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Comparative analysis of anuran diversity from the central Western ghats of Maharashtra

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ABSTRACT

A comparative study to investigate diversity and abundance of anurans was conducted in Central Western Ghats of Maharashtra. Anurans were studied using opportunistic and visual survey method in the quadrates. The selected study sites comprises of Amboli as control site, Malvan, Vengurla as coastal towns, Lanja as commercial plantation, Lote as industrial site and Sawantwadi, Chiplun as growing townships. Anuran diversity was highest at Amboli, followed by Sawantwadi, Lanja, Malvan, Lote, and Chiplun while Vengurla ranked last. The Shannon index showed that species diversity was higher in Amboli (H'= 2.16) and Lowest in Vengurla (H'= 0.97).

KEYWORDS

Western ghats;
Anurans;
Diversity indices.

INTRODUCTION

Habitat plays a crucial role in moulding life histories of organisms. Generally, the life history of an organism depends upon the environmental conditions and habitat[3] and the resource distribution has an important effect on its ecology[23]. The habitat, distributions, abundances and ecologies of various larger animals have been reported during the process of their conservation strategies. However, for amphibians, such data are few and knowledge of the role of habitat in determining distribution is limited. However, there are great concerns about the future of these animals in the face of growing anthropogenic activities like, effect of pesticides[19], habitat fragmentation[17,22] and habitat loss[18,20,21].

The most predominant factor responsible for the decline in the density and diversity of the amphibians is supposed to be the anthropogenic activities, which result in shrinkage of habitats wherever they are found. Some studies have been conducted on amphibian communities in diverse ecosystems. Niche overlap and inter-specific competition in three species of *Rana* in Sarawak have been reported by Inger and Greenberg [13]. Inger[11] also studied the organisation of communities of frogs in lowland streams of Sarawak. Crump[4] made a quantitative analysis of ecological distribution of tropical herpetofauna. Densities of floor dwelling frogs in lowland forests of Southeast Asia and Central America have been studied by Inger[12].

Inger and Voris[14] made a comparative study on the Bornean amphibian communities. Resource utilisation by the amphibian community in Borneo has been reported by Das[8]. However, similar studies are limited in India[9,10,15,27]. The community structure of amphibian assemblages in three protected areas of Kerala i.e. Peppara wildlife sanctuary, Periyar Tiger reserve and

Agasthyavanam biological park have been studied in detail by Andrews et al.[1].

Amphibians have high species richness and endemism in India, with two major centres of distribution, i.e. Northeast India and the Western Ghats[13,16]. Therefore both the areas offer great potential for monitoring studies, with the help of indicator species, to assess the decline in the quality of their habitats. Some workers have reported that in the Western Ghats in India amphibians are facing habitat loss induced by deforestation and fragmentation[2,6,7,24]. This situation has led to the formation of isolated patches of habitats and an unusual distribution of amphibian species[27].

Amphibians are known to be unique in their biology and the local environment significantly influences their community structure[7]. Hence, to implement a conservation programme for amphibians, it is important to know the distribution pattern within fragmented habitats[18]. In confronting the decline of amphibian populations, it therefore becomes increasingly important to recommend conservation priorities, both in terms of species and areas. Rapid habitat destruction requires quick and reliable assessment of community structure, even for areas as yet unaffected. Monitoring at the community level can also detect single species or groups of species that are especially prone to decline[18] and hence these may be powerful indicators of habitat changes[28].

MATERIAL AND METHODS

The undertaken study has emphasis on the current status of anurans present in the selected sites in the two districts from the Western Ghats in Maharashtra. The study area, which falls in the northern Western Ghats, is in the two coastal districts of south Maharashtra namely Sindhudurg and Ratnagiri, having excellent mosaic of habitats, which range from almost untouched habitats to highly degraded one. These habitats broadly include coastal wetlands, marshes, forests, hill slopes, agricultural lands, plantations, settlements and industrial area in the south Konkan region as well as on near the western slopes of the Western Ghats. The study area is influenced by both, the agro climatic regions of the west coast and the Western Ghats. The study sites include Amboli, Sawantwadi, Malvan and Vengurla from Sindhudurg district while Chiplun, Lote and Lanja from the Ratnagiri district. Out of the seven study sites Malvan and Vengurla were coastal; Sawantwadi, Chiplun, Lote and Lanja in the mid distance from the Western Ghats to coast and Amboli on the crest of the Western Ghats. Malvan (16^0 03' N 73^0 46' E)(site 1) and Vengurla (15^0 87' N 73^0 63' E)(site 2) are two coastal sites having paddy fields, mango, cashew and coconut plantations. These are also developing towns in the Konkan area. The Amboli (15^0 57' N 73^0 59'E)(site 3) site is considered as control site over all other study sites. The Amboli is almost undisturbed site as there is no industrial pollution and very less agricultural practices. Sawantwadi (15^0 56' N 73^0 45' E) (site 4) is a town on the national highway surrounded with woody hills. It has natural luxuriant ever green and semi ever green forest with under growth, water holes and streams. Chiplun (17^0 53' N 73^0 52'E) (site 5) is a growing township. The surrounding region is hilly and town is situated in valley. Lote (17^0 57' N 73^0 63' E)(site 6) is the industrial area where all the effluent coming from the industries directly get mixed in to the natural water bodies. Lanja (16^0 85' N73^0 65' E)(site7) has good number of commercial plantations on the hill slopes where there is use of fertilisers and pest control chemicals which get in to the natural water bodies.

