The problem of conserving amphibians in the Western Ghats, India

R. J. Ranjit Daniels

Habitat distruction and hunting for dissection specimens have taken their toll. But there may be other, subtle factors causing loss of amphibian populations.

Amphibians are probably the best indicators of environmental health of all vertebrates. The amphibian skin is extremely sensitive to changes in external temperature and humidity. Being easily permeable, the skin makes these creatures comparatively more susceptible to the adverse effects of aquatic, terrestrial and air pollutants. Moreover, the fact that the skin has to be moist for normal gas exchange limits the available habitats that amphibians can invade. Therefore any change in local amphibian populations should alarm conservationists[1].

Some of the well-known causes of amphibian decline in the tropical countries are direct exploitation by man for the frog-leg trade, large-scale habitat destruction, and heavy use of fertilizers and pesticides in agricultural and forest lands. There are other, less publicized ways of amphibian destruction going on in many parts of the tropics. India is no exception, and unless some of these aspects are brought to light, it, like any other developing tropical country, would be blamed for letting its amphibians disappear primarily through habitat destruction.

Habitat destruction has indeed caused considerable damage to the overall amphibian fauna of India. The Western Ghats have felt the hard hands of humans ever since the European invasion a few centuries ago. Few would have known that the Western Ghats are the richest in amphibian species for the entire tropical Asia[2]. Including 13 of the 15 species of Indian caecilians (limbless amphibians), there are nearly 120 species of amphibians hitherto reported from the Western Ghats. At least 60% of these are considered endemic to the area and more species are being discovered from this hilly region. For instance I recently collected from parts of the southern Western Ghats a species of tree-frog of the genus *Polypedates* (earlier *Rhacophorus*). Experts from the Zoological Survey of India could not separate this species from *P. cruciger*, which has been considered endemic to Sri Lanka[3]. There can be more such examples. However, many new species of amphibians may not remain to be discovered if habitat destruction continues at the present pace in the Western Ghats.

Ecology

In my experience with amphibians in tropical forests of the Western Ghats and of Panama in Central America, the moist evergreen forests contribute the most to the local amphibian diversity. They include terrestrial, arboreal and aquatic species in the community. It is also apparent that the forest canopy is primarily responsible for maintaining a majority of the species round the year. It regulates the local understory temperature, the wetness of soil and leaf litter, the amount of light reaching the ground, and the perinneality of streams. All amphibians are sensitive to these environmental factors, which even influence their behaviour. For instance, while there are amphibians that are strictly nocturnal, such as some of the tree-frogs, many are opportunistic, switching between being nocturnal and being diurnal depending on the environmental conditions. The terrestrial frog *Eleutherodactylus fitzingeri* in Panama can be found active during both day and night within canopied forests. However, it is seen in forest clearings and near buildings only during the night. There are similar examples among Indian frogs too. I have seen the narrow-mouthed frog *Microhyla ornata* under logs and stones during the day in open habitats, and active in litter in closed evergreen forests even during the dry season in the Western Ghats. Species of frogs and toads show clear shifts in niches depending on the surrounding environmental conditions. Toads (*Bufo* spp.) retreat into crevices and holes during the day in hot, open areas but rest exposed on litter within canopied forests. The bronzed frog (*Rana temporalis*) moves about considerably and even ascends bushes as high as one metre above the ground during the night but stays close to water between rocks during the day. For an amphibian it is the surrounding temperature (which should ideally be 20–30°C) and the relative humidity (which is 50–75% even during dry seasons within canopied forests) that matter. Hence forest amphibians such as *Bufo parietalis* and *Rhacophorus malabaricus* die when the surrounding temperature goes beyond 34°C and the relative humidity drops below 40%.

Habitat disturbance, pollution

Besides direct destruction there are many other ways of rendering a habitat unfit for amphibians. A common practice in the Western Ghats is for local villagers to enter the forests and collect all the leaf litter on the floor. These are dumped directly in their betelnut (*Areca catechu*) gardens close by or transported several kilometres away to fertilize a paddy field. Leaf litter on the floor is an important daytime refuge for both terrestrial and aquatic frogs during the dry season. While all terrestrial frogs seek the cover of moist litter during the day, even the most aquatic of frogs, *Rana hexadactyla*, often disappears under it. Some species of tree-frogs (*Philautus* spp.) lay eggs in the litter and grass, where there is direct development without a tadpole stage. These frogs are common in forests where there is a thick

layer of leaf litter on the floor. Hence, despite protecting habitats from logging, fire, etc., if the leaf litter is continuously harvested without any consideration of the effects, much of the amphibian life would be affected.

Tea and rubber estates are causing considerable damage to the forest ecosystem in the Western Ghats by polluting the soil and water with chemical fertilizers, pesticides and factory wastes. Clear perinneal streams are made turbid and seasonal owing to soil operations within the estates. *Ansonia ornata* (Bufonidae) and *Micrixalus saxicola* (Ranidae) are species of amphibians endemic to the Western Ghats showing a preference for clear torrential streams within evergreen forests. Though such streams are frequent along the Western Ghats, these species are very local today, restricting themselves to a few unpolluted, clear perinneal streams. Though locally abundant, populations are widely separated. The hills of the southern Western Ghats, viz., Keeriparai and Maramalai, which are contiguous with the Ashambu Hills, are some of the most affected areas, owing to the large-scale planting of rubber during the past 25–40 years. Many perinneal streamlets have dried up here owing to direct soil operations or diversion of water into estates for irrigation and factory use. Factory wastes have left the water milky and putrefying in many streams. Amphibians in these streams are certainly affected. A clear indication of this is the decline of the bronzed frog *Rana temporalis*. This species, which was very common along the southern streams 25 years ago, is locally rare or absent today. It is, however, widespread in the Western Ghats, being hardy and capable of surviving at surrounding temperatures in the range 11–36°C and low humidity (RH 10%). It is locally common such as along the unpolluted river Kunthipuzha flowing through the Silent Valley National Park.

