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Consequences of habitat loss and habitat fragmentation on the survival of monitor lizard populations in Bangladesh: a review and prospectus

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Abstract

The ecosystems of Bangladesh support three different monitor lizard's species (*Varanus bengalensis, V. flavescens and V. salvator*). But, these huge populations are in great threats from habitat loss and fragmentation point of view. Nonetheless, maximum research studies have not given clear insights into their population-level implications. There is an obvious need to explore the mechanisms that dispose activity patterns, abundance and distribution of monitor lizard. The primary objectives of this paper is to sum up the current research knowledge, information gaps and propose scientific approaches to give clear idea, efficient management and conservation of monitor lizard populations in ecosystems facing habitat loss and fragmentation. Most of the research study showed that due to habitat loss and fragmentation all of the Monitor lizards are facing continuous threats for surviving in their natural habitats. Habitat fragmentation decreases territory range and dispersal and increases mortality rates of the Monitor lizards. It's narrowing the genetic diversity and perhaps the production of infertile youths. The species also faces the high vulnerability to pathogens, invasive species, climate change, increased Ultraviolet-B exposure and environmental pollution. The ultimate result or impact of habitat loss and fragmentation is actually the total loss or extinction of wild fauna including monitor lizards from that particular habitat. So, proper conservation and management strategy could only save these important species from extinction.

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Introduction

Bangladesh is a small subtropical country of South Asia. The Biodiversity of Bangladesh is basically based on three different types of forest. Mixed-evergreen forest, moist deciduous forest and costal mangrove forest, which is home to the different types of flora and fauna. Besides forest habitat, wetland ecosystems of Bangladesh also support vast number of wildlife fauna. Three different Monitor lizard species found in the country's vast ecosystems. Of them Bengal monitor (*Varanus bengalensis)* and semi-aquatic Yellow monitor (*V. flavescens)* are widely distributed all over the country and Asian water monitor (*V. salvator)* found only in the mangrove ecosystems of the Sundarbans (Khan, 2008) (Table 1). A decade before Monitor lizards were the most easily seen lizard species of Bangladesh. Because of the anthropogenic activities, like- habitat destruction, habitat fragmentation and alteration, over exploitation, illegal trades, excessive uses of insecticides in the farm land and unconsciousness of the people the number of monitor lizards are declining at an alarming rate. However, maximum research studies have not given clear insights into their population-level implications. There is an obvious need to explore the mechanisms that dispose activity patterns, abundance and distribution of monitor lizard. The primary objectives of this paper is to summarize the current research knowledge, information gaps and propose scientific approaches to give clear idea, efficient management and conservation of monitor lizard populations in ecosystems facing habitat loss and fragmentation.

Status and distribution

Most of the monitor lizards are widely distrusted in the different ecosystems including the government declared protected area habitats of Bangladesh. Bengal monitor (*Varanus bengalensis*) is the most common and easily seen monitor lizard species widely distributed in different habitat types. All protected area of Bangladesh supports this species. According to IUCN Red List the species fall in the categories of least concern but the population is decreasing globally (IUCN, 2015). Yellow monitor (*Varanus flavescens*) is uncommon type lizard species of Bangladesh. They are basically semi-aquatic and distributed all over the countries. On the report of the IUCN Red List of Threatened Species, globally yellow monitor is still regarded as the lower risk/least concern species (IUCN, 2015) Water monitor (*Varanus salvator*) strongly built monitor lizard of Bangladesh. Nationally hey are common, occurs on the coast of Bangladesh, but mainly in mangroves of Sundarbans. Protected areas that support this species are three wildlife sanctuary of Sundarbans, Char kukri-mukri wildlife sanctuary, Nijhum dweep national park and Teknaf gave reserve (Khan, 2008). As stated by IUCN Redlist, the species is near to threatened globally and population trend also decreasing (IUCN, 2015). Overall, status and distribution of monitor lizards are shown in the table 1 (Khan, 2008).

Impact of habitat loss and fragmentation

Habitat fragmentation is the most important cause of biodiversity extermination (Hansson, 1991; Hobbs, 1992; Fahrig, and Merriam, 1994; Hogan, 2015). Habitat loss and habitat fragmentation poses greatest threat to monitor lizard's species. Bangladesh forest, swamps, beels, marshes, plains, lakes and other habitats of monitor lizards continue to disappear as they are harvested for human utilization and cleared to make path for agronomy, housing, roads, gas-pipelines and the other tasks of industrial development. Without a solid plan to establish protected areas like sanctuary and national park based on both terrestrial and wetland habitats, our important ecological habitats will continue to be lost.