The method followed for the amphibian collection involves quadrate search and opportunistic records. For the quadrate survey 5m × 5m quadrates were selected for collection. Area of quadrate was then examined for the presence of amphibians especially anurans. The leaf litter, rocks, fallen logs, tree holes, cavities were searched for the presence of the amphibians as per the method recommended by Vasudevan et. al.[27]. The collected anurans were examined, identified and released back near the sampling quadrate. The anuran identification was done y using published keys[5] and books. The preferred habitats and microhabitats were recorded. This method was particularly used to sample the floor dwelling amphibian species. For canopy dwelling and burrowing anuran species opportunistic and visual encounter survey method was used. These individuals were identified and again released near the collected spot. The aquatic anuran species were visually counted.

The anuran diversity was studied in the study sites for species richness, effective species richness, species

diversity indices like Shannon's index, Simpson's index, Shannon's evenness and diversity ration by using standard formulae. The percentage proportional abundance for each species was also calculated.

RESULTS

TABLE 1 provides information on occurrence of the anuran species recorded in the study sites. Twenty species were recorded during the study period. There was substantial variation in observed anuran species among the study sites. The most species rich study site was Amboli with twenty species, followed by Sawantwadi (12), Malvan and Lanja (6 species each), Chiplun and Lote (5 species each) and then Vengurla (4 species). Five species were common in all the study

TABLE 1: Occurrence of the anuran species recorded in the study sites

Sr. no.	Name of species	Malvan	Vengurla	Amboli	S'wadi	Chiplun	Lote	Lanja
1	Bufo melanostictus = Duttaphrynus melanostictus	√	√	√	√	√	√	√
2	*Bufo koynayensis*	--	--	√	--	--	--	--
3	*Microhyla ornate*	--	--	√	√	--	--	√
4	*Ramanella Montana*	--	--	√	√	--	--	--
5	*Euphlyctis cyanophlyctis*	√	√	√	√	√	√	√
6	*Euphlyctis hexadactylus*	√	--	√	--	--	--	--
7	*Hoplobatrachus tigerinus*	√	√	√	√	√	√	√
8	Fejervarya limnocharis	--	--	√	√	--	--	--
9	Fejervarya brevipalmata	--	--	√	√	--	--	--
10	*Indirana beddomii*	--	--	√	--	--	--	--
11	*Indirana leithii*	--	--	√	√	--	--	--
12	*Rana malabarica = Hydrophylax malabaricus*	√	--	√	√	√	√	√
13	*Rana curtipes =Clinotarsus curtipes*	--	--	√	--	--	--	--
14	*Rana temporalis =Sylvirana temporalis*	--	--	√	√	--	--	--
15	*Sphaerotheca breviceps*	--	--	√	--	--	--	--
16	Fejervarya rufescens	--	--	√	--	--	--	--
17	*Nyctibatrachus spp.*	--	--	√	--	--	--	--
18	*Philautus bombayensis*	--	--	√	--	--	--	--
19	*Polypedates maculates*	√	√	√	√	√	√	√
20	*Rhacophorus malabaricus*	--	--	√	√	--	--	--
	Total Species	06	04	20	12	05	05	06

TABLE 2: Average percentage proportional abundance of the twenty species as per the study sites