The bronzed frog *Rana temporalis*: surviving in the Western Ghats, but for how long?

Specimen hunting

While it is science that calls for the conservation of species, it is science that is rather unconsciously destroying them. The common green frog *Rana hexadactyla* is a classic victim of destructive science. This species is being locally exterminated day after day purely through collection for biology classes. Dissecting frogs has long been a laboratory practice in schools and graduate courses. An average biology student in India handles a minimum of two dead frogs during his zoology laboratory course. This has been part of the science syllabus in India for at least the past 40 years. Where do the frogs come from year after year? No effort has been made so far to culture frogs for this purpose. Since for local boys and men it is a money-fetching business to supply frogs regularly to schools and colleges in the neighbourhood, they go rampant, collecting frogs all through the year. The criterion for collecting is large size, and the result is that the catches are female-biased, with many being gravid. Collections often include females of similar species such as *Rana tigrina* and *Rana cyanophlyctis* as well.

Another form of damage is caused directly by the scientists themselves. Massive collecting expeditions are still being undertaken by scientific institutions and museums. It is data from the tropics that they are interested in and within a short time. They are therefore resorting to short-cuts such as destructive sampling. For instance, in the recent herpetofaunal study at Ponmudi

The green frog *Rana hexadactyla*, victim of destructive science teaching.

during 1982 in which the Field Museum of Natural History, Chicago (USA), and the National Museum of Natural History, Delhi (India), collaborated[4,5], about 1500 amphibians and reptiles were collected from a small hill range (ca 80 km^2) in the Western Ghats within a short period of 6 weeks. While it is true that such studies contribute considerably to our understanding of geographical range and ecology of several species, the large-scale killing of animals cannot be overlooked. The Ponmudi study did discover two new species of frogs for the Western Ghats (*Nyctibatrachus minor* and *N. aliciae*) and added a bit of information regarding the habitat and microhabitat preferences of some amphibians. However, considering the elimination of a major population of amphibians (964 individuals) in a locality, should conservationists not be alarmed? Who knows how many generations of each species collected were nipped off by killing so many juveniles and adult females? The study period (May–June) coincided with the first rains and the breeding time of most amphibians in the Western Ghats.

Need for objective study

It is true that, in the Western Ghats as in many other parts of the tropics, habitat loss plays a significant role in the disappearnce of species, amphibians being no exceptions. However, what is more apparent and alarms conservationists throughout the world are statements like 'a few hundred hectares of rain forests are being felled per day in the tropics'. Less striking factors threatening local existence of amphibians are not always noticed. That scientists are 'perplexed' by declining amphibian populations even in 'well-protected' habitats, as Blaustein and Wake[1] put it, is due to the fact that many of the subtle factors operating within the ecosystems towards the elimination of species have not been brought to light fully. At least in the Western Ghats a few of these causes are apparent. Removal of leaf litter from the floor of otherwise intact forests, chemical pollution of water from estates upstream, and collection of specimens can play a significant role in the loss of amphibians. Destructive sampling by scientists has been a common practice though not always publicly announced. Since the Western Ghats offers the best species pool of amphibians over most of the Asian tropics, it is more susceptible to frequent destructive sampling by scientists than any other. Local populations of amphibians would soon be threatened if some of these subtle factors are not identified and controlled.

1. Blaustein, A. R. and Wake, D. B., *TREE*, 1990, **5**, 203.
2. Inger, R. F. and Dutta, S. K., *J. Bombay Nat. Hist. Soc.*, 1986, **83**, 135.
3. Morgan-Davies, A. M., *J. Bombay Nat. Hist. Soc.*, 1958, **55**, 11.
4. Inger, R. F., Shaffer, H. B., Koshy, M. and Badke, R., *J. Bombay Nat. Hist. Soc.*, 1984, **81**, 406 and 551
5. Inger, R. F., Shaffer, H. B, Koshy, M. and Badke, R., *J. Bombay Nat. Hist. Soc.*, 1987, **8**, 189.

R. J. Ranjit Daniels is in the Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560 012.

Addendum

In Singh, R. P., 'Technology transfer—successes and failures', *Curr. Sci.*, 1991, **60**, 272–275 the following references had been left out.

1. Manning, G. K., *Technology Transfer: Successes and Failures*, San Fransisco Press Inc., San Fransisco, California, 1974, p. 233.
2. Mogavero, L. N. and Shane, R. S., *What Every Engineer Should Know About Technology Transfer and Innovation*, Marcel Dekker, New York, 1982, p. 154.
3. Ramesh, J. and Weiss, C., *Mobilizing Technology for World Development*, Praeger Publishers, New York, 1979, p. 234.
4. Rosenberg, N. and Frischtak, C., *International Technology Transfer: Concepts, Measures, and Comparisons*, Praeger Publishers, New York, 1985, p. 329.
5. Samli, A. C., *Technology Transfer: Geographic, Economic, Cultural and Technical Dimensions*, Quorom Books, Westpark, CT, USA, 1985, p. 296.