Amphibians of Uttar Pradesh and Their Ecological Importance

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Introduction

Amphibians belong to class Amphibia that comes under group of vertebrate. Term Amphibians is derived from Greek words "amphibious" for their dual life style (Amphi- dual; Bios- life). Animals characterized by their ability to exploit both aquatic and terrestrial habitats. Some species are permanent land dwellers, while other species have a completely aquatic mode of existence.

Amphibians are classified into three Orders namely

1. Anura (Greek: An- absent, Oura - Tail) includes Frogs and Toads.
2. Caudata (Greek: Cauda- Tail) includes Newts and Salamanders.
3. Gymnophiona (Greek: Gymno- Naked, Ophios- Snake) include Caecilians.

All the members of above order are closely dependent on water, especially for breeding purpose. Anuran includes frogs and toads. Generally those species belonging to the genus Bufo are described as toads where as members of genus Rana are referred as frogs. There is some confusion, however, in the case of other genera. In the order Caudata (literally meaning tailed Amphibians) there is no clear distinctions between the two categories of Newts and Salamander, both common name are often interchanged.

It was not so long ago that frogs and toads seemed to be almost universally condemned as loathsome slimy creature. Amphibians are seen in all continents of the world except in Arctic and Antarctic. Amphibians have existed on earth for over 300 million years, yet in just the last two decades there have been an alarming number of extinctions, nearly 168 species are believed to have gone extinct and at least 2,469 (43%) more have populations that are declining. This indicates that the number of extinct and threatened species will probably continue to rise (Stuart *et al.* 2004).

According to the IUCN Red list of threatened species, the global status of Indian amphibians is, 47% Data deficient; 30% Least concern; 9% Endangered; 6% Threatened; 5% Critically endangered; 2% Near threatened and 1%Threatened (Dinesh *et al* 2012). Out of the 342 species of Amphibian known from India, 161 are still under the data deficient category, which indicates that very elaborative, systematic and co-ordinate efforts are required in estimating the populations and delimiting the distribution of species especially pertaining to those under the data deficient category.

Daniels (1995, 1999a), Molur Walker (1998) highlighted the need of Amphibians research and conservation in India, in terms of Amphibians taxonomy, range distribution, ecology and their conservational requirements. Dash and Mahanta (1993) highlighted the need of extensive quantitative ecological studies on the Amphibians communities in the Indian Ecosystem. Of the 225 species of Amphibians known from India (Biju 2001), more than 120 occur in the Western Ghat and about 60 species occurs in Eastern Himalayas, many being endemic. Out of these more than 100 are anurans (Frogs and Toads). (Daniel 1997). Datta (1992) listed systematically all known species from India, primarily using the generic classification of Dubois (1992). Similar works have been done in other district of Uttar Pradesh such as 7 species of Anurans

under- 3 families were identified by Ravi Kumar Singh and Sant Prakash (2007) in district Agra. The amphibians' fauna of Katerniaghat wildlife sanctuary Uttar Pradesh India was studied by Hegde and Roy (2011). This sanctuary contains 10 species belonging to 9 genus and 4 families under the order Anura.

Amphibians of Uttar Pradesh

Recently a project has been completed funded by Uttar Pradesh State Biodiversity Board, Lucknow entitled "Annotated and colored checklist of Reptiles and Amphibians of Uttar Pradesh". A total of **24 species of Amphibians has been reported from Uttar Pradesh** they are as follows-

