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Diversity of amphibian population with reference to various degrees of infestation of *Eichhornia crassipes* in the ponds of Cauvery delta region, Tamil Nadu, India. https://doi.org/10.56343/STET.116.012.002.001

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Abstract

The study was carried out in the Cauvery delta areas of selected village ponds of Nagapattinam, Thiruvarur and Thanjavur districts. Amphibians are considered as "Environmental sponges" because of their semi-permeable skin which allows environmental toxins. In India, 342 species of amphibians have been classified, in which 161 are still under the data deficient category which indicates the need of coordinated efforts for estimating the population and delimiting the distribution of species. The faunal diversity of amphibian in Tamil Nadu includes 76 species in which 23 species of amphibians are included under the Schedule IV as reported by Tamil Nadu Forest Department. A total of 12 amphibian species have been recorded from 31 village ponds during the study period. About 6 species of *Euphlyctis cyanophlyctis, Euphlyctis hexadactylus, Hoplobatrachus tigerinus, Hoplobatrachus crassus, Fejervarya limnocharis and Sphaerotheca breviceps* were belonged to the family Dicroglosidae whereas only three species of *Microhyla ornata, M. rubra* and *Ramanella varigata* were belonging to the family Bufonidae. The only one arboreal species *Polypedates maculates* also encountered, which belonged to the family Rhacophoridae. Regarding amphibian diversity, about 12 species were reported from Nagapattinam, 11 species from Thiruvarur and only 10 species from Thanjavur districts.

Key words: Amphibia, Diversity, Eichhornia crassipes, Nagapattinam, Thiruvarur and Thanjavur District

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INTRODUCTION

Amphibians are excellent "Bio indicator species" because they can provide information on the health of two habitats. Due to their biphasic lifestyle and permeable skins, amphibians are commonly used as "Bio indicators", which in turn makes it very common for amphibian populations to be severely affected when there are serious disturbances to their natural habitats (Collins and Storfer, 2003). Amphibians are also considered as "Environmental sponges" because of their semi-permeable skin which allows environmental toxins to be easily absorbed. Throughout the history of civilization, human (SERC, 2007) activities have been detrimental to the natural biota, which is particularly evident in the clearing of the forest that houses the greatest diversity of anurans (Duellman and Treub, 1986). There are several possible causes for the decline of amphibians, such as agriculture, habitat destruction, exotic species, pollution, toxic substances, acidification and excess nutrients. Disease, pollution, invasive species,

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have been documented or proposed to be responsible for particular or widespread amphibian declines (Collins and Storfer, 2003; Weldon et al., 2004; Thenmozhi, et al., 2015). More than 500 scientists from over 60 nations contributed to the assessment. Sufficient data are lacking to accurately assess the status. Scientists estimate that about 43% of amphibians or about 1,856 species are threatened and are declining at a rapid rate worldwide (Stuart et al., 2004). Globally 7,044 amphibians have been reported (Frost, 2013) and 342 species are known from India (Dinesh et al., 2012). The faunal diversity of amphibian in Tamil Nadu includes 76 species. In India, 342 species of amphibians are classified, in which 161 are still under the data deficient category. It indicates the need of coordinated efforts for estimating the population and delimiting the distribution of species. One-third of 6,000 worldwide amphibian species are under threatened category. Besides habitat loss, over exploitation or introduced species, amphibians are affected due to pollution of surface waters with fertilizers and pesticides (Richard, 2010). However, amphibian populations naturally fluctuate (Skelly,

excessive collection, global changes and other causes

1999) and the Habitat alteration has been attributed as one of the major causes of the current global amphibian decline.

