

COMMUNITY ANALYSIS OF AMPHIBIAN FAUNA IN BOLANGIR, ODISHA, INDIA

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KEYWORDS

Community analysis
Amphibian fauna
Diversity study

Received on :
02.10.2012

Accepted on :
17.01.2013

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ABSTRACT

Community analysis of amphibian fauna in Bolangir has been studied by dominance, diversity and evenness Indices. The distribution of 13 species of amphibian, collected from study sites in various habitat has been studied In paddy field, both irrigated and unirrigated, human habitation sites, both urban and rural areas, forest areas and water bodies is studied. The maximum average density of amphibian per unit area per month is 74 in water bodies, where as it is minimum of 31.8 in rural habitation sites. The Simpson dominance index is 0.2399 in water bodies and 0.1337 in urban habitation sites. The Shannon diversity index is -2.1496 in urban habitation sites and -1.7049 in water bodies. The evenness index is 0.6213, higher in urban habitation, is an indication of less variation in amphibian community, but the value is 0.5378 in water bodies indicating more variation in community. The all amphibian species sampled from the study site belongs to order Anura, where 59 % species are Ranidae, 21% Microhylidae, 14% Bufonidae and 4% Rhacophoridae. *L. limnocharis* species contributes 34.1% and *R. variegata* species contributes 0.49% of the total amphibian population. The study is focused on Bolangir owing to its significant increase of temperature in the context of global climate change.

INTRODUCTION

Recently, Amphibian species or communities have been touted as useful indicators in many situations (Welsh and Ollivier 1998, Collins and Storer 2003, Hammer et al., 2004). Others have attempted to use the species assemblage (Sheridan and Olson 2003) or the abundance of populations (Welsh and Ollivier 1998, Campbell et al., 2005) as indicator of ecosystem health or habitat quality. It is likely that amphibians can be good indicators of changes in the whole ecosystems because they are sensitive to changes in the aquatic and terrestrial environments. India has a very rich fauna of amphibians (Inger and Dutta 1986) and some 51 million hectares of land in India are available as the habitat of amphibians (Pandian and Marian, 1986), but as to how the amphibian community utilizes the available resources of a particular area in Indian ecosystem is lacking. Dash (1993) has carried out a quantitative analysis of community structure of tropical amphibian assemblage in Sambalpur district of Odisha. Keeping this view in account, a study on amphibian community has been carried out in Bolangir district of Odisha.

MATERIALS AND METHODS

Study Sites

Bolangir district of Odisha is located between 20 degree 9 minute and 21 degree 11 minute north latitudes and 82 degree 41 minute and 84 degree 16 minute east longitudes. The extremely high temperature and low humidity prevailing in this area is considered an agro climatic zone different from coastal districts of Odisha. The survey was conducted from April 2008 to March 2009.

Sampling

The sampling of amphibian was carried out by visual encounter survey (VES) formalized by Crump and Scott, 1994. VES by definition is a time constrained method in which observers sample for species richness and abundance along A survey path. The amphibian sampling was carried out in all possible habitats such as paddy field (both irrigated and unirrigated), human habitation sites, both urban and rural human habitation sites, forest areas and water bodies. On each sampling day about 2h of sampling (one unit) from 5 to 7 am in the morning and 6 to 8 in the evening was done by using powerful torches and collecting nets. Sampling was done in the first week of each month in all the possible habitat of the study sites. The amphibious mode of life, burrowing, hibernation and aestivation habit of the anuran make the population count a difficult task. The number of species sampled per unit per specific site is therefore considered a minimum estimate of amphibian density. The species were identified by the species accounts of amphibians of peninsular India by Daniels (2005) and the species were physically identified by S K Dutta.

Dominance diversity and evenness indices were calculated from the field data collected in one year. Dominance values of each species in each site were calculated

Using Simpson's (1949) index.

$$D = \frac{\sum(n_i)^2}{N}$$

Where n_i = importance value for each component and Σ = total of importance values. The diversity index was calculated using Shannon and Weaver (1963).

$$\bar{H} = -\sum \left(\frac{n_i}{N} \right) \log_e \left(\frac{n_i}{N} \right)$$

Where N_i =importance value for each component and Σ = total of importance values of all components. Evenness or equitability of the species in the study sites was calculated using Margalefs (1963) equation

$$j = \frac{\bar{H}}{H_{Max}}$$

Where H = Shannon and Weaver diversity index and $H_{Max} = \log_2 S$ and S = number of species.