Species	Malvan	Vengurla	Amboli	S'wadi	Chiplun	Lote	Lanja
Duttaphrynus melanostictus	26.89	28.19	14.46	16.01	14.33	9.10	17.80
Bufo koynayensis	-	-	22.82	-	-	-	-
Microhyla ornate	-	-	0.75	2.38	-	-	37.57
Ramanella Montana	-	-	1.16	2.04	-	-	-
Euphlyctis cyanophlyctis	47.57	49.78	8.76	13.19	33.12	56.72	14.68
Euphlyctis hexadactylus	0.67	--	0.20	-	--	--	--
Hoplobatrachus tigerinus	5.96	7.55	4.57	11.63	13.21	10.28	10.62
Fejervarya limnocharis	-	-	1.04	3.68	-	-	-
Fejervarya brevipalmata	-	-	0.81	3.56	-	-	-
Indirana beddomii	-	-	1.63	-	-	-	-
Indirana leithii	-	-	1.53	6.59	-	-	-
Hydrophylax malabaricus	4.73	-	2.99	12.09	9.02	8.49	17.86
Clinotarsus curtipes	-	-	0.81	--	-	-	-
Sylvirana temporalis	-	-	4.74	4.03	-	-	-
Sphaerotheca breviceps	-	-	0.42	-	-	-	-
Fejervarya rufescens	-	-	0.92	-	-	-	-
Nyctibatrachus spp.	-	-	22.15	-	-	-	-
Philautus bombayensis	-	-	1.22	-	-	-	-
Polypedates maculates	14.15	14.46	6.78	15.88	30.29	15.39	1.43
Rhacophorus malabaricus	-	-	2.14	8.86	-	-	-

TABLE 3: Averages of species richness, efective species richness, shannon's index, simpson's index, evenness and diversity ratio at study sites

Sites/Diversity indices	Malvan	Vengurla	Amboli	S'wadi	Chiplun	Lote	Lanja
Species richness	4.63	3.44	14.83	9.44	4.83	4.71	5.33
Effective richness	3.54	2.84	9.04	8.36	4.30	3.30	4.63
Shannon's index	1.20	0.97	2.16	2.05	1.45	1.17	1.53
Simpson's D index	0.60	0.53	0.84	0.84	0.74	0.59	0.75
Shannon's evenness	0.82	0.83	0.82	0.94	0.92	0.76	0.91
Diversity ratio	0.75	0.77	0.74	0.89	0.87	0.66	0.85

sites. The species were *Duttaphrynus melanostictus, Euphlyctis cyanophlyctis, Hoplobatrachus tigerinus, Hydrophylax malabaricus* and *Polypedates maculatus*.

The proportional abundance of *Euphlyctis cyanophlyctis* was found higher at Malvan, Vengurla, Chiplun and Lote (TABLE 2). The *Euphlyctis cyanophlyctis* contributed almost 56.72% of the total population at Lote site. At Amboli the *Bufo koynayensis* (22.82%) was the most abundant species, which is endemic to that area followed by *Nyctibatrachus* species (22.15%). The lowest proportional abundance was of *Euphlyctis hexadactylus* (0.42%) at Amboli. *Polypedates maculatus* and *Microhyla ornata* were the prominent species from the Sawantwadi and Lanja site respectively.

Diversity indices

The analysis of dominance, diversity and evenness indices provide valuable quantitative information in different sites. For the analysis of dominance, two indices were used in the present study. The results suggest that the Amboli site was the most diverse site with regards to the number of anurans and this is represented by both Shannon's index and Simpson's index (TABLE 3). The Sawantwadi site followed in diversity and the least diverse habitat was the Vengurla site.

The distribution of amphibians in the study sites in terms of Shannon's evenness index was ranging from 0.76 to 0.94. The highest evenness was recorded from Sawantwadi site while lowest from Lote site. Similarly, the diversity ratio was also higher at Sawantwadi and Lowest at Lote.

DISCUSSION

Ecological requirements determine the distribution of species in nature. Species occur where their ecological requirements are easily met[26]. The anuran diversity and distribution varied from site to site in the study area. The Amboli site has average rainfall of about 350-400 cm and humidity almost 98 % during monsoon. The unique plateaus and natural vegetation on the slopes harbours rich anuran diversity. The water holes and stream catchments are also of great importance. The hilly area of Sawantwadi has luxuriant evergreen and semi evergreen natural vegetation and undergrowth on the slopes, water holes and small streams. These all factors are contributing much towards the anuran diversity and evenness in these two sites.

The anuran diversity and diversity indices were lowest at Vengurla. This low number was due to the growing horticultural practices in this area. The increased plantation of mango, cashew, coconut and subsequent use of agricultural chemicals are causing the low number in the anurans. Same is the case with Lanja and Malvan, which has lower diversity of anurans as compared with the Amboli. The Lote site represents the industrial area with second lowest effective species richness. It also has the lowest evenness amongst all the sites. The effluent coming from the industrial areas contributing toward the minimal number of anurans and their distribution pattern.

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