S.N.	Common name	Scientific Name	Family	IUCN* Status
1.	Jerdon's Bull Frog	*Hoplobatrachus crassus*	Ranidae	C
2	Common Indian Toad	*Duttaphrynus melanostictus*	Bufonidae	NE
3	Marbled Toad	*Bufo stomaticus*	Bufonidae	NE
4	Himalayan Toad	*Bufo himalayanus*	Bufonidae	LC
5	Beautiful stream frog	*Amolops formosus*	Bufonidae	LC
6	Stoliczka's frog	*Rana vicina*	Bufonidae	LC
7	Marbled Toad	*Duttaphrynus stomaticus*	Bufonidae	LC
8	Skipper frog	*Euphlyctis cyanophlyctis*	Dicroglossidae	NE
9	Indian Bullfrog	*Hoplobatrachus tigerinus*	Dicroglossidae	LC
10	Common Pond Frog	*Fejervarya limnocharis*	Dicroglossidae	LC
11	Ornamented Pygmy Frog	*Microhyla ornata*	Microhylidae	LC
12	Gray Balloon Frog	*Uperodon globulosum*	Microhylidae	LC
13	Marbled Baloon Frog.	*Uperodon systoma*	Microhylidae	LC
14	Assam Narrowmouth Toad	*Kaloula assamensis*	Microhylidae	LC
15	Sri Lankan Bullfrog	*Kaloula taprobanica*	Microhylidae	LC
16	Terai Cricket Frog	*Fejervarya teraiensis*	Ranidae	LC
17	Indian Burrowing Frog.	*Sphaerotheca breviceps*	Ranidae	LC
18	Roland's Burrowing Frog.	*Sphaerotheca rolandae*	Ranidae	LC
19	Field frog	*Limnonectes limnocharis*	Ranidae	V
20	Common Sand Frog	*Tomopterna species*	Ranidae	LC
21	Common Tree Frog	*Polypedates maculates*	Rhacophoridae	LC
22	Dudhwa Tree Frog	*Chirixalus dudhwaensis*	Rhacophoridae	DD
23	Not Known	*Polypedates taeniatus*	Rhacophoridae	N K
24	Not Known	*Chiromantis dudhwaensis*	Rhacophoridae	N K

** Note- C- Common, NE- Not Evaluated, LC- Least Concern, V- Vulnerable, DD- Data Deficient, N K- Not Known*

Photographs of the Amphibians of Uttar Pradesh

Rana vicina (Stoliczka's frog)

Duttaphrynus stomaticus (Marbled Toad)

Duttaphrynus melanostictus (Common Indian Toad)

Bufo stomaticus (Marbled Toad)

Bufo himalayanus (Himalayan Toad)

Euphlyctis cyanophlyctis (Skipper frog)

Hoplobatrachus tigerinus (Indian Bullfrog)

Microhyla ornata (Ornamented Pygmy Frog)

Uperodon globulosum (Gray Balloon Frog)

Uperodon systoma (Marbled Baloon Frog)

Kaloula taprobanica (Sri Lankan bullfrog)

Sphaerotheca breviceps (Indian Burrowing Frog)

Limnonectes limnocharis (Field frog)

Polypedates maculates (Common Tree Frog)

Fejervarya limnocharis (Common pond frog)

Kaloula assamensis (Assam Narrow mouth Toad)

Fejervarya teraiensis (Terai Cricket Frog)

Sphaerotheca rolandae (Roland's Burrowing Frog)

Why do we need amphibians?

Cultural and traditional importance-Frogs and toads were parts of culture since the beginning of the civilization, be it Vedic or Egyptian, as a symbol of fertility, prosperity and Harbinger of rain. Even today, in many parts of India, frog marriages take place so as to appease rain gods and get rain during periods of drought and monsoon. Amphibians have been playing an important role in tales, drawings, paintings, and sculptures in many countries. In Korea, amphibian tales and drawings are often used to portrait an intelligent person of good mind. During the Goguryeao dynasty (BC58-AD668), toad was described as the god of the moon in drawings painted on the wall of an old tomb. In Japan, the frog is usually seen as a symbol of good fortune associated with magical powers.

In Europe, salamanders were considered for a long time like a diabolic animal! For example, by killing salamanders, a person would get 100 days of indulgence and even gold coins during the Middle Ages. During the same time, toads were associated with the devil. However, during the Merovingien Dynasty (1600s), toad was a symbol of eternity. (http://www.endangered speciesinternational.org/amphibians6.html). Today, there are several frog festivals around the world. In China, during the frog festival the Zhuang people of Guangxi capture one frog, then honor it, and finally bury it to ensure good weather and harvest for the following year. Photographs and drawings of frogs are also used in many countries for advertisements, books, and video games.