RESULTS

Out of 13 species collected from the study sites 11 species were observed in irrigated paddy field, 12 species in unirrigated paddy fields, 11 species in urban habitation, 9 species in rural habitation, 11 species in forest areas and 9 species in water bodies. The average density of amphibian per unit area was 41 in irrigated field, 41.5 in unirrigated field, 45.25 in urban habitation, 31.8 in rural habitation, 32.4 in forest area and 74 in water bodies.

Analysis of data in different study sites indicate the percentage

of contribution of each species to the amphibian fauna composition. In irrigated field *Limnonectes limnocharis* contributes 44.5%, *Microhyla ornata* 26.3%, *Euphlyctes cyanophlyctes* 19.2% and rest other species contribute only 10% of amphibian community. In unirrigated paddy fields *L. limnocharis* contributes 35.7%, *M. ornata* 24.6%, *E. cyanophlyctes* 21.2% and 19.5% by rest species. In urban habitation *Duttaphrynus melanostictus* contributes 25.5%, *M. ornata* 20.4%, *L. limnocharis* 17.3%, *D. stomaticus* 16.2% and 20.6% by rest species. In rural habitation areas *D. melanostictus* contributes 37%, *M. ornata* 22.2%, *D. stomaticus* 18.3% and 22.5% by rest species. In forest areas *L. limnocharis* contributes 33.9%, *M. ornata* 22.8%, *Polypedatus maculatus* 18.7%, *Euphlyctes cyanophlyctes* 14.3% and 10.3% by rest species. In water bodies *L. limnocharis* contributes 43.3%, *E. cyanophlyctes* 42.5% and 14.2% by rest species. But, when the numerical value is taken into account from the total number of amphibian (Table 1). Distribution of Amphibian in different study sites collected from various study sites, 25% of the total population is observed in irrigated field, 24% in water bodies, 14% in urban habitation, 13% in unirrigated field and 10% each in both rural habitation and forest areas.

In the study sites, the species reported were only Anuran. Among the Anuran species, Ranidae contributes 59%, Microhylidae 21%, Bufonidae 14% and Rhacophoridae 4%

Table 1: Distribution of Amphibian in different study sites

Species	Irrigated Fields	Unirrigated Fields	Urban Habitation	Rural Habitation	Forest Areas	Water Bodies	Total
<i>Dmelanostictus</i>	20	20	139	144	2	4	329
<i>Dstomaticus</i>	13	11	88	70	0	0	182
<i>Dscaber</i>	10	7	0	0	3	0	20
<i>Mornata</i>	245	123	111	85	89	53	706
<i>Ktaprobanica</i>	0	0	9	3	5	5	22
<i>Uglobulosus</i>	0	5	5	5	5	16	36
<i>Pmaculatus</i>	14	24	23	27	73	5	166
<i>Ecyanophly ctes</i>	179	106	57	8	56	378	784
<i>Llimnocharis</i>	415	178	94	35	132	385	1239
<i>Htigerinus</i>	22	9	8	5	6	32	82
<i>Hcrassus</i>	5	1	2	0	0	11	19
<i>Srolandae</i>	3	9	7	0	10	0	29
<i>Rvariegata</i>	5	5	0	0	8	0	18
							3632

Table 3: Ecological distribution of amphibian in different study sites

Species	S1	S2	S3	S4	S5	S6
<i>Dmelanostictus</i>	1	1	2	2	1	1
<i>Dstomaticus</i>	1	1	2	2	0	0
<i>Dscaber</i>	1	1	0	0	1	0
<i>Mornata</i>	2	2	2	2	2	1
<i>Ktaprobanica</i>	0	1	1	1	1	1
<i>Uglobulosus</i>	0	1	1	1	1	1
<i>Pmaculatus</i>	1	1	1	1	2	1
<i>Ecyanophly Ctes</i>	2	2	1	1	1	3
<i>Llimnocharis</i>	3	22	2	1	2	3
<i>Htigerinus</i>	1	1	1	1	1	1
<i>Hcrassa</i>	1	1	1	0	0	1
<i>Srolandae</i>	1	1	1	0	1	0
<i>Rvariegata</i>	1	1	0	0	0	0

S1 - Irrigated field, S2 - Unirrigated field, S3 - Urban habitation, S4 - Rural habitation, S5 - Forest areas, S6 - Water bodies

Table 2: Dominance, Diversity and Evenness Indices of Amphibian in Different Study Sites

Study sites	Number of Species	D=Simpson Index	H=Shannon Diversity Index	J=evenness Index
Irrigated Fields	11	0.2001	-1.9036	0.5502
Unirrigated Fields	12	0.1495	-2.1359	0.5957
Urban Habitation	11	0.1337	-2.1496	0.6213
Rural Habitation	9	0.1768	-1.908	0.6019
Forest sites	11	0.1697	-1.8889	0.546
Water Boodies	9	0.2399	-1.7049	0.5378

of the total amphibian population. *Limnonectes limnocharis* contributes 34.1%, *Euphlyctes cyanophlyctes* 21.5%, *Microhyla ornata* 19.4%, *Duttaphrynus melanostictus* 9%, *D. stomaticus* 5%, *Hoplobatrachus tigerinus* 2.25% and the rest contributes less than 1% of the total amphibian population.

