Busuanga Island, was a collection by members of the 1946 Zoological Expedition to the Philippines conducted by the Field Museum of Natural History in Chicago. The fourth collection, by the Stanford University - Silliman University Expedition in 1961 (Brown and Alcala, 1970), provided the first record for Palawan Island. Specimens were taken from a large pool in the Malatgaw River at an elevation of about 500 meters on the side of Thumb Peak near the center of the island, west of Puerto Princesa. However, no information about their microhabitat or behavior was obtained, because the specimens were found dead, along with dead fish. The deaths were the result of the local inhabitants having poisoned the pool with an insecticide (Endrin) in order to obtain the fish. No other specimens of Barbourula were taken by members of that expedition, although about two thousand amphibians and reptiles were

collected in the lowlands and mountainous area around Thumb Peak over a period of several weeks.

In 1978 a second species of the genus, Barbourula kalimantanensis, was described by Iskander (1978) from northern Borneo. The unique type of this species was from a mountain stream, the same general habitat as that known for the Philippine species. These infrequent collections, always in mountain stream habitats, as well as the general appearance and extensively webbed fingers and toes, provided the basis for the view that this was a very secretive, aquatic frog.

Inger (1954:212) noted that eggs in the ovaries of gravid females were relatively low in number, large and without pigment. He suggested that they might be deposited under stones in the creek beds.

It is of interest, however, that no larvae associated with this species have ever been found in the mountain streams where adult populations are known. This led Brown and Alcala (1983), in their review of modes of reproduction of Philippine anurans, to speculate that this type of egg is an adaptation to a very specialized mode of reproduction, perhaps one lacking an aquatic larval stage. This conjecture was based on the similarities in number, size and appearance of the eggs to those of Philippine species in the genera Platymantis (Ranidae), Philautus (Rhacophoridae) and Oreophrne (Microhylidae). All of these species deposit eggs in sites outside of the water. The larvae for some species undergo direct development in the egg capsules at the deposition site; those of other species escape from the egg capsules and make their way by various means to a nearby body of water.

For a period of three weeks in June 1984 a six-man field-party from Silliman University, Dumaguete City, Philippines and the California Academy of Sciences, San Francisco, California collected in the Tinitian-Langogan area, northern Palawan Island. The survey took the party from sea level to an elevation of about 700-800 meters on forested mountains. One objective was to find and study a population of Barbourula. A few hundred amphibians and reptiles were taken, but unfotunately the collection included only a single example of Barbourula busuangensis. This was a juvenile taken from a pool in Arotayan Creek, a tributary of the Langogan River. Arotayan Creek and other tributary creeks of the Langogan River appeared to be mildly flooded at the time, and it was surmised that the high water may have made it difficult to find other individuals of this species. But the finding of only one specimen served to strengthen the view that Barbourula is a very secretive, primarily aquatic frog.

In late March 1985 the senior author and Braulio Gargar made a trip to the Langogan River area to again search for Barbourula. The month of March is in the middle of the dry season and is a favorable time for such field work. The objective was to locate populations of this frog and collect at least 20 individuals for a proposed captive breeding program at Silliman University. It

was also hoped that observations might be made on its microhabitats and general behavior. We report these observations in the present paper.

METHODS

Stream-bed transect-surveys to elevations of about 300 meters were carried out in Arotayan and Bolo-bolo Creeks, which empty into the Langogan River on opposite banks some five to six kilometers above the mouth of the river. Arotayan Creek was a relatively shallow creek; the flow was more or less uniform along the gradual slope of the stream bed. Bolo-bolo creek had a more deeply cut, steeper stream bed, with deeper pools (about one meter deep). This stream was bordered by extensive rock walls in the upper segment of the transect. There were large boulders at various locations in both streams, and quantities of leaf litter tended to cover the pools.

The transect along Arotayan Creek was about 1.7 km and along Bolo-bolo Creek, about 0.75 km. Collecting stations were established about every 190 meters (300 steps), resulting in five on Bolo-bolo and 10 or Arotayan Creek. Two trips were made along each transect between about 1500 and 2030 hrs on different days. Vegetation cover was noted, and at each station water temperatures were measured. Samples of the species of frogs found along the streams were collected and their habitats noted. In the case of Barbourula, which we wished to keep alive, all specimens were placed in wet cloth bags containing rotting leaves at the collecting site. At camp, animals were transferred to small basins with water, rocks, and leaf litter and enclosed within a netting material to prevent escape. The frogs were later returned to the wet cloth bags for transport to Dumaguete City, which took four days. They were fed with termites every night from the time they were transferred to the field containers, throughout the period of transport. Collected specimens of the other species were killed and preserved at the collecting site.

RESULTS

Water temperature. At station 1 on Arotayan Creek the temperature of the water was 29°C; at station 10, at the upper end of the transect (elevation about 300 meters), 25°C. The decrease in temperature between stations ranged from about 0.2 to

(mean change 0.4) , as elevation increased. On Bolobolo Creek at station 1 the water temperature was 27.3°C, and 25°C at station 5, a mean change of about 0.46 between stations along the steeper gradient of this creek.

