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THE IMPACT OF HUMAN ACTIVITIES ON THE STATUS AND DISTRIBUTION OF AMPHIBIANS IN PAKISTAN

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ABSTRACT: Human activities may be beneficial or detrimental to amphibian populations in the plains of Pakistan. Threats to amphibians as well as advantages brought by development activities are described. Suggestions for protecting the more vulnerable species have been made.

Several factors are responsible for the compositions of the amphibian fauna in the plains of Pakistan, including geographic accesibility. The microhylid genus *Microhyla* is essentially tropical, invading the plains of northern Punjab comparatively recently (Khan, 1974, 1980, 1985). The genus *Bufo* radiated out from North America during the Cenozoic and invaded Eurasia twice, first establishing in Indo-Malayan region (broad-skulled *melanostictus* group), later invading the Himalayan upland and evolving into the taxa: *melanostictus, parietalis* and *himalayanus*. During the second invasion, which was directed to the European region, the narrow skulled *viridis* group entered and later speciated in the Indo-Gangetic plains and Himalayan region into the taxa: *stomaticus, fergusoni, olivaceous, surdus, viridis, raddei, latastei* (Inger, 1972). The ranid genus *Rana* differentiated in tropical Africa during the Cenozoic and radiated out to different parts of the world (Savage, 1973). In the Indian subcontinent, it differentiated into the highland Himalayan subgenus *Paa* of which four forms have been recorded from Pakistan: *barmoachensis, hazarensis, sternosignata,* and *vicina* (Dubois and Khan, 1979; Khan and Tasnim, 1989). The subgenus *Euphlyctis* (=*Dicroglosus*) is represented by the taxa *cyanophlyctis, tigerina, limnocharis,* and *syhadrensis. Tomopterna* is represented by the single taxon *T.breviceps* (Khan and Tasnim, 1987).

Subtropical conditions in parts of Pakistan support a grass-land biotape. Originally a part of the Indo-Gangetic plain, it has a riparian type of faunal distribution. Extensive canalization has drastically changed the topography of the plains of Punjab and Sindh during the past century, affecting amphibian distribution.

OBSERVATIONS ON ANTHROPOGENIC PRESSURES

I have been studying the effect of human activity on amphibian populations and their distribution since 1963. Human intervention in the natural environment has affected the local amphibian fauna in two ways:

i) adversely, by destroying natural habitat, and

ii) favourably, by creating new habitats.

The same change may be adverse for some species and favourable for others.

ADVERSE EFFECT OF HUMAN ACTIVITY: Human needs have grown with the extensive growth in the human population and this has necessitated boosting agricultural production to meet the ever-growing needs. At governmental level, efforts are being made to keep pace with the advances in science and technology. Various measures taken, have been shown to have affected the world's frog fauna adversely (Dodd, 1977; Barclay, 1980).

a) INDUSTRIALIZATION: Large tracts of land have been acquired to set up various types of industry, mainly in the suburbs of large cities and

towns, which were once water catchment areas where amphibians bred during the monsoons. The original vegetation provided the amphibians with suitable habitats for reproduction and development. Levelling of these areas has adversely affected the local fauna and flora. The population of the cities in Punjab (Lahore, Gujranwala, Wazirabad, Sheikhupura, Faisalabad, Sargodha, Rawalpindi) have increased enormously during the past decade. Perhaps the most seriously affected frog species are the hydrophyllic forms: *Rana cyanophlyctis, R.tigerina* and *R.syhadrensis*, and also *Microhyla ornata*.

b) URBANIZATION: Villages and small towns and their surrounding areas once supported amphibian populations. Every human habitation used to have a pond, formed by excavations for building houses with earth. During monsoons it was filled with water, and utilized by amphibians for breeding. At present, in a majority of villages, such ponds have been filled, being considered potential breeding grounds of mosquitoes.

c) MECHANIZATION OF AGRICULTURE: Almost all amphibians take refuge during the daytime in holes and crevices in the ground, close to their breeding and feeding grounds. Ox-driven ploughs are slow and do not dig deep; however, the mechanization of ploughing, unearths amphibians from deep holes so that they are crushed under the heavy wheels of the tractor. Thus, the mechanization of agriculture has drastically affected the local amphibian population.

d) USE OF PESTICIDES : It has been contended that crop pests have become a serious problem because of the removal of amphibians from fields. Poisons of several types are sprayed on the crops for controlling pests. The effectiveness of chemicals has always been questioned. Also, they are readily absorbed by the skin of amphibians, often with fatal results. During a survey of 8 sprayed fields of cotton, 489 *Bufo stomaticeus*, 42 *Rana tigerina*, 25 *R. syhardensis* and 14 *R. cyanophlyctis* were found dead. Nearby water catchments, had their entire tadpole populations killed by the washout of the sprayed poison.