The dominance value (D) in irrigated field and unirrigated field were 0.2001 and 0.1495 respectively. The Shannon diversity index (H) and evenness (J) value were 1.9036 and 0.5502 for irrigated paddy field and 2.1359 and 0.5957 for unirrigated paddy field. These values indicated that amphibian species were not very evenly distributed in irrigated field. The dominance value (D), diversity index (H) and evenness index for urban habitation were 0.1337, 2.1496 and 0.6213 respectively. For rural habitation sites these values were 0.1768, 1.908 and 0.6019. These values indicated that the species were more evenly distributed in the urban habitation than rural sites.

In forest sites the D value, H value and J value were 0.1697, 1.8889 and 0.5460 respectively where as these values were 0.2399, 1.7049 and 0.5378 for water bodies.

The distribution of amphibians in different study sites is different. In irrigated paddy field the species richness is highest (12/13 = 92%), followed by irrigated paddy field, urban habitation and forest areas with (11/13 = 84%) and the lowest species richness in rural habitation and in water bodies (9/13 = 69%).

The abundance indices for each species in each sites were coded as follows: 0 = apparently absent (not found in any sample), 1 = not commonly found (0-15% samples contained the species), 2 = moderately common (16-40% samples contained the species), 3 = common (40-50% samples contained the species) and 4 = abundant (more than 50% of the samples contained the species). The total abundance index (Crump 1971) is highest in unirrigated fields (16), followed by irrigated and urban habitation (15), forest sites (14), water bodies (13) and rural habitation (12).

(0 - Apparently absent, 1 - Not commonly found < 15% of the sample, 2 - Moderately common 16-40% of the sample, 3 - Common 41-50% of the sample, 4 - Abundant > 50% of the species)

DISCUSSION

About 3632 amphibian were collected from the study sites in one year period. Out of 13 species of amphibian found in the study sites, one species was arboreal, three species were terrestrial and nine species occurred largely on wet land ecosystems. The study made by Dash (1993) had reported 10 species from Sambalpur area, but in this present study sites 13 species were reported. The occurrence of Ferguson's toad (*Duttaphrynus scaber*), Painted balloon frog (*Kaloula taprobanica*) and Grey Balloon frog (*Uperodon globulosus*) in the study sites indicate the adaptation of some selected amphibian species to the existing ecological condition of the study site. The report of *D. scaber* is very uncommon, it may be treated as an indicator species that speaks about the prevalence of the arid condition in this part of Odisha. The distribution and occurrence of maximum number of species found in the unirrigated paddy fields, where as some species were altogether absent in the irrigated paddy fields, it may be due to the heavy use of pesticides and fertilizer. The occurrence of more number of species in the urban habitation sites may be due to more suitable habitat than the rural habitation sites.

Table 4: Number of individual species of amphibians

Species	Total
<i>D. melanostictus</i>	329
<i>D. stomaticus</i>	182
<i>D. scaber</i>	20
<i>M. ornata</i>	706
<i>K. taprobanica</i>	22
<i>U. globulosus</i>	36
<i>P. maculatus</i>	166
<i>E. cyanophlyctes</i>	784
<i>L. limnocharis</i>	1239
<i>H. tigerinus</i>	82
<i>H. crassus</i>	19
<i>T. rolandae</i>	29
<i>R. variegata</i>	18

In water bodies 9 species were observed, but *E. cyanophlyctes* and *L.*

limnocharis were dominated species and all other species were represented in meager proportion. The dominance index is maximum, 0.239 in water bodies and minimum, 0.1337 in urban habitation sites. But diversity index is maximum, 2.1496 in urban habitation sites where the evenness index is also higher. It is an indication of more diversity and less evenness sites for distribution of amphibians. In water bodies, the dominance index is maximum (0.23990), diversity index is minimum (-1.7049) and evenness index is least (0.5378). It indicates that the water bodies have more diversified habitat, which can accommodate less number of species and the distribution is more even than other study sites.

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