



Review Paper

Current Status and Possible Causes of Reptile's Decline

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Abstract

Among poikilothermic terrestrial vertebrates, reptile plays an important role for maintaining the ecological balance of nature by balancing the food chain. They perform a vital role both as prey species and predator. As predator of insects, rodents, and other pest species they provide a significant benefit to agriculture and recreational activities. Similarly reptiles provide food for small mammals, birds, and other animals. Some reptiles are even used in traditional medicines, Skin of various reptiles used for creation of shoes, handbags and belts, and tortoise shell is used for jewellery and decoration purpose. However due to several anthropogenic reasons, today the reptilian population is at stake. According to IUCN, the number of critically endangered species of reptile have increased from 73 to 164, the number of endangered species have increased from 101 to 329 and vulnerable species of from 187 to 386 in between 2006 to 2013. Also this result is the reflection of only 4204 evaluated species among the total of 9831 species of reptiles. This trend will surely increase on evaluation of increased number of species. Many factors play a role on reptile population decline. Some factors are natural process but other factors like habitat loss and fragmentation, predation by and competition with non-native and invasive species, natural calamity, UV radiation, environmental pollution, and disease play a significant role for reptile's decline. Due to global climate change these reptiles are also at the stake. The biology and ecology of reptiles are tightly related to temperature and moisture. Their phenology, demography, and habitat choice is sensitive to climatic factors. In reptiles, the timing of the seasonal activities, hibernation, aestivation, and breeding are tightly related to climatic conditions. For better conservation strategy a long-term monitoring process should be needed where populations are predicted to become extirpated, so that we can accurately determine what the probable causes of reptile decline are. Similarly Common people's participation and awareness about importance of the reptiles for their survival should be needed.

Keywords: Hibernation, reptiles, food-chain, population, predator

Introduction

Reptiles are important members of many ecosystems and play important roles in food webs. They are mostly found in wet tropical countries, where they are abundant and species rich. Reptiles provide food to Birds anything from boas to lizards. Sea turtle hatchlings are preyed upon by dogs and other carnivorous animals. They also provide an important protein source for many people, or may be sold as a luxury food. By eating carrion they play a great role in clearing dead animals from the environment. Reptiles helps in controlling pest by eating rats, mice, slugs, termites, crickets, and many other insects. Similarly crocodiles and alligators keep the aquatic ecosystems healthy and balanced by controlling the overpopulation of fish species in coastal regions and wetlands. Some reptiles are even used in traditional medicines. Snake venom contains many active components which are used for variety of medical purposes like preventing the growth of cancerous tumors, serving as pain-killing drugs and ointments for cuts and burns etc. Reptiles also act as model for many biomedical and basic biological research programs. The skin of snakes and crocodiles are used in the creation of shoes,

handbags and belts. Tortoise shell has become a popular material for jewellery and decoration purpose.

In many parts of the world over the past few decades decline and extinction of reptilian species populations have been reported. Similarly it is assumed that reptiles will be adversely affected by rapid changes in climate in the forthcoming decades and will face many hazards. Through this review work we have tried to throw a light on the probable cause of reptile species decline and current status of reptile species.

At the present time the term "global warming" has not only drawn attention of the scientists but also of the common people as well. The entire humanity and civilization is now facing the real challenge or threat of climate change due to global warming. Change in global climate is observed because of three major changes such as global average temperature, rise in sea level and regional precipitation. Environmental temperature can regulate the biological function of many animals. Different animals regulate their body temperature by changing the biochemical and physiological process of their own body. This dependency should ultimately translate into a latitudinal and

altitudinal distribution of reptiles. In reptiles the timing of the seasonal activities, hibernation, aestivation, and breeding are tightly related to climatic conditions. Due to rapid climate change, reptiles quickly changes their habitat and shift to favourable places. Some times for limited dispersal abilities of crocodiles, snakes, lizards, they may face more extinction than birds or any other animals although they shift their habitat due to changing condition of the environment. Similarly rise in environmental temperature also have a direct impact on sex determination of reptiles, because sex of reptiles hatchling is directly determined by nest temperature during incubation period. As for example in turtle cool beaches produce male hatchling, while warm beaches produce mostly females.

