IMPACT OF URBANIZATION ON AMPHIBIANS OF PUNE

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Pune is undergoing industrialization and urbanization for the past 50 years. The industrial growth has been especially rapid since about 1970. the population has been growing tremendously and, as a result, areas around the city is coming under human pressures.

The first and foremost pressure on amphibians in and around Pune is habitat destruction. Many areas which were once populated by amphibians are now human habitations. Natural streams and nullahs have disappeared. Vegetation cover for many of these areas has vanished. Pune is surrounded by many hills and the vegetation cover of such hills used to support various amphibians. During monsoon, the same area would form temporary rainwater pools for breeding. Many of these areas are now no more free from human interference.

The other serious problem is loss of proper breeding sites for the amphibians. All the anurans that we have around require a temporary or permanent waterbody for breeding purposes. The anuran tadpoles are perhaps the best converters of the energy that accumulated in such water-bodies. At present, pollution of water-bodies is seriously impending reproductive success of the local anurans. Some permanent waterbodies have been rendered totally useless for amphibians and are now choked with either aquatic weeds or algal blooms.

Introduction of fishes in some of the smaller permanent waterbodies has also affected breeding of the amphibians. Burning of dried-up vegetation is also observed to be damaging the anurans in certain areas. Agricultural activity is, as yet, not seriously affecting amphibians around Pune. Use of fertilizers and pesticides is perhaps moderate as we did not find serious mortality of the frogs in any of the nearby agricultural fields. Use of frogs for educational purpose is, at present, not a serious threat because of the Government restriction on collection of frogs. It is felt that definite plan to protect the habitats and to provide breeding sites must be evolved to protect our amphibians. Western Ghat areas include some endemic genera and species and every care must be taken to preserve this rich heritage of nature.

DISCUSSION

Pune (18° 31' North Latitude and 73° 51' East Longitude) is situated on Deccan Plateau almost on its Western margin and lies on the leeward side of the Western Ghats. It is 54 km from the crest line of Sahyadris and around 110 km from the sea. The main parts of Pune are surrounded by various hills and hillocks. It is situated in the basin of the river Bhima. Two main rivers, Mula and Mutha, run through the city and finally meet river Bhima jointly (Sawant, 1972).

The climate is cool practically throughout the year in and around Pune. It is located in tropics showing monsoonal climate rainy summer and dry winter. Average rainfall is around 715 mm per year as Pune lies in a narrow strip of scanty rainfall (rain shadow of Sahyadri). Rainfall is spread over 5 months from June to October with a peak during July. Many areas, especially on the outskirts of the city, are still green with vegetation, though only partially. During the past 50 years, Pune has been the centre of industrialization. In fact it is the second largest industrializedcity in Maharashtra. Concomitant with industrialisation, there has been a rapid growth in population around Pune. The net result is urbanization at the cost of forest. Even the hills and hillocks around the city are now occupied by slum dwellers or private housing societies. This growth of the city has been especially rapid since 1970.

The senior author has been collecting amphibian eggs for various experiments as well as for the study of natural history, since 1973. The various areas from where the eggs were regularly collected or observed were: Pashan, Kirkee, University campus, Vitthalwadi and many other areas along the banks of Mutha river right up to Khadakasla dam, Hingne, Kothrud, Hadapsar, Yeraada, Pune - Nagar road and adjacent areas. Steadily over a period of about 15 years we have been observing habitat destruction within these areas. Over 50% of the area, which was once available as habitat for amphibians, is covered over either by industries, housing societies or slums. There has been wanton destruction of the vegetation covering the area adjacent to the industries and slums. Habitat destruction of this kind has deprived various amphibians of their feeding, breeding and hiding places.

Along with habitat destruction there is a severe problem of water pollution. Many streams, nullahs, water-filled stone quarries and rivers are polluted with domestic and industrial wastes, which is further creating problems for the amphibians. As per the earlier lists of Yazdani and Mahabal (1976), and Paranjape and Mulherkar (1979), there are twelve different species of amphibians which are found in and around Pune city. These species are included in Bufonidae, Microhylidae, Ranidae and Rhacophoridae. We have found three more ranid and a rhacophorid species inhabiting the areas on the outskirts of Pune city. The species names with an asterix are newly added names.