1. **Importance in medicine**- The skin of frogs and toads are store house of novel chemical compounds which are useful in developing new drugs to cure much disease from HIV to ulcer. More than 73 amphibian species are known to have some kind of medicinal values. The skin of frogs and toads has been used for medicine by many cultures since ancient times. For example, in the Korean culture, burning Japanese Tree frog (*Hyla japonica*) oil was believed to heal wounds, whereas the Gold-spotted Pond Frog (*Rana plancyi chosenica*) has been prescribed for fewer, weakened immune system, and to cure infectious diseases from wild animals. Each amphibian species has its own protective compounds against predators and micro-organisms. Compounds include amines, alkaloids, and peptides. They play as poisons, antibiotics, and pain relievers.

   Several hundred of amphibian antimicrobial peptides have been isolated from amphibian species. Peptides may be active against a broad spectrum of pathogens and have significant potential application for our health and conservation of other species. For instance, the peptide caerin 1.1 from *Litoria caerulea* inhibits growth of cancer cells, viral infection of target cells, prevents growth of malaria parasite, and kills nematodes. Amongst the known alkaloids found in frogs, the alkaloid epibatidine from the endangered Ecuadorian frog Epipedobates tricolor is a potent non-addictive analgesic considered to be 100 to 200 times more effective than morphine.

   In many countries, amphibians are still used in traditional medicines often to meet primary health needs. More than 30 species of amphibians have been recorded in Traditional Chinese Medicine alone. In Korea, a commercial medicine for athlete's foot is made from toad skin secretions. In Mexico, the endangered Axolotl (*Ambystoma mexicanum*) is believed to provide remedies for respiratory ailments such as bronchitis. Losing more amphibians species would have terrible impacts on our current and future application for human health.

2. **Amphibians in genetic study**- Unlike nearly all vertebrates, newts and salamanders have the ability of re-growing tissues (*e.g.*, heart muscle) and organs such as complete limbs, jaws, and tails. The first study on amphibian regeneration was conducted by Lazzaro Spallanzani. In a newt or salamander, following the loss of a limb, a new one can be grown in about three months. Many genes that control this process have been identified also in human beings. They may offer a great hope for understanding how we may be able to unlock our own latent ability to generate lost cells, tissues and may be even organs.

3. **Frozen frogs**- Five species of frogs are known to survive after being frozen solid. Those frog species are the Eastern Gray Treefrog (*Hyla versicolor*),

Cope's Gray Treefrog (*Hyla chrysoscelis*), Spring Peeper (*Pseudacris crucifer*), Midland Chorus Frog (*Pseudacris triseriata*), and Wood Frog (*Rana sylvatica*). In the case of wood frog, its heart ceases to beat for up to several weeks. The frog's capability to survive in frozen environment has drawn the attention of scientist involved in human organ transplantation.

4. **Frog glue**- The Crucifix Frog (*Notaden bennetti*) from Australia spends nine months of the year living underground in dried mud, emerging after heavy rains. Its sticky skin protects the frog against predators including biting insects. New research has shown that the sticky adhesive secreted from the crucifix frog can help with shoulder rotator cuff repair. The unique properties of this frog glue (strong, flexible and sets in water) may ultimately lead to its use as an adjunct to rotator cuff repair in humans.

5. **Importance in the environment**- Amphibians are one of the main links in many ecosystem food webs. Often unseen, they can be quite abundant in some habitats. In temperate and tropical region, amphibian can exceed all other terrestrial vertebrates such as birds, mammals, and reptiles. Amphibians including their larvae are important predators of invertebrates. Removal of amphibians from particular habitat can have drastic consequence by increasing insect populations. Through metamorphosis, many species of frogs and salamanders are a link of transfer of nutrient from aquatic systems to terrestrial ones. Therefore, removing amphibians from a particular habitat can affect drastically algae communities, invertebrate populations, predator dynamics, leaf litter decompositions, and nutrient cycling. Preserving amphibian diversity is an important component for living in a healthy environment.

6. **Amphibians are beautiful**-The diversity of colors, body shapes of amphibians is remarkable. *Mantella* frogs are famous for being the world's most colorful animal species. The endangered Venezuelan yellow frog (*Atelopus carbonerensis*) is fully covered by a yellow sticking color. Colors can vary greatly amongst individuals within a single species. For example the Oriental fire-bellied toad (*Bombina orientalis*) has drastic color differences within a single population. Individual toads can be covered by dark grey or a vivid attractive green with few patches of black. The sheer diversity of form provides an endless aesthetic treat for the observer. However, one of the most appealing characteristics of amphibians is their calling during breeding season. Everybody, remember and often miss the chorus of the common tree frog species (*Hyla* species).