In India only few studies have been reported, Karunakaran 2014. Seshadri et al. (2012) reported 14 species of amphibians from the wetlands of Puducherry, India. Grazy Kutty (2007) recorded 12 species of amphibians from agricultural areas of PeriyakulamTaluk. Jayasekar (2013) reported 10 species of amphibians from agricultural areas of Kanyakumary District. Tews et al. (2004) proposed the Community Ecology theory which predicts that heterogeneous habitats will have higher species richness than homogenous habitats at local and regional scales. Weins et al. (1993) reported that the modification of the lands. Is one of the causes of declining of anurans. The present article deals with survey of the study area with the help of GPS and GIS programs in order to understand the status of diversity of amphibians in the Cauvery delta areas and management recommendations to protect amphibians. The study was carried out in the selected village ponds of three districts *viz.*, Nagapattinam, Thiruvarur and Thanjavur districts. Annual seasonal pattern has been classified into 1. Post Monsoon season from January to March; 2. The summer season from April to June; 3. The Pre-Monsoon from July to September, and 4. Monsoon season from October to December. The above said wetlands received the rainfall during the northeast monsoon from October to December.

MATERIALS AND METHODS

Amphibian counting

A field survey was conducted in Cauvery delta area ponds in June 2012 to June 2015 in order to document the diversity and conservation issues of the amphibians in the area. The selected village ponds were monitored monthly once to find out the diversity and density of amphibian population. Visual Encounter Survey Method (VES) was carried out to estimate the amphibian population (Heyer *et al.*, 1994) in various ponds and the diversity of frog species was recorded in the morning or evening time. Amphibians

Study Area

Table.1. List of amphibian species, belonging to their families with IUCN status encountered in the study area of Nagai, Thiruvarur and Thanjavur, during the study period 2013-2015.

SI.	Family	Species Name	Nagai	Thiru-	Tanjure	Total No. of	IUCN Status
140.		Name		varui		Individual	518183
1	Bufonidae	Duttaphrynus	1	1	1	378	LC
		melanostictus					
2		Duttaphrynus	1	1	0	9	LC
		scaber					
3	Dicroglossidae	Euphlyctis	1	1	1	2071	LC
		cyanophlyctis					
4		Euphlyctis	1	1	1	570	LC
		hexadactylus					
5		Hoplobatrach	1	1	1	239	LC
		us tigerinus					
6		Hoplobatrach	1	1	0	27	LC
		us crassus					
7		Fejervarya	1	1	1	325	LC
		limnocharis					
8		Sphaerotheca	1	1	1	8	LC
		breviceps					
9	Microhylidae	Microhyla	1	1	1	97	LC
		ornate					
10		Microhyla	1	1	1	51	LC
		rubra					
11		Ramanella	1	0	1	2	LC
		varigata					
12	Rhacophoridae	Polypedatus	1	1	1	26	LC
		maculates					

were thoroughly searched in the water bodies, edge of the water, grasses, bushes, holes, crevices and over the surface of the water (Katie Finlinson *et al.*, 2002)

Mapping

The ponds were marked by GPS and GIS Program in Cauvery delta regions of Nagapattinam, Thanjavur and Thiruvarur districts, Tamil Nadu, India. Thirty one ponds were selected on the basis of the degree of water hyacinth infestations *i.e.* Dense, Medium and Low. A pond surface area could be estimated by walking the perimeter of the pond and stopping at various waypoint locations along the pond shoreline. The way points were stored at each location where the pond shape changes, the resulting area will be extremely accurate, probably within 1 per cent of the actual pond area.

Statistical analysis

Species richness was calculated based on the number of amphibians recorded in the pond (Heyer *et al.*, 1994) and the species diversity was calculated by using the Shannon –Wiener Index H' (Shannon and Wiener, 1949). Individual of amphibian density was calculated as number per hectare of the pond in each season. Statistical analyses were performed by using Windows based Statistical package viz., Microsoft Excel, SPSS (Statistical Package for Social Science).

RESULTS

Checklist of amphibian population in Cauvery delta areas

A total of 12 amphibian species were recorded from 31 village ponds during the study period. About 6 species of Euphlyctis cyanophlyctis, Euphlyctis hexadactylus, Hoplobatrachus tigerinus, Hoplobatrachus crassus, Fejervarya limnocharis and Sphaerotheca breviceps were belonged to the family Dicroglosidae, whereas only three species of Microhyla ornate, Microhyla rubra and Ramanella varigata were belonged to the family Microhylidae and toads, and terrestrial species of Duttaphrynus melanostictus and Duttaphrynus scaber were observed from the family Bufonidae. The only one arboreal species, Polypedatus maculates, was also encountered which was belonged to the family Rhacophoridae. Regarding amphibian diversity, about 12 species were reported from Nagapattinam, 11 species from Thiruvarur and only 10 species from Thanjavur districts (Table1).