A: Bufonidae	*1) Bufo melanostictus*
	2) Bufo microtympanum
	3) Bufo parietalis
	4) Bufo stomaticus
B: Microhylidae	*5) Microhyla ornata*
	6) Uperodon globulosum
C: Ranidae	*7) Hoplobatrachus tigerinus*
	8) Occidozyga cyanophlyctis
	9) O. hexadactyla
	10) Limnonectes limnocharis
	11) Tomopterna breviceps
	**12) Tomopterna sp.*
	**13) Rana malabarica*
	**14) Nyctibatrachus humayuni*

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D: Rhacophoridae *15)Philautus bombayensis*
**16) Polypedates maculatus*

Of these enlisted amphibians, *H. tigerinus, O. cyanophlyctis, B. melanostictus* and *M. ornata* are the commonest. With the exception of *M. ornata*, the above frogs are seen practically throughout the year in suitable habitats. Population of *H. tigerinus* is however certainly declining and the areas which were once densely populated by *H. tigerinus* do not show even a single individual. During the hotter period of summer, the species often congregate in the moist or semi-moist beds of nullahs and streams. Unfortunately, now such areas are very few. Besides, vegetation cover is also partially or completely removed from these areas. Some stone quarries which are filled with water throughout the year do show *H. tigerinus* individuals in fair numbers. Unfortunately even such water-filled quarries are now being used by human beings and have become grossly polluted and eutrophic. In many such quarries there is a dense growth of algal mats or aquatic macrophytes like *Pistia* and *Eicchornia*. These growths have been observed to steadily reduce amphibian breeding over the last 10 years. It has been observed that some of these quarries also contain a considerable proportion of detergents and related chemicals - obviously related to cloth and utensil washing activity.

In a few isolated cases people have released *Gambusia* and *Tilapia* in such water bodies. These fishes have either selectively or generally eliminated amphibian eggs and tadpoles. In the case where there is only *Gambusia*, we have observed that *M. ornata* suffered the most while ranids and bufonids, continued to breed. This was the case of two water bodies within the University campus (Ghate and Padhye, 1988). *Tilapia* has also been released in some such water bodies now. *Gambusia* is already there in our rivers and now *Tilapia* has also been introduced (purposely ?) in rivers Mula and Mutha. Since these rivers support a good population of *O. cyanophlyctis* it is necessary to see the effect of this introduction as well. Knowing the voracious feeding habits of *Tilapia*, it is definitely going to affect the amphibian breeding in future.

We have observed that *O. cyanophlyctis* is the most widely distributed frog of the Pune city. It is found in practically all permanent water bodies throughout the year. It is found even in the river Mutha, especially in the shallower areas where there is dense aquatic vegetation and very slow water current. Large tadpoles are found in the river any time between April to October. This frog often occupies pools isolated from the main body of the river,especially in the large depressions of the basaltic rocks. These spots are often subjected to pollution, domestic as well as industrial. We have bodies and affecting *O. cysnophlyctis* tadpoles. In fact such observation promoted the senior author to investigate the effects of industrial effluents as well as various chemicals on amphibian embryos and tadpoles. Many of these observations are published. (Ghate *et.al.*, 1978; See review by Ghate, 1990).

Though *O. cyanophlyctis* appears to be a hardy frog compared to *M. ornata*, pollution is likely to eliminate *O. cyanophlyctis* from many places. Many eutrophic water bodies are still supporting successful breeding populations of *O. cyanophlyctis*. Even various places on the banks of river Mutha, where the domestic pollution is becoming apparent, are supporting the breeding populations of *O. cyanophlyctis*. This frog is also found in the swampy places and backwaters of some of the dams where water is considerably more saline. We are also trying to study the effects of altered salinity on the embryonic development of the amphibians and the results of our work with respect to embryos and tadpoles of *M. ornata* are just published (Padhye and Ghate, 1992). We intend to do a comparative study regarding salinity tolerance of embryos and tadpoles of different species.