7. **Amphibians as food**-Frogs and toads are also foods for other species like birds, snakes and small mammals etc. If frogs and toads are removed from the ecosystem, there will certainly a negative influence on the ecosystem.

8. **Conveyor belt of energy from Invertebrates to Vertebrates**- While tadpoles scrap and feed on Algae (Green, Brown, Red Algae), diatoms, zooplanktons and larvae of some insects in the water body, thus they control the algal blooms to certain extent.

9. **Amphibians as biological controller**- Adult individuals of frog and toads are the major biological controller of insects, some of which can cause disease to human being or may act as transmitters of disease or pest of agriculture.

10. **Amphibians as ecosystem indicator species** - Due to their ectothermic nature, biphasic life style, and capability to respire through skin and anamniotic embryo, amphibians are very sensitive to change in environment and are aptly considered as canaries in a coal mine as they indicate the health of ecosystem. They are also capable of alarming about the earthquakes.

Why Amphibian Population Is Declining?

As part of an overall "biodiversity crisis" many amphibian populations are in decline throughout the world. Numerous causes have been invoked to explain these declines. They include-

1. **Habitat destruction and alteration**- The most obvious factors contributing to amphibian population declines are habitat destruction and alteration (Fisher and Shaffer 1996, Davidson *et al.* 2001, Marsh and Trenham 2001) Clear cutting

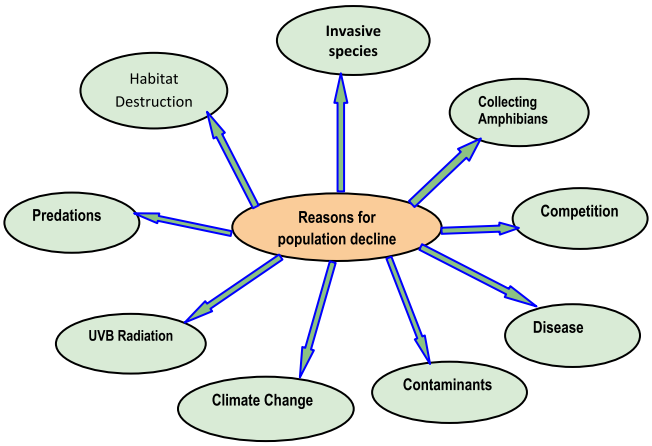

Fig- Reasons for Amphibians declining

forests, draining wetlands and altering vegetation may directly affect amphibian populations. Roads, introduced species, or other factors separate remaining populations of amphibians from each other. A vast majority of Indian amphibians occupy regions that are increasingly being used for agricultural purposes. In addition to this, a vast majority of amphibian species dwell in regions that are undergoing urban development, logging and industrialization that have resulted in a drop in stable amphibian habitats. The building of dams and water management systems disturbs stable environments by altering the natural river flow in areas populated by amphibians.

2. **Ultra Violet Radiation**- Increasing ultraviolet-B (UV-B) radiation caused by stratospheric ozone depletion and other environmental changes may contribute to amphibian population declines. For example, the hatching success of a number of amphibian species is lower when they are exposed to ambient levels of UV-B radiation compared with eggs that are shielded from UV-B (Hayes *et al*. 2002, Blaustein et al. 2003). Moreover, in many cases, exposure to UV-B radiation induces sub lethal effects that may affect growth and development, behaviour and the physiology and anatomy of amphibians ((Hayes *et al.* 2002, Blaustein et al. 2003). Continued mortality in early life stages may ultimately contribute to a population decline.

3. **Diseases**- A variety of pathogens affect wild amphibian populations. These include viruses, bacteria, parasites, protozoans, oomyscetes, and fungi .These pathogens can be the proximate causes of mortality or they can cause sub lethal damage such as severe developmental and physiological deformities. Pathogens may infect amphibians at various life stages. Three pathogens that have received recent attention with regard to amphibian population declines are the chytridiomycete, Batrachochytrium dendrobatidis, found in several areas where population declines have occurred, a *pathogenic oomycete, Saprolegnia ferax*, contributing to large-scale amphibian embryonic mortality in North America, and an iridovirus (*Ambystoma tigrinum* virus, ATV) isolated from diseased tiger salamanders. Chytridiomycosis is one such disease that may be involved in some of the mortality and die-offs found in Central and South America. A number of investigators have categorized chytridiomycosis as an EID. Infectious diseases (Daszsak *et al*. 2003).

