Amphibian Decline and Agrocontaminants: A Cause for Concern

A Review On Amphibian Population Decline

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As a consequence of agricultural, urban and industrial development, the chemical profiles of air, soils and water bodies are being altered. The alteration of the habitat may have deleterious effects on native flora and fauna. As we modify environment for our own needs, the destruction of the habitat of various species occurs that directly leads to the disappearance of many of them. The current global loss of biodiversity is a process generated by such anthrapogenic interventions. During the last few decades amphibian decline has emerged as a key example of the global biodiversity crisis. Concern is so great for the phenomenon of amphibian declines, that the International Union for Conservation of Nature and Natural Resources (IUCN) has set up the Declining Amphibian Population Task Force (DAPTF) to investigate the matter in the year 1991.

The impact of environmental contaminants on amphibians is a subject that has received limited attention. It is possible that amphibians are responding adversely to the environmental changes. They were abundant and functionally important elements in many terrestrial and most freshwater ecosystems and constituted a significant component of world's biota. They are the only class of vertebrates that do not include any pests or species harmful to man. Amphibians play key roles in many aquatic and terrestrial ecosystems. As tadpoles they consume vast quantities of algae and other plants, thus regulating aquatic oxygen levels. On land adult amphibians act as excellent biological control agents as they consume large quantities of insects and other invertebrates. The pest control benefits of amphibians have long been recognized. Amphibians also support the many different types of animals that prey upon them; they are important in the diet of many reptiles, birds, mammals and freshwater fishes. Thus in both aquatic and terrestrial food webs, amphibians often play an important role in energy transfer and nutrient cycles.

They have survived more than 300 million years through drastic environmental changes that led to the disappearance of dinosaurs and many other species. Yet scientists are alarmed by the recent rapid decline of amphibians in many parts of the world. In many instances their decline is attributed to adverse human influences acting locally such as deforestation, draining of wetlands and pollution. Among amphibians, anurans, particularly frogs are likely to be exposed to dangerous levels of chemicals because of their higher concentrations in irrigation ditches, ponds and marshes. They are greatly valued as indicators of environmental stress as they are in close contact with water as larvae and have some contact with land as adults. Therefore, they experience both aquatic and terrestrial stressors. In light of their apparent sensitivity, and extremely permeable skin the frogs may serve as early warning systems for environmental degradation. There has been dramatic increase in sightings of deformed frogs all over the world (Blaustein and Bancroft, 2007), and as we choke our streams, ponds and wetlands with lead, mercury, fertilizers and pesticides, frogs are being poisoned and deformed on a massive scale.

Review of literature reveals that they show moderate to high sensitivity in acute and chronic sensitivity tests compared to other aquatic organisms. At present there are no regulatory criteria on toxicants for frogs. Instead, data from fish studies are often assumed to provide knowledge about toxicants on frogs also. This implies that fish and frogs are equally sensitive to the toxicants for which criteria have been established. But Birge *et al.* (2000) compared the toxicity of a variety of toxicants to amphibians and many fish species. In all, 50 metals and compounds were tested. Their results showed that amphibians have lower LC_{50} values than fishes. The researcher's overall conclusion was that there exists great variation among amphibian species in their sensitivity to metal and other organic contaminants; they generally are more sensitive than fishes and the water quality criteria established for fish may not be protective of amphibians. Owing to their bimodal life, complex life history, varied reproductive strategies and highly sensitive skin amphibians tend to be more sensitive to chemical contaminants than most other species of vertebrates (Daniels, 2003).

Amphibian population declines were first recognised as a global phenomenon in the early 1990s (Wake, 1991). While pesticides have the potential to affect almost all aquatic species their impact on amphibians are of particular concern because of the apparent global decline of many species in the past two decades. Amphibians are good bioindicators of environmental pollution due to their susceptibility to chemicals during their freshwater life cycles (Venturino *et al.*, 2003). They can be exposed to contaminants in nature through many routes but perhaps the most likely route is agricultural runoffs in amphibian breeding sites (Storrs and Kiesecker, 2004).

Eventhough less in number reports are available on the impact of contaminants on amphibians. Bridges and Christine (1997) studied general activity and swimming performance of *Rana blairi* tadpoles after acute exposure to three sublethal concentrations of carbaryl and reported that there is a reduction in both tadpole activity and swimming performance even at 24th hour of exposure. Loss of equilibrium was reported in bull frog tadpoles treated with malathion (Fordham *et al.*, 2001). A concentration dependent internal abnormality of the liver was reported in the anuran Xenopus tropicalis after 90 days of exposure to methoxychlor (Fort *et al.*, 2004). In the frog *Rana cyanophlyctis* treated with the mercurial fungicide, emisan, the testes exhibited a reduction in GSI, diameter of seminiferous tubules and Leydig cell nuclei, number of secondary spermatocytes and spermatids (Kanmadi and Saidapur, 1992). Histopathological changes in the testis of the green frog, *Rana hexadactyla* exposed to sublethal concentration of endosulfan were explained by George and Andrews (1994). Frog *Rana perezi* treated with DMBA, a cytotoxic and immunosuppressive chemical agent caused decrease in alkaline phosphatase activity (Al- Attar, 2004). The effect of Di-n-butyl phthalate, an endocrine disrupting compound on the African clawed frog *Xenopus laevis*, was studied by Lee and Veerramachaneni (2005). The northern leopard frog, Rana pipiens, treated with nitrate and atrazine, showed no treatement related effects on the total number of spermatogenic cells. But the ratio of cell types differed in treated frogs exhibiting more spermatogonia and fewer spermatocytes and fewer spermatids than in control (Orton et al., 2006). They also observed that a sublethal chronic exposure resulted in fibrogenesis in tunica albuginea, abnormal configuration of seminiferous tubules, deformed primary and secondary spermatocytes, atrophy in interstitial cells and a significant fall in gonadosomatic index.

The negative impact of anthropogenic activities on bio-diversity is becoming increasingly conspicuous and amphibians are currently the most globally threatened group of all vertebrates (Serrano *et.al.*, 2012). The introduction of chemicals or other anthropogenic modifications to an aquatic habitat can produce profoundly different responses in consecutive life stages of a single amphibian species. Pesticides exposure more likely possible in amphibian as compared to other vertebrates (Islam and Malik 2018). The eggs of amphibians are naked without any protective hard shell and are susceptible to all sorts of aquatic pollution. Their reproductive seasons often overlap with agrochemical applications that affect their reproduction since there is greater probability of exposure, particularly to pesticides in agricultural landscapes. Studies show that pollutants at environmentally relevant concentrations are important threats to amphibians and may play a role in their present global decline.

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