Reptiles are important members of food chain and help to control insects, rodents and fishes. On the other hand they also play a role in clearing dead animals from environments. In an ecosystem, reptiles themselves are often used for food for many animals. There is an immediate need to assess the threat of reptiles and to find out if it have any impact on natural environment or not through environment impact assessment (EIA)¹.

Threats and Decline of Reptiles population

Among animals, reptile species are declining rapidly on a global scale. There are many factors responsible for this decline. Although by the short term monitoring of reptilian population, it is very hard to predict if the decline is due to natural or other external factors force them to decline. Among various threats to reptile populations decline, common are destruction of natural habitat and degradation, environmental pollution, various disease of reptiles, unsustainable use reptiles as food and other purpose, and obviously rapid global climate change. The climate change generally forced the reptilian species to become extinct². Lizards and other reptiles generally prefer cooler regions. It was reported that increase of temperature may affect the egg development among different reptiles³. Today most of the people have recognized the value of reptiles in our natural ecosystems and also they are integral part of an ecosystem⁴.

Due to rapid spread of urbanization normal habitat of reptiles are becoming reduced and degraded day by day. Many species of reptiles die when passing through the road or railway track. Domestic dog and human's disturbance and killing of reptiles also a cause of reptile's decline. Similarly due to rise in sea level and coastal inundation occur rapidly every year which may destroy many reptiles suitable habitat including sea turtle. It has been observed through in South Carolina, where due to changes in coastal Plain wetland there is a reduction in the habitat of black swamp snakes (*Seminatrix pygaea*) and eastern green water snakes (*Nerodia floridana*)⁵. For this reason their distribution has also changed. In South eastern Arizona due to cattle grazing the native bunchgrasses has been eliminated which may cause the decline of the bunchgrass lizard (*Sceloporus scalaris*) because these lizard uses these bunchgrasses for their own protection.

Now days, there is rapid economic growth around the world which is dependent on burning of fossil fuel. Simultaneously, large quantity of pollutants is released into the atmosphere which is affecting our ecosystem⁶. Recently due to excessive uses of various pollutants like pesticides, metals, radioactive elements have some direct and indirect effects on reptiles⁷. Radioisotope contaminators incur genetic damage to slider turtles (*Tachemys scripta*) when exposed for a long period⁸. Similarly due to chemical contamination of water of lake Apopka of Florida, the male American alligator (*Alligator mississippiensis*), have reduced plasma testosterone levels and gonadal changes have occurred permanently⁹. In turtles due to contamination of pollutant's like olychlorinated biphenyls, dieldrin in tissues and eggs, either abnormal gonadal function or permanent sex reversal has been observed¹⁰.

Introduction of different new non native species in a habitat is a big problem for native reptiles. Now in New Zealand the tuatara (*Sphenodon punctatus*) are found in the two islands and some other offshore islands¹¹. But they have become extinct on the main islands because of the introduction of mammals, primarily rats. Some ants (*Solenopsis invicta*), have been reported to prey upon the eggs of some reptiles¹². The invasive species are not always animals. Sometimes due to introduction of non native plants, the desert tortoise (*Gopherus agassizii*) and gopher tortoise are threatened because these plant species changes the habitat structure¹³.

The use of animals by human is a part of many cultures. Commercial use of reptiles is harmful for environment and one of the common examples is Asian freshwater turtles which are on threats. In India many tribal people kills many reptiles for food. Similarly China, and many other countries consume turtles as delicious food items. Most of the sea turtles have declined in all warm seas of the world. One of the largest fresh water turtles (*Macrolemys temminckii*), is going to be extinct due to the commercial turtle trappers¹⁴. Asian freshwater turtle and tortoise are captured for food source and also it is used in traditional Chinese medicinal remedies. But for their extensive and unregulated capture in many countries it have now become endangered and even waiting for complete extinction. Not only turtles but also lizards and many reptile species have declined due to overharvesting for food and their excessive use. Similarly in Tropical America, green iguanas (*Iguana iguana*) and spiny-tailed iguanas (*Ctenosaura similis*) are also facing such problems¹⁵.