Perhaps habitat loss is the strongest challenge to the animal diversity on this planet today

It is distinguished as a major threat to 85% of all species pointed out in the IUCN's Red List (those species precisely categorized as "Threatened" and "Endangered"). Expanding food yielding is a main cause for the reformation of natural habitat into farm land. At present global extinction rates for animals

and plants are estimated to be up to 1000 times higher than the background rate in the fossil record (Wilson, 1999; Baillie *et al*., 2004). Vertebrate animal taxa are disappearing at disproportionately high rates, and amphibians and reptiles are the group with the highest proportion of species threatened with extinction (Humphreys and Kitchener, 1982; Hobbs *et al*., 1993b; Stuart *et al*., 2004).

Because of the habitat loss and fragmentation, monitor lizards including the other animals are living in the habitat types that have a limited carrying capacity, so in that types of habitat always have more possible risk of populations decline and extinction (Scholes and Biggs, 2004). Habitat destruction also decreases the territory range of the monitor lizards. Because of the habitat loss and fragmentation, monitor lizards including the other animals are living in the habitat types that have a limited carrying capacity, so in that types of habitat always have more possible risk of populations decline and extinction (Scholes and Biggs, 2004).

Habitat destruction also decreases the territory range of the monitor lizards. This can result in the contraction of genetic diversity and perhaps the production of infertile youths, as these organisms would have a higher possibility of mating with related organisms within their population, or different species. Habitat fragmentation by roads and other barriers decreases dispersal and increases mortality (Norton *et al.,*1995; Nunney and Elam, 1999; Carr *et al.,* 2004). In Bangladesh, every year lot of monitor lizard species died during crossing the road. The Sundarbans is the habitat of Water monitor (*V. salvator*) (Khan, 2004) Most of the mangrove habitats are interconnected each other with different channel and river (Fig. 1).

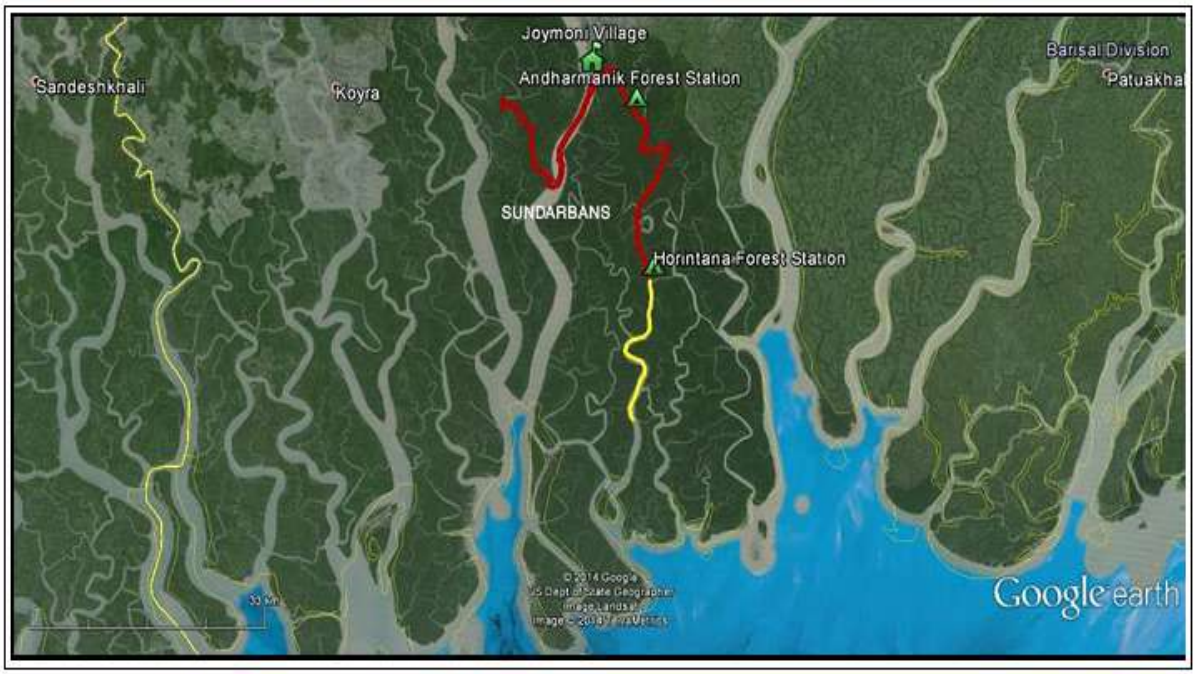

Fig. 1. Bangladesh Sundarbans have been substantially affected due to habitat fragmentation both due to natural topographical causes as well anthropogenic circumstances critically interrupting the life cycle of biota. Red color shows the distribution of recent past oil spill incident.