Bufo melanostictus is another anuran which is perhaps not significantly affected as yet. It is found in many places within the city, even in places which are remote and distant from any waterbody. It is certainly adapted to drier conditions and has been observed to migrate through the sewer or drainage pipes. In some places, it has become almost abundant probably due to removal of *H. tigerinus*. This may be also due to prolific breeding of *Bufo* and reduction in snake populations in such areas. Our studies indicate that juveniles of *Bufo* have better chance of survival. However, adult *Bufo* are regularly consumed by various snakes. *Bufo* are active almost throughout the year and remain hidden only during December and January. They seem to be adapted to take the advantage of warmer places around human habitation, a fact also noted by Inger and Dutta (1986).

Burning grasses and vegetation during winter and summer is another serious threat to the amphibians. We have found this type of burning in the regions where the populations of *B. melanostictus* as well as *M. ornata* are present. *M. ornata* is a common abundant anuran around Pune. We have reported its breeding habits and presented a photographic atlas of earlier developmental stages of the species (Padhye and Ghate, 1989 a & b). We have already expressed our feelings regarding habitat destruction as well as pollution of breeding sites and its impact on *M. ornata* (Padhye and Ghate, 1989 a). In fact in many places, where *M. ornata* was known to breed regularly, there is a complete destruction of habitat. Temporary rain-water pools are not at all formed in such areas now, effectively blocking breeding of the species.

The other frogs (ranids) are rare but their breeding populations are present in restricted parts like Paud, Pirangut, and Kothrud. On the basis of the survey of tadpoles carried out at different places, it is assumed that some ranids are found in restricted areas away from human habitation. *Nyctibatrachus humayuni* is present only in Bhimashankar area of Pune district. It is an endemic genus of the Western Ghats and the species is known from Khandala, Matheran and Mahabaleshwar - the hill stations near Pune (Bhaduri and Kripalani, 1954).

Philautus bombayensis seem to be common around Pune city but it is also present in some hilly areas. It is definitely not found any more in the area from where it was reported by Paranjape and Mulherkar (1979). We have also not observed *B. parietalis* and *B. microtympanum*, which were reported by Yazdani and Mahabal (1976). It has already been pointed out by Inger and Dutta (1986) that the distribution of amphib-

ians in various regions of India is poorly known and that additional collections in Eastern and Western Ghats are likely to uncover new species.

Agricultural fields in and around Pune city are observed to be still supporting amphibians. We did not find any serious mortality of adults or embryos/ tadpoles in the nearby areas. Perhaps the use of pesticides and fertilizers is moderate and not affecting these animals. No data is available regarding how much additional land has been put under cultivation during the last 20 years or so. Similarly, exact figures regardng the use of various pesticides and fertilizers are not available.

There are not many "specimen collectors" around us in Pune. In fact few people are interested in studying the amphibians around us. We use an insignificant number of embryos and tadpoles for education and for research and that too only during part of the breeding season, taking every possible care not to damage the local population. In fact, we often rescue tadpoles from drying up pools to release them elsewhere. We have rarely come across frogs killed under vehicles, though we often find snakes killed in this fashion. It seems that this is not a serious problem as yet, though again a survey of nearby highways has not been carried out regulary.

As is well known, modern agricultural practices use large quantities of synthetic fertilizers and pesticides. Both these chemicals pollute soil and ultimately the ponds and nearby streams. How amphibians are susceptible to pesticide impact has already been shown by Dutta and Mohanty-Hejmadi (1978).

We have recently tried to understand possible effects of altered pH on early development of *M. ornata* (Padhye and Ghate, 1988). We did these experiments because sooner or later there is possibility of acidic rainfall in various industrialized sectors in India.

Thus we have tried to outline the present status of amphibians around Pune. The authors are aware of the fact that there is little quantitative data, either for Pune or for other cities. Even quantitative data regarding the populations of large common amphibians is not available. Data in terms of the area (habitat) available or lost is also not on record. Due to these difficulties it is not easy to say anything confidently about the status of even common species in the form of figures or statistics.

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