Biology of amphibians



Fig.1.Indian Toad (Duttaphrynus melanostictus)

Indian Toad

Description

Indian Toad (Fig.1) is identified by its medium to large size and the numerous black tipped, horny warts spread all over the body. The hardened and horny ridges on the head, like the numerous warts and the tips of the fingers and toes, are all black. The underside is largely whitish with fine black spots. In juveniles, the throat has a blackish band that runs between the chin and breast. The breeding males have the throat region enriched in colour, often sporting bright yellow –orange hues. Such males often turn lemon yellow in overall colouration. The ear drum is as big as the eye or at least ½ of its size and is very conspicuous. Calling males inflate a singles, large balloon like external vocal sac.

Habit and Habitat

The common Indian Toad uses any available habitat from sea level to over 2000 m ASL in the hills of peninsular India. It is amongst the few species of amphibians that inhabit at the close vicinity of the sea. Despite its preference for human modified habitats and home steeds, it could be seen even along the edges of forests, including those in the Western Ghats.

Distribution

The species is found all over India and in the adjacent countries. It is also found in Indonesia and it is the commonest species almost the Indian amphibians.



Fig.2. Tree Frog (Polypedates maculatus)

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Tree Frog

Description

The adult of this species measures between 3.5-8.5cm in length. The body bears a series of small spots and stripes on the back. The toes are about ½ webbed and there are traces of webbing on the fingers. Both the fingers and toes have large discs. The single internal vocal sac is clearly visible when the males call (Fig. 2).

Habits and Habitat

The common Tree frog is a well-known Indian amphibian due to its fondness for inhabiting human dwellings. It takes shelter during the daytime with in cupboards, between books, inside shoes, buckets, vases and any artifact that keeps it cool during the dry summer months. This species is generally an urban tree frog. However, it also occurs within secondary forests and in the Western Ghats up to over 2000 m MSL.

Distribution

The Common Tree frog is widespread in India, Nepal, Bangladesh, and Sri Lanka. In peninsular India, it is found practically everywhere except in the semi-desert areas.



Fig.3. Indian Skipper Frog (Euphlyctis cyanophlyctis)

Indian Skipper Frog

Description

The skipper frog is a medium sized aquatic frog. It is easily identified by its habit of floating in open water. The skipper frog floats even in deep water, effortlessly and with all limbs on level with the body. The back is dark olive –brown, normally bearing black blotches. The adult of this species attain a maximum length of 6.9cm and the females are normally larger than males. The eardrum is clearly visible. The toes are fully webbed, appearing more or less similar to that of ducks. The vocal sacs are external, bluish and are visible on either side of the throat as the males call (Fig.3).

Habits and Habitat

The adult of this species are rather territorial and aggressive, commonly inhabiting open wells and small stagnant ponds. The males keep challenging each other by calling and chasing away intruding rivals. Falling insects are picked up from the surface of water. The adults are known to capture and eat fish and tadpoles. The skipper frog is one of the most adaptive of Indian amphibians and hence found practically in all kinds of water bodies including polluted ones from sea level to over 2000 MSL. This species is quite tolerant of brackish water and often inhabits puddles and channels close to estuaries.

Distribution

This species is widely distributed in Asia including India, Sri Lanka, Pakistan, Afghanistan, Nepal, Bhutan, Bangladesh and Myanmar. It occurs virtually everywhere with in peninsular India, including the highest hills in the Western Ghats.