The increased warmth and humidity in many parts of the world will increase chances of diseases in both humans and animals¹³. Many fungal and bacterial diseases are also one of the major threats to the decline in reptile population. Bacterium like *Mycoplasma agassizii*, create a severe respiratory trouble among desert tortoise in US South-west and gopher tortoises in the US South West and rapidly decline their population¹⁶.

Climate Change and Reptiles

The reptiles are very much sensitive to seasonal activities, hibernations, aestivations and breeding time. On the other hand, their distribution pattern, genetic variation and localized evolution are related with climate change. The increase of greenhouse gases due to air pollution results in an increase of global temperature. The climate change such as rise in temperature and fluctuation in rainfall patterns have occurred due to global warming. Due to climate change, many species have changed their habitat to cope up with changing environment. Similarly shift in altitudinal distribution with latitude have also occurred in many reptiles which indicates the changing environment. Sometimes increase in temperature also help the reptile population. Like the warmer temperatures in the cooler northern habitats create opportunities for colonization to new habitats. Due to sea level rise, on low elevated sand beaches the impact of erosion and flooding is expected to cause increase in egg mortality and loss of some nesting areas of tortoises.

Rise in temperatures may have some effects upon embryonic or larval development, survival and also on reproductive success. Temperature strongly accelerates embryonic and larval development in reptiles. Few reptile species shows temperature-dependent sex determination during egg incubation that could be influenced by changes and variability in global climates¹⁷. Similarly increase in temperature also have severe impact on sex ratios of the reptile population. The sex of many reptiles is determined by egg incubation temperature. That is because the sex ratio of the hatchlings of Crocodilians and some turtles is determined by nest temperatures during incubation because they have temperature-dependent sex determination¹⁸. Lizards, crocodilians and most turtles may face a test of survivability in future because of rising air temperature. Sex determination of these species is controlled by environmental temperature and recent researches suggest that rise in temperatures favour the hatching of females over males. Incubation of alligator eggs at 30°C produces 100% females at 33°C 100% males; temperatures in between produce varying sex-ratio. On the other hand *Alligator mississippiensis* show similar effects and the populations are biased towards females¹⁹. Similar reports have been found in painted turtles on the Mississippi River where nearly 100 percent of hatchings were female during the warmest summers. Loggerhead turtles in Florida also shows that temperature increases skew hatchings towards females, up to 99.9 percent of the population²⁰.

Reptile populations are very much sensitive and respond strongly to changes and variability in air and water temperature, precipitation, and also on hydroperiod (length of time and seasonality of water presence) of their environments²¹. In case of lizards, for better activity, they must warm their muscles by absorbing heat from their surroundings environment. If temperature increases too much, then they rest under the tree or small bushes until temperature drops. Due to rise in temperature

lizards get less time for normal activity. For this reason their foraging time reduces and they get less food and procures less energy from their diet. In spring time, when lizards reproduce, their diet even fall short of energy requirements needed to reproduce. If this happen, for long time then the lizards may disappear soon.

Due to climate change, water resources and food production gradually decrease which ultimately give a positive role on reptile decline²². India is also facing an environmental degradation in the hands of uncontrolled human activities. The detection of population declines in snakes is difficult due to their low population densities. On the other hand, the reptiles have high mortality rates as a result of human civilization. In fact, snakes can change considerably their dietary habits with habitat alterations²³. Although for a long time our saints have made a holy effort to conserve Snakes by making a ritual to worship them but snakes population is gradually declining due to prevailing fear among people²⁴. For increase in anthropogenic activity global climate is changing rapidly which directly effects on the natural habitats of reptiles. Sea turtles even though tend to live in warmer waters, but the climate changes also create an effect on natural habitat. There are many elements that have to be explored to fully understand how climate change affects them. Many marine species such as sea turtles are directly affected by global warming. Climate change directly affects their reproduction in three ways. First, due to sea level rise nesting beach areas on low-level sand beaches such as Bonarie, the Maldives and the Great Barrier Reef are submerge under water, Second, rising environmental temperature sometimes exceed the upper limit for egg incubation which is 34°C. Third, rising of temperature directly hamper the male female ratio of turtle population and more females are produced because temperature determines the sex of the egg of turtle.