4. **Contaminants**- Pollution plays a major role in creating an unstable environment for amphibians in India. A wide array of contaminants may affect amphibian populations. These include pesticides, herbicides, fungicides, fertilizers and numerous pollutants. Excessive use of pesticides such as DDT, Dieldrin and Malathion have been shown to affect the immune systems of certain amphibian species while use of herbicides such as Atrazine has an effect on their reproductive ability by inducing sex reversal. Toxic substances can severely affect amphibians in a variety of ways. They can kill amphibians directly, affect their behaviour, reduce their growth rates, act as endocrine disrupters or induce immune suppression.

5. **Introduced species**- Non-native species prey on or compete with native amphibians so it is very important to remove the non native or introduced species. Some species face a dramatic drop in number due to the introduction of alien species such as mosquito fish *Gambusia affinis* that that destroy amphibian eggs. Introduced species have the potential to affect amphibians in a variety of ways. They may compete with native amphibian species, prey upon them, or introduce diseases that may affect them. (Vredenburg 2004, Kats and Ferrer

2003). Present decline in the population of the Amphibians in the world has been related to introduction of predatory fishes in to the water (Alfored and Richard 1999).

6. **Over- exploitation**-Amphibians are removed from the wild and sold internationally as food, as pets, or for medicinal and biological supply markets (Jennings and Hayes 1985, Lannoo *et al.* 1994).

7. **Climate Change**- Amphibians are considered to be the best indicators of environmental health. A decline in amphibian populations indicates ecosystem deterioration that might affect a wider spectrum of the earth's biological diversity. During the last 12 years there has been a great concern, worldwide, about the rapid decline in amphibian populations. Amphibians are extremely sensitive to small changes in temperature and moisture. Changes in global weather patterns (e.g. El Niño events or global warming) can alter breeding behavior, affect reproductive success, decrease immune functions and increase amphibian sensitivity to chemical contaminants. (Pounds et al. 1999, Kiesecker *et al.* 2001). The underlying mechanisms behind these factors are complex and they may be working synergistically with more straight forward factors, such as habitat destruction and introduced species, to exacerbate declines (Kiesecker *et al.* 2001, Blaustein and Kiesecker 2002).

8. **Food**-In the last few decades, a large numbers of frogs were captured and their limbs exported as part of the frog-leg industry to gain foreign exchange. However, this activity resulted in a tremendous increase in agricultural insects or pests. Realizing this, the Government of India banned the export of frog legs since April 1986. Since then, the trade has declined but some illegal export still takes place through the neighboring countries.

Possible Solution to Save Amphibians-

1. Captive breeding programs for endangered species can be done *in situ*.
2. Reintroduction programs place amphibians back into wild habitats in the hope that new populations can be established.
3. Introduced species are being removed where they threaten native species.
4. Measures taken to protect amphibian habitats.
5. Land and water management techniques modified to minimize the impact on amphibians.
6. Restoration of habitats and natural processes.
7. Preparing and implementing species recovery programmes for selected species.
8. Eat organic food. By reducing pesticide and fertilizer use, you directly help in reducing the amount of chemical contamination that affects many amphibian species.
9. Avoid releasing environmental estrogens into the water. Environmental estrogens are known to affect amphibian worldwide including human being.
10. Pesticide kills amphibians and insects that amphibians eat hence their use dhould be avoided.
11. Leave natural and artificial ground cover (e.g., old wood cover boards or dead wood) in your backyard. Ground cover provides moist shelter to amphibians.
12. Leave native aquatic vegetation growing at your pond. It provides food, refuge, and breeding habitat for amphibians.
13. Join campaigns to stop frog and salamander trade. Frog trade has been responsible for introducing amphibian diseases and non-native predators.
14. Protect amphibian from pets. Cats and dogs can disrupt breeding activities of frogs and salamanders. Be a responsible pet owner and discourage your pets from disturbing amphibians.

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