Frog species. Aside from Barbourula, both creeks harbored populations of several frog species. These included Staurois natator, Rana signata, Rana microdisca, Rana magna, Rana sanguinea, Ooeidozyga laevis, Chaparina fusca and Bufo biporcatus. One juvenile Leptobrachium hasselti was taken from Arotayan Creek. Unidentified ranid tadpoles belonging to three species were also collected.

The most common species was Staurois natator, represented by both juveniles and adults, mostly the former, and including newly metamorphosed individuals. Rana signata, Rana magna, Rana microdisca, and Bufo biporcatus were fairly common. Ooeidozyga laevis, Chaparina fusca, and Leptobrachium hasselti were less common or even rare. Ooeidozyga was found only in the lower portions of both creeks and not at the uppermost stations. Barbourula was found only at station 5 on Bolo-bolo Creek and stations 9 and 10 on Arotayan Creek, the highest stations. The juvenile of this species which was taken in 1984 near station 5 on Arotayan Creek had most likely been carried down by water current, as a thorough search at this station in 1985 produced negative results. In contrast, Ooeidozyga laevis was found only at the lower stations along each transect. Other species had ranges all along the transects.

Microhabitats and Habits of Barbourula. We collected a total of 22 Barbourula, including a 13-mm newly metamorphosed juvenile. We saw 10 other individuals, mostly large ones, but failed to catch them. Smaller specimens (all presumed juveniles) and large adults occupied different microhabitats. Juveniles were observed under rocks and among rotting leaves in cool, relatively quiet, shallow pools of the two streams. When not disturbed, these young animals stayed mostly in the water, with only their eyes and nostrils out. Occasionally, a juvenile was seen on the top of floating leaf litter. On the other hand, large individuals, presumably all adults, were observed under large boulders, usually with streams of water underneath, or inside rock crevices in the bordering walls on Bolo-bolo Creek at the level of the water or even above the water. At night these large animals were observed to emerge and stay at the entrances of these crevices, which usually led to water. Presumably they were feeding. Two of the four large adults collected were taken from crevices and the other two from undersides of boulders. Six more large adults were seen in rock crevices but were not collected. In contrast, all smaller frogs were taken from pools drained by slow-flowing streams. Adult frogs, despite their habit of getting out of the water at times, can be considered aquatic.

It is also interesting to note that adults and juveniles differed somewhat in coloration. Live large adult frogs are

blackish above with fading crossbars on the limbs. Juveniles are in general lighter-colored, being whitish to yellowish brown with blackish spots above. The color pattern makes it difficult to spot young frogs against a background composed of a mosaic of dark and light rocks on the bottom of pools. Similarly, adults, which are dark, are difficult to distinguish from the blackish rocks among which they hide.

DISCUSSION

Barbourula kalimantanensis, based on data for the unique type, occupies a similar habitat to that of B. busuangensis. The former was found beneath a large rock in the forested Rincon River in northern Borneo (Iskander, 1978). Thus far, all of the data indicate that the species of this discoglossid genus are limited to rocky microhabitats in mountain streams.

Tadpoles have never been observed, but the collection in 1985 of a small 13-mm juvenile, which had probably just metamorphosed, indicates a breeding season extending to the drier months. Although no eggs have thus far been found, the finding of this juvenile, as well as the observation that the habitats of adults are under large boulders in the beds of mountain streams or crevices bordering rock walls, provides supporting evidence for the speculations of Inger (1954) and Brown and Alcala (1983). It is possible that eggs might be attached underneath boulders along the stream banks or deep in crevices in rock walls, where they undergo direct development. Newly hatched individuals of very small size (note the 13-mm measurement above) could then enter the creek fully metamorphosed. This scenario has a parallel in the mode of development exhibited by the ranid frog Discodeles guppyi from the Solomon Islands (Boulenger, 1887).

Why is Barbourula limited to the uppermost stations and Ooeidozyga to the lower stations? One suggestion is that the former is stopped by water temperatures higher than 25 C. But is the latter species limited by low temperatures, resulting in its failure to co-exist with the former species in the upper stations? Observations elsewhere tend to rule out low temperature as a factor, since Ooeidozyga ascends to 1,000 m altitude on Negros Island, where temperatures are in the lower 20's.

Another possible reason, indicated by our observations, is competition for space and/or food. Both young Barbourula and young and adults of Ooeidozyga are found in similar situations in shallow pools with leaf litter. The two species have a similar habit of staying almost submerged, with only their snouts and nostrils out of the water. Both species appear to take similar

food items, which they capture in the water or at the edge of pools.

As of June 1986, a year after returning the live collection of Barbourula to appropriately prepared tanks at the Biological Laboratories at Silliman University, 20 specimens are still alive and healthy, as are the two juveniles which were shipped to the Herpetoloty Department at the California Academy of Sciences. No breeding activities have been observed, neither have eggs been deposited by any of the adults, even after injection with hormones. Thus, assuming that the series of four adults originally collected and others that may have reached maturity in the interim includes both males and females, it appears that we have not established appropriate breeding conditions in the laboratory. It is important that a captive program be initiated in order to ensure the survival of this species, which is threatened with extinction as a result of the continuing forest destruction on Palawan and nearby islands.

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