Fig.4.Indian Bull Frog (Hoplobatrachus tigerinus)

Indian Bull Frog

Description

The Indian Bull frog is the largest frog in India. It is readily identified by its large size and the bold tigerlike strips and spots on the pale skin. The overall colouration is yellowish and some individuals have traces of green on the sides. A broad white band runs along the sides separating the darker colour pattern of the back from the unmarked white belly. The adult Indian Bull frogs may grow up to 16.0 cm in length. They are very bulky with long and muscular limbs. The snout is distinctly long and pointed. The males are smaller and darker than the females, they also have large breeding pads on the first finger (Fig.4).

Habits and Habitat

The Indian Bull frog is generally a slow-moving frog. While hopping about it clearly shows sign of heaviness. In general, the Indian Bull frog is not very

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shy. It has been observed moving and feeding amongst the feet of people who wade and clear vegetation from irrigation channels during the dry season, the adults burrow deep into the soil and have been observed 2-3 m below the surface. This species is found in a wide range of habitats from sea level to about 2000 m MSL. It is however, more often found in the hills inhabiting rice fields, irrigation channels, ponds and stream sides.

Distribution

The Indian bull frog is found in India, Sri Lanka, Nepal, Bangladesh and Pakistan. It has also been introduced into Madagascar with in India. It is widely distributed throughout the peninsula. India it is most common in the Western Ghats.



Fig.5.Indian Pond Frog (Euphlyctis hexadactylus)

Indian Pond Frog

Description

The Indian pond frog is a medium to large sized frog that is commonly seen in fresh water ponds throughout the plains of peninsular India. The frogs that occur in the coastal plains of the eastern peninsula are exceptionally green dorsally, blending in well with the background of water plants where the adults tend to rest. The younger frogs are more strikingly coloured with patches of green and black scattered over the olive-black back. At this stage, the Indian pond frog tends to resemble the skipper frog. The adults of the Indian pond frog reach a maximum length of 14.4 cm. The eyes are placed more towards the top of the head and the air drum is large and distinct. The vocal sacs are external and the region around the vocal sacs tend to turn yellow in breeding males (Fig.5).

Habits amd Habitat

The Indian Pond frog is locally abundant, where it stays floating in water in water amongst aquatic plants. It leaps out of water when pursued splashing loudly The adults of this species have the unique habit of feeding on aquatic plants .The younger individuals feed on a variety of insects, fish and small frogs. As the name implies, the Indian pond frog is more of pond dweller. It is seen in paddy fields, tanks choked with water plants and sometimes in pools beside hill streams .It is generally a species that does not ascend the hills beyond 700 m MSL. The Indian Pond Frog is most common in the stagnant waters of the coastal plains.

Distribution

This species occurs in India, Sri Lanka and Bangladesh. In India, it is restricted to peninsular India, occurring in Maharashtra, West Bengal, Orissa and southwards till Kerala. It is also commonly found along the coastal plains of northern Tamil Nadu, especially in Chennai.



Fig.6. Marbled Narrow - Mouthed Frog (*Ramanella variegata*)

Marbled Narrow

Description

The marbled Narrow –mouthed frog is a small, squat, olive brown frog with a small head and a distinctly narrow neck. The skin is entirely smooth and the large and well developed triangular discs on the fingers are pale and clearly visible. The adults of this species reach a length of 3.5 cm. The eardrum is not visible. The toes have rudimentary webbing. The digging appendages on the inner and outer aspects of the sole are present, the inner being larger than the outer. The single vocal sac is external and is most conspicuous when the males call (Fig.6).

Habits and Habitat

This species is rather shy and is not generally seen except during the rain. They are also known to inhabit termite mounds and share burrows with scorpions and other insects. In soft soil, they burrow and stay underneath with their noses above the ground. The Marbled Narrow mouthed is one of the most widely occurring species in the genus Ramanella. It occurs from near the sea till about 1000 m ASL. It is known from highly urbanized cities to cultivated areas and forests.

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Distribution

This species is found in peninsular India and Srilanka. It occurs in Mathya Pradesh, Orrisa, West Bengal, Tamil Nadu, Karnataka and Kerala.