Now a day the river of Sundarbans is using as passage for crude oil business. The risk of oil spill is increasing day by day which could be the serious threats for the Water monitor living in Sundarbans ecosystems. Recent past, 9th December 2014 in the mangrove ecosystems of Sundarbans a severe oil spill incident occurred. Because of oil spill the death of several Water monitors are reported. The species which

experienced habitat loss also have the high vulnerability to pathogens, invasive species, climate change, increased Ultraviolet-B exposure and environmental pollution (Kitchener and How, 1982; Pounds *et al.,* 1999).

Habitat fragmentation leads to reduced patch size patches, increased patch isolation, and increased risk of demographic, stochastic and genetic events. This increases extinction risk by reducing demographic and genetic input from immigrants and reducing the chance of recolonization after extinction (Lande, 1988; Lord and Norton, 1990). Most of researcher argued that habitat connectivity plays key role to build viable Varanids population. Some studies suggested that population number may decline if immigration is prevented (Simberloof and Abble, 1976; Brown and Kodric-Brown, 1977; Simberloof and Abble, 1984). Many cases monitor lizards' population could be totally extinct from the local habitats in the absence of meaningful immigration. Habitat loss and fragmentation can substantially reduce the abilities of juvenile Monitor lizards to disperse across landscapes and the resulting reductions in post-metamorphic survival and population connectivity can threaten viability. Fragmentation not only reduces the amount of functional habitat, but it may isolate a species population into subpopulations, that may be sufficiently near the minimum viable population size to risk local extinction from successive demographic processes or catastrophic events (Simberloof, 2000).

Table 1. Status and distribution of monitor lizards (Reptilia: Varanidae) in Bangladesh.

Sl no.	Scientific name	English name	Local name	Status	Distribution
Order: Lacertilia					
Family: Varanidae					
1	*Varanus bengalensis*	Bengal monitor	Gui shap	V	W
2	*Varanus flavescens*	Yellow monitor	Sona gui	U	W
3	*Varanus salvator*	Water monitor	Ramgadi gui	C	CO, more common in Sundarbans

Status Code: V – Very Common, C – Common, U- Uncommon.
Distribution Code: W – Wide, Co- Coast.

Research and conservation needs

Monitor Lizards plays great role for the balance of ecosystems and food chain in their respective habitat (Burden, 1928; Brown and Alacala, 1970; Rahman *et al.,* 2015; Rahman and Rakhimov, 2015;). Amphibians and reptiles have traditionally received less attention than groups perceived to be more charismatic by the public, such as mammals and birds. However, they play important ecological roles as both predators and prey, and are an integral component of biodiversity. Their physiology and ecology makes them well suited to serve as indicators of environmental health of both aquatic and terrestrial ecosystems (Auffenberg, 1979d; Yeboah. 1993; Ovaska *et al.,* 2004). Stable monitor lizard population in fragmented ecosystems depends on the interaction among the pattern of roads, ecology of the habitats, and the dispersal characteristics of the species (Carr *et al.,* 2004). No true studies yet have been done about ecology and conservation of the monitor lizards in the human altered fragmented ecosystems of Bangladesh. Several conservation project is going on in Bangladesh for the protection of wildlife population. But monitor lizard populations always remain out of consideration in this types of conservation initiatives. In Bangladesh there is no wildlife institution, which is badly needed for the conservation of the monitor lizards as well as other

wildlife of the country. A Wildlife Working Circle was established within the Forest Department in 1977 with the responsibility for wildlife and nature conservation and was headed by a Senior Conservator of Forests responsible directly to the Chief Conservator of Forests (Khan, 2008). But Bangladesh forest department still have lack of experience wildlife professionals and herpetologist for take care of the conservation and management practices of wild reptilian populations including monitor lizards. Beside other wild fauna, monitor lizards are playing great role for the protection and balance of ecosystems and food chain.

Though according to IUCN Red List still these lizards are considered as least concern species in terms of conservation priorities but their population trends is going downwards. So, research and conservation initiatives should be taken for the protection of monitor lizards before they become enlisted as an endangered species in the IUCN Red List.

Conclusion

From the above discussions we can draw a conclusion that the ultimate result or impact of habitat loss and fragmentation is actually the total loss or extinction of Varanids species. So, to ensure the survival of monitor lizards species in the different ecosystems of Bangladesh immediate conservation and management action should be taken. One thing we have to mind that the habitats of all the wildlife species are non-renewable natural resource. Once if they have gone, it means they are essentially gone forever.

Competing Interests

Authors have declared that no competing interests exist.

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