e) FUMIGATION OF GRANARIES: Large grain houses have been built recently throughout grain producing areas of Punjab and Sindh. The granaries are surrounded by green compounds, which are periodically watered, attracting amphibians, which take refuge in the granary buildings during the day. The stored grains are periodically fumigated to remove grain destroying pests. During this process all inlets and outlets are closed. Records of the amphibians killed during fumigation of a local granary for four years are given Table 1.

f) CASUALTIES ON ROADS : Observations on a study area in Sharah-e-Mahita, Darul Saddar North, 1 km long and 4 m wide, on the western outskirts of Rabway town, are given in Table 2.

g) USE IN SCIENTIFIC EXPERIMENTATION AND DEMONSTRATION: Amphibians are extensively used for demonstration of biological phenomena and experimentation in laboratories, throughtout the world. On the Indian subcontinent, *Rana tigerina* (often breeding size adults) is one of several species used in schools, colleges and universities.

In Baluchistan, *R. tigerina* is absent, and so the pressure is on *R. cyanophlyctis* and *R. sternosignata*. Degradation of natural habitat and capture for biological research appears to have drastically affected the local populations of these amphibians.

DISCUSSION

Amphibians are intimately linked to marshy and well-watered areas, and are well represented in riparian systems throughout the world (Brode and Burry, 1984; Wiest, 1982; Jones, 1982; Dubois, 1980). The Indus riparian amphibian fauna, though poor in diversity is rich in population (Khan, 1976, 1979, 1980, 1982; Khan and Tasnim, 1987).

The plains of Pakistan were originally a temperate grassland community. Extensive canalization during the last century has carried water to far flung areas which were barren. This has increased the habitat available for the local amphibian species. In 1969, amphibians known from Punjab, Pakistan were *Bufo stomaticus, R. cyanophlyctis, R. tigerina, R. limnocharis* (Minton, 1966; Khan 1974; Mertens, 1969). Later *Microhyla ornata*, (Khan, 1976), *Tomopterna*

TABLE 1: The number of amphibians killed during fumigation of granary in Pakistan.

Year	B.stomaticus	R. tigerina	R. cyanophlyctis	R. syhadrensis
1983	126	6	4	2
1984	245	10	3	5
1985	105	4	7	1
1986	209	7	4	6

TABLE 2: The number of amphibians found killed on a road at Darul Saddar North, Pakistan.

	Feb	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1985	42	86	129	220	210	40	23	225	11	1	0
1986	34	109	264	98	134	44	20	321	22	5	0

breviceps and *R. syhadrensis* (Khan, 1976) were added to the list. This indicates how the creation of suitable habitat in the plains of Punjab has extended the distribution of frog taxa.

Road construction is an important element in urbanization schemes. Roadside excavations are soon filled with water and colonized by breeding amphibians. I have observed the colonization of such excavated pits on the sides of the pit of Sargodha-Faisalabad Road, during its renovation and widening in 1986, between Rabwah city and Ahmed Nagar. Fourteen pools were created, which were used by almost all the local amphibian species for breeding. Our study on the reproductive strategies of amphibians resulted from our earlier observations in the area (Khan and Malik, 1987). Though a great majority of the roadside puddles are shortlived, killing the amphibian larvae in the premonsoon period by drying up, they are kept filled during the monsoons by periodic rain and are used successfully by the amphibians then. (Dubois 1980).

Paddy fields are the main breeding sites of amphibians throughout the plains of Punjab and Sindh. During the monsoons, these rice fields are filled with water and invaded by several amphibian species. Water level is maintained in the field and allows the species to complete their development. Areas recently reclaimed are being converted to grow paddy, helping in the wider distribution of amphibians forms.

Floods have played a major role in the distribution of the herpetofauna (Khan, 1980). Floods in the Punjab rivers are almost an annual feature. Wide tracts of land are washed away, and amphibians are carried far and wide throughtout the country, allowing them to colonize new areas.

Urbanization and land reclamation activities have sometimes helped in creating suitable habitat and widen the distribution of a majority of the amphibian species. Crops which provide moisture and cover from the summer heat and premonsoonal watering of the crops often help amphibians to breed. At the same time, the periodic spraying of chemicals on crops greatly affects the local amphibian populations. Minimizing use of non-specific pesticides in favour of biological control techniques would save millions of frogs. Large numbers of amphibians are crushed on roads. A book "Amphibians and Roads", has been published, expressing serious concern about this problem (Langton, 1989). Making people aware of amphibian breeding areas near roads and signs advising drivers to drive slow there could help. Many thoudsands of amphibians are killed by fumigation of granaries, which could be minimized if all the inlets close to the ground of granaries are gauzed to prevent entry by frogs and toads. Extra care should be taken in biological research institutes in minimizing the number of frogs used in lab dissection.

Amphibians eat vast quantities of insects pests and are an interesting part of our natural world. Human activities can either help or destroy popu-

lations of frogs and toads. In Pakistan an awareness needs to be created to make sure we help our amphibian population to survive and thrive.

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