Fig.7. Paddy Field Frog (Fejervarya limnocharis)

Paddy Field Frog

Description

The paddy field frog is a small -to-medium sized frog of the Indian wetlands. Meadows and other damp ground it is olive -brown in colour with black spots and bands all over the upper surface. The adults of this species reach a length of 2.0-6.4 CM. The males are much smaller than the females. The skin on the back may bear some folds and warts. The snout is pointed. The first finger is longer than the second. The males have external vocal sacs that are visible when they call (Fig.7).

Habits and Habitat

The paddy field frog is commonly seen in paddy fields amongst the rice plants, even when there is little standing water. Large numbers of them may be seen in grass and other damp areas especially when it rains. It is commonly seen along streams and other water.

Distribution

This species is widely distributed in India, Pakistan and Sri Lanka, throughout Southeast Asia to China and Japan.



Fig.8. Ornate Narrow Mouthed Frog (Microhyla ornata)

Ornate Narrow Mouthed Frog

Description

The ornate Narrow-mouthed frog is a small, vividlypatterned, squat frog. It is generally bronze-gold in color with a dark brown band running through the eyes along the sides. The limbs are distinctly crossbarred with dark band. The under parts are white, except the throat that is black in breeding males. The adults of this species reach a length of 2.5cm. The head is rather small with a narrowly pointed snout. The digging appendages on the sole are well developed (Fig.8).

Habits and Habitat

The ornate narrow- mouthed frog is a very active species, capable of leaping high and across distance remarkable for its size. It normally moves amongst grass and it feeds mainly on ants and other insect. The species has a wide habitat preference ranging from urban garden to dense forests. It occurs from close to the sea till about 1500m MSL in the hills.

Distribution

The ornate narrow-mouthed frog is widely distributed in India, Sri Lanka and neighboring countries, the species is known from the coasts to the hills of the Western Ghats.



Fig.9. Jordon's Bull Frog (Hoplobatrachus crassus)

Jordon's Bull Frog

Description

The Jordon's Bullfrog is a medium-large sized frog. It is identified by the colouration of the back that is olivebrown, boldly marked with black stripes and spots. Many individuals bear a thin white vertebral line along the entire length of the back. The adults of the Jordon's bullfrog reach a maximum length of 13.0cm. The vocal sac in the males is external and turns black at the time of breeding. The snouts are shorter and blunt (Fig. 9).

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Habits and Habitat

The Jordon's Bull frog is a very active frog, especially after the rains the adults generally rest along the edge of the water, partially submerged in a saucer-like excavation that they make in the sand or wet mud. The calling males tend to keep changing posture in a rather agitated manner by quickly turning around within their small territory. The species is more commonly seen in the plains till about an elevation of 250 m MSL, inhabiting rainwater pools, tanks, and rice field and irrigation channels.

Distribution

The Jordon's Bullfrog occurs in India, Sri Lanka and Nepal. In India, the species is widely distributed in most parts of peninsular India. It is most common around Chennai. The adults of this species start breeding after heavy rains. The male may be heard calling throughout the night in quick succession. The upper surface of the body is more densely spotted. The belly of the tadpole is more bulged in profile.



Fig.10.Marbled Narrow-Mouthed Frog- Microhyla rubra

Marbled Narrow Mouthed Frog

Description

Snout rounded, a little shorter than the diameter of the orbit, inter orbital space broader than the upper eyelid. Fingers moderate, first much shorter than second; toes moderate, one-third webbed; tips of fingers and toes not swollen ; subarticular tubercles very distinct ; two rather large, oval, compressed, very prominent metatarsal tubercles, outer somewhat larger than inner. The tibio-tarsal articulation reaches somewhat beyond the shoulder, never to the eye. Skin is smooth. Reddish brown above, sides darker; a dark brown line from the tip of the snout through the eye along the side of the back to the groin; a dark brown mark across the thigh, beginning on the loin; limbs with more or less distinct dark cross bars; sometimes a dark X-shaped marking on the anterior portion of the back, commencing between the eyes; beneath whitish, immaculate or with a few brown dots on the throat (Fig.10).

Distribution

This species is widely distributed throughout Sri Lanka and much of peninsular and northwestern India, and is also present in Bangladesh. It occurs from sea level up to around 460m MSL in Sri Lanka and 700m MSL in India. Habitat is distributed from Southern India and Sri Lanka. Some adults have been observed dwelling in elephant dung.

Habit and Habitat

A lowland species is inhabiting dry forest, shrubland and grassland, agricultural land and often close to human habitation (including urbanized areas). Individuals are found in loose soil, amongst leaf-litter, and under logs and other ground cover. Breeding takes place in still waters and paddy fields.

Major Threats

Pollution of land and waterways by agrochemicals, wetland reclamation (drainage for urbanization) and loss of habitat to infrastructure development are all threats to this species.



Fig.11.Bufo Fergusonii - Duttaphrynus scaber

Bufo Fergusonii

Description

Duttaphrynus scaber is a terrestrial species that occurs in various habitats: wet evergreen tropical forest, tropical dry forest, dry scrubland, grassland, coastal marshes and rural farmland areas. Adult toads are generally found under ground cover, except during the breeding season when they are found in grasslands close to water bodies. The tadpoles develop in stagnant waters (Fig.11).

Habit and Habitat

This terrestrial species inhabits a number of habitat types including wet evergreen tropical forest, tropical dry forest, dry scrubland, grassland, coastal marshes and rural farmland areas. Adults are generally found under ground cover, or during the breeding season they are found in grasslands close to water bodies. Larvae are aquatic and occur in stagnant waters. It is

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seriously threatened by habitat loss caused by deforestation, pollution, and urbanization.

Distribution

This species is widespread in India and Sri Lanka. It is generally present from sea level to 300 m ASL

Threats

Deforestation for commercial purposes, pollution of land and water bodies with agrochemicals and the loss of suitable habitat due to urbanization are the major threats to this species.

Conservation actions

It is found in many protected areas in India and Sri Lanka.



Fig.12.Indian Burrowing Frog (Sphaerotheca breviceps)

Indian Burrowing Frog

Description

The head is short, with a rounded snout; and the inter orbital space is narrower than the upper eyelid. The tympanum is distinct, about two-thirds the diameter of the eye. The fingers are moderate and obtuse, with the first extending much beyond second, nearly as long as third; the toes are moderate, obtuse, and halfwebbed; sharp-edged, shovel-shaped, and longer than the inner toe; no outer tubercle or tarsal fold is present. The hind limbs are short. The skin above is smooth or granulate, with some scattered tubercles or short, interrupted longitudinal folds; a strong fold runs from the eye to the shoulder; the belly and lower surfaces of thighs are granulate. It is light brown or olive above, with darker spots, often a light vertebral band, and sometimes another on the upper side of each flank; the throats of males are blackish, and those of females are usually brown-spotted. The male has two welldeveloped internal subgular vocal sacs. From snout to vent which in about 2.5 inches.

Habit and Habitat

It is found in the drier regions of India from Punjab and Sind to southern India and Sri Lanka. In the Himalayas, it occurs up to about 7000 feet. The structure of the hind limbs enables this frog to burrow in the ground for about 1.56" feet. The habitat ranges from dry, arid land to moist deciduous forest. The microhabitat in which this frog is found includes leaf litter or under rocks, crevices or open spaces in arid areas

Distribution

Indian burrowing frog is a species of frog found in south Asia (Fig. 12).



Fig.13. Season wise amphibian population in the districts of Nagapattinam, Thiruvarur and Thanjavur during the study periods from Dec. 2012 to April 2015.



Fig.14. Season and species wise amphibian population in the districts of Nagapattinam, Thiruvarur and Thanjavur during the study periods from Dec. 2012 to April 2015.

Season wise amphibians

The season wise amphibian density was higher in the monsoon season whereas less in post monsoon season. (Fig.13). The *Euphlyctis cyanophlyctis* was the highest amphibian species in all the seasons, whereas the species *Ramanella varigata* was less in all seasons (Fig 14). Amphibian population was estimated in various

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Fig.15. Density of amphibians based on degrees of *Eichhornia* infestations (High, Medium and Low)



Fig.16. Percentage of infestations on various degrees of *Eicchornia* ponds of the study area during the study period 2012-2015

Table.2. Density, Diversity and Richness of amphibian species on Eichhornia infested village ponds of the study area during the study period 2013-15

Category	Amphibian species	Density	Diversity	Richness
Dense(1)	1047	0.2738	0.15403	12
Medium(2)	889	0.23248	0.1473	11
Less(3)	1888	0.49372	0.15133	11

degrees of infestations of *Eichhornia* ponds. The density and percentage of amphibian species was higher in less infestation ponds than the high and medium infestations of *Eichhornia* ponds (Fig.15and 16). Amphibians were higher in the less *Eichhornia* infested ponds than densely infested ponds (Table 2). The results of Shannon Weiner clearly showed that the variation is significant in different village ponds i.e., (H = 0.151 (less), 1.54 (Dense) and 0.14 (less) in various water hyacinth infested ponds. The diversity indices showed that the amphibian population was higher in less water hyacinth ponds and lower in dense water hyacinth ponds which were influenced by *E. crassipes* infestations (Table2). The density of amphibians were also estimated with various degrees of *E. crassipes* infested ponds, in which low density of amphibians (0.23/ acre) were in medium and (0.27/acre) in dense water hyacinth ponds when compared with less infestation ponds (0.49/acre). The only one species RMV could not be observed in low and medium level of infestation of Eichhornia inponds Fig. (14).

DISCUSSION

Thenmozhi et al. (2015) reported that the amphibian species were severely disturbed with exotic species. All of these species breed in ponds. Most parts of the Cauvery delta areas have been transformed into aqua culture farms and residential plots. As a result, various microhabitats such as leaf litter, rotten logs, tree holes, shrubs and bushes have been destroyed. Breeding sites such as swamps, freshwater marshes, small creeks and ditches become dry due to increased light intensity. This phenomenon will affect the population of frog species and some species that cannot survive in a new environment will die. Infestations of invasive species like water hyacinth, Eichhornia crassipes, is one of the major factors in declining of the amphibian population (Thenmozhi et al., 2014 and 2015). On the other hand, the use of pesticide and herbicide in the agricultural areas also affected the survival of the frog species. To protect the frog species in the Cauvery delta region the government, especially the agriculture department, should monitor or minimize pesticides, control exotic species like water hyacinth in these areas. It has been stated that the number of individuals that represents, each species in the community may vary from place to place depending on the amount of rainfall, availability of habitats and human interferences as the structure and diversity of an amphibian community is determined by the availability of food, moisture and micro habitat. In the present study, the anuran population got suddenly decreased during post monsoon and summer. This might have happened due to aestivation of anurans because of the unfavorable conditions. Certain external factors like weather fluctuations, biomass of aquatic plants, predator's population and variations in water levels, harvesting of crops, etc., also directly influenced the collection of data. In some months, Ponds were full of water with ideally warm and moist, and some were too cold, and rights during the period led to more prevalent anuran

calling. Originally, each site of four habitats was supposed to have been visited daily twice.

Habitat preservation and protection are important steps in maintaining amphibian population. Mehra and Parris (2002) suggested that the baseline information on species distribution, abundance, and habitat requirements are needed, especially in the case of poorly known and/or threatened species to clarify the extent and pattern of population declines. Analysis of habitat variables can help to elucidate the distribution, habitat requirements and preferences of a particular amphibian species. Thenmozhi and Thangapandian, (2013) observed more number of Duttaphrynus melanostictus was encountered in the non cultivable habitat, Euphlyctis cyanophlyctis was more in the field of cultivable and pond habitats. But in the present study *Euphlyctis hexadactylus* was encountered in more number in most of the ponds. These results emphasize the importance of the variation in various natural habitats and their role in supporting biodiversity.

MANAGEMENT RECOMMENDATIONS

Anurans are habitat specific and highly sensitive animals. When the habitat is degraded, anurans population and density are decreased. Hence the anurans need urgent and immediate conservation to protect the environment and the balanced ecosystem.

• An intensive