According to reptile database compiled by Peter Uetz and Jiri Hošek²⁵. The estimated number of described reptile species is 9,831, out of which 4,204 species has been evaluated by IUCN (version 2013.2) The evaluated species falls under 09 different categories; Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Lower Risk/conservation dependent (LR/cd), Near Threatened (includes LR/nt - Lower Risk/near threatened (NT), Data Deficient (DD), Least Concern (includes LR/lc - Lower Risk/least concern) (LC) (table-1).

Out of 4,204 species evaluated by IUCN, maximum evaluated species falls under order Squamata followed by tetudines, Crocodylia and Rynchocephalia. No. of Species in IUCN Red List Categories of different orders of Reptilia shown in table-2.

Trends Changes in numbers of species in the threatened categories shows that there is a positive trend of the increase of the threatened species during the year 2006 to 2013 (table-3).

Table-1
Red List category summary for reptile (IUCN Red List version 2013.2)

EX	EW	CR	EN	VU	NT	LR/cd	DD	LC	Not Evaluated
22	1	164	329	386	281	2	775	2,244	5627

Table-2
Number of Species in IUCN Red List Categories of different orders of Reptilia (IUCN Red List version 2013.2)

Order	EX	EW	Subtotal	CR	EN	VU	Subtotal	NT	LR/cd	DD	LC	TOTAL
Crocodylia	0	0	0	6	1	3	10	0	1	1	11	23
Rhynchocephalia	0	0	0	0	0	1	1	0	0	0	1	2
Squamata	16	0	16	127	284	323	734	245	0	763	2,193	3,951
Testudines	6	1	7	31	44	59	134	36	1	11	39	228
Subtotal (Reptilia)	22	1	23	164	329	386	879	281	2	775	2,244	4,204

Table-3
Trends Changes in numbers of species of reptiles in the threatened categories (CR, EN, VU) from 2006 to 2013

	Critically Endangered (CR)	Endangered (EN)	Vulnerable (VU)
2006	73	101	167
2007	79	139	204
2008	86	134	203
2009	93	150	226
2010	106	200	288
2011	137	284	351
2012	144	296	367
2013	164	329	386

Conclusion

Although IPCC has taken several measures but the ecosystem is bound to be altered in the next 50 years to fulfill the basic needs of human civilization. The endangered status of the Reptiles is a very good example of environmental degradation. The possible results of climate change are decrease in the number of species, reducing population size and loss of the ecosystem as a whole. Necessary action should be taken before the species go on for extinction. Basic research works should be carried out to reduce the possible causes of extinction of reptiles. These research works should focus to provide necessary data to choke out conservation decisions and strategies to mitigate the problem of reptilian extinction. Global warming is heating up the planet and is shifting nature's delicate balance. Due to global rise in temperature sex ratio of reptiles is hampered. Also due to temperature rise the normal foraging activity of the lizards are hampered which will ultimately affect their reproduction ability. For better understanding excessive monitoring of reptile populations is needed. The decline of reptiles from our planet is genuine but awareness is important. There is a dire need to establish environment impact assessment (EIA) to assess whether a proposed project have any impact on natural environment or not²⁶. In today's global environment every country is focusing on sustainable development. Public participation is a tool to achieve sustainable development²⁷. We suggest that the decision making and policy development

organization is already lacking in their job to carry out effective mitigation. It is only by changing the human attitude towards environment and reptiles the biodiversity will be preserved to meet the need for future.

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