Hydromedusa maximiliani

The Brazilian Snake-Necked Turtle

Text and photos by
Franco Leandro Souza

The Brazilian Atlantic rainforest is considered one of the most endangered ecosystems of the world (and a biodiversity hotspot), with native vegetation already reduced to only 5–10 percent of its original area. In part, deforestation has been inevitable — the geographic range of this rainforest encompasses areas of highest concentrations of human populations in Brazil, with up to thousands of inhabitants per square kilometer.

The Brazilian rainforest is topographically complex, including areas of coastal lowlands, valleys, river systems, and mountains. Together with this altitudinal gradient, the variation in temperature and rainfall cycles across the vast rainforest extension results in numerous distinct habitats with particular environmental conditions. In turn, this variety of habitats supports a great diversity of plant and animal species, many of which are endemic — among them, the Brazilian or Maximilian's snake-necked turtle, *Hydromedusa maximiliani* (Mikan, 1820).

The Brazilian snake-necked turtle *Hydromedusa maximiliani* is a shy reptile species

Marine turtles and some podocnemidid river turtles (e.g., the Arrau side-necked turtle, *Podocnemis expansa*, and the Yellow-headed side-necked turtle, *Podocnemis unifilis*) are considered species with high dispersal capability, but most Brazilian freshwater turtle species are sedentary, and their movement is limited to only a few meters a day. In addition to their naturally sedentary lifestyles, freshwater turtles may have geographical distributions in complex landscapes that further restrict dispersal. This is the case of the rainforest dwelling Maximilian's snake-necked turtle.

Hydromedusa maximiliani is endemic to eastern and southeastern Brazil (in parts of southern Bahia, Minas Gerais, Espírito Santo, Rio de Janeiro, and São Paulo states), with a distribution always associated with mountainous regions. Most Brazilian freshwater turtles inhabit large rivers or lagoons with clay bottoms and turbid water. On the contrary, *Hydromedusa maximiliani* lives in streams with sandy and rocky bottoms and clear water, normally with small waterfalls.

Hydromedusa maximiliani is one of the smallest Brazilian freshwater turtles. The carapace reaches a maximum length of only 198 millimeters; the plastron, only 140 millimeters. The weight is less than 530 grams. The male is larger and heavier than the female, and also has a larger tail and a more concave plastron. Adult dorsal coloration, of the carapace and the extremities, is dark to light brown; the plastron and ventral surfaces of the extremities are cream colored. Hatchling dorsal coloration is dark brown to dark gray; the ventral surfaces of the extremities are cream colored as in adults, but the hatchling plastron is totally black. Individuals of different ages are associated with different habitats, in which their different colorations provide the best camouflage. Adults are frequently found in streams where their lighter color and flatter carapace make them resemble river stones. Juveniles explore (though not exclusively) areas close to the shoreline. Hatchlings are normally found in areas with no flow, such as flooded areas along the stream banks, where dead leaves accumulate.

The cryptic coloration of the turtle can be associated with differential habitat. Adults are frequently found in streams where their light color and flat carapace make them look similar to river stones. Hatchlings are black, and often found in shoreline areas with little flow and an accumulation of dead leaves. Juveniles also explore shoreline areas

The tranquil stream flow may be broken in places by small waterfalls

In some areas of Atlantic rainforest, the population density and biomass of *Hydromedusa maximiliani* can be very high, reaching more than 190 turtles and 40 kilograms per river hectare, according to long-term research including intensive mark-recapture field studies.

The Atlantic rainforest is home to several potential predators of this turtle, including the jaguar (*Panthera onca*), puma (*Puma concolor*), raccoon (*Procyon cancrivorous*), coati (*Nasua nasua*), and river otter (*Lontra longicaudis*). However, in more than a decade of fieldwork in a preserved area of Atlantic rainforest, only two turtles were found dead with typical signs of river otter predation, such as dilacerated head and forelimbs. Although predators could carry turtles far from streams, where their remains would be difficult to find in the rainforest litter, it is likely that the cryptic coloration and secretive behavior of the turtles limits their susceptibility to predation.

Being a reptile, *Hydromedusa maximiliani* could depend on sunlight to increase its body temperature for daily activities such as searching for food, mating, and dispersal. However, the dense Atlantic rainforest canopy allows little sunlight to penetrate to the understory and river. Moreover, as an aquatic animal, the turtle faces loss of body heat to the water, especially because of its small size. River water temperature is about 20°C (68°F) year-round, even during summer. Nonetheless, in more than a decade of studying this turtle, only once was an individual found basking (where trees had fallen creating a natural gap in the canopy). On the other hand, recorded turtle body temperatures are frequently higher than the water temperature, suggesting that these reptiles have a physiological mechanism for dealing with heat loss.

The dispersal rate of this sedentary species is extremely low. Capturing and recapturing specimens showed a mean daily displacement of only 2 meters, and it was not uncommon to recapture a turtle at the same spot where it had been captured and marked 10 years earlier. This means that a given stream can have its own long-term turtle population.

It is well known that degradation and fragmentation of natural ecosystems has produced landscape islands. Populations decline as the distribution area is reduced, and the resulting small, isolated populations are vulnerable to extinction. The Atlantic-rainforest home of *Hydromedusa maximiliani* has been continually disturbed by humans since the 16th century, resulting in a high degree of habitat fragmentation.

Furthermore, the topography of this area is complex, with hundreds of ridges and valleys drained by river and stream systems. Thus, the turtle's sedentary behavior, habitat fragmentation by deforestation, and natural topographic barriers all contribute to limiting gene flow between turtle populations inhabiting different streams, even within the same watershed. Such factors must be taken into consideration for the development of management and conservation programs.

Hydromedusa maximiliani feeds on a plethora of aquatic invertebrates that it finds in streams, including small crustaceans (shrimps and crabs), and insect larvae (mayflies, dragonflies, caddisflies, stoneflies, beetles, and mosquitoes). This diet is complemented by terrestrial invertebrates that fall into the water, such as earthworms, cockroaches, crickets, termites, and spiders, as well as vertebrates, such as small frogs, or carrion of larger animals. The diet can vary with the availability of prey in different seasons of the year. Observations reveal that this turtle searches for food in areas of slow-moving water, such as around fallen trees, or along the inside curves of river bends. The turtle may remain virtually in one spot, moving only its long neck, from side to side, scouring the area of stream bottom within its reach. This behavior continues for about 40 minutes before the turtle, without leaving the water, moves to another area of slow current.

The long neck of *Hydromedusa maximiliani* (from which comes the common name snake-necked turtle) seems to be used to lunge after agile prey (such as certain insect larvae). Also, the neck allows the turtle to stay in deeper water, helping to protect it from predators. After being submerged for about 15 minutes the turtle can extend its long neck to reach the water surface with its nostrils for breathing, even standing up on its hind limbs on the stream bottom if necessary. In addition, if the turtle falls over onto its back, a common occurrence when on land, it can use its long neck as a lever to right itself.

Hydromedusa maximiliani activity depends greatly on environmental conditions, particularly rainfall and temper-

This turtle is well camouflaged in the shadows (near the trunk under the leaf)

The Atlantic rainforest in southeastern Brazil

ature. Many of the turtles may be found on hot humid days following a nighttime rainfall, whereas few are found after a sudden decrease in temperature. Searching the same stream during different seasons (e.g., January and July) confirms the association between turtle activity and climatic conditions.

Periods of greatest activity for freshwater turtles usually involve mating behavior — including males looking for females, and females looking for safe nesting sites. To date, the reproductive behavior of *Hydromedusa maximiliani* has not been described, but there is strong evidence suggesting that the reproductive season extends from September to January. It is during this period that the turtles can be most frequently captured, reflecting an increase in their activity. Hatchlings (with shells that have not yet hardened, and carapace lengths of less than 50 millimeters) are found in early September and October, coinciding with the beginning of the rainy season. A typical strategy of freshwater turtles, hatchlings can then take advantage of temporary streamlets and flooded areas for reaching the main streams.

There is little information on the nests of this species, but judging by the habitat, the female may lay eggs among tree roots, or beneath fallen trees or leaf litter. The few existing reports indicate *Hydromedusa maximiliani* clutches consisting of two or three ellipsoidal eggs. The incubation period is estimated to be 250–300 days.

Growth is slow for a long-lived organism such as a turtle, so long-term studies are necessary for monitoring increases in size and weight. Measurements of *Hydromedusa maximiliani* specimens recaptured after more than 10 years indicated that some individuals had increased in size by a total of only 6–7 millimeters, and in weight by only 80–100 grams. Hatchlings and juveniles grow faster than adults. Small turtles are more susceptible to predation, so it is advantageous for them to grow quickly until

The turtle is in the center of the photo between the green leaf and the stone, under the branch.

Close-up of the shy *Hydromedusa maximiliani*

Forelimb, internal organs, and head eaten by predator

they reach a safer size. Not by coincidence, study of stomach contents revealed that the stomachs of specimens with carapace lengths of less than 70 millimeters were full of food more frequently than were the stomachs of larger specimens; and the incidence of calcium-rich prey (such as shrimps and crabs) was higher in the stomachs of specimens with carapace lengths of 50–120 millimeters than in the stomachs of larger specimens.

Hydromedusa maximiliani is not officially listed as threatened with extinction. However, this does not mean that there is no threat to the survival of the species. In some areas of its distribution, local population numbers can be high. Nevertheless, we know virtually nothing about population parameters in several localities where the species occurs. Despite intensive scientific and political efforts to protect the Atlantic rainforest, this ecosystem still suffers from human impact, including deforestation, pollution, and introduction of exotic species. The magnitude of the threat to *Hydromedusa maximiliani* is unknown. ■

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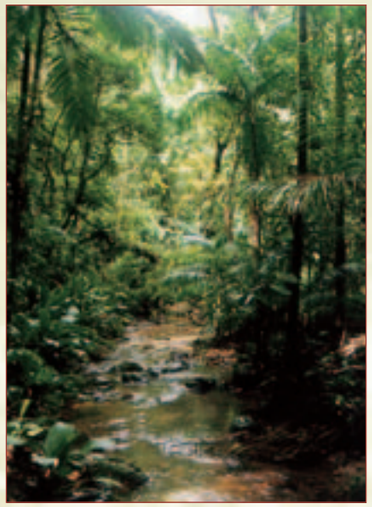

Typical *Hydromedusa maximiliani* habitat: shallow rocky stream, clear water, and dense vegetation along banks (mainly broad-leafed plants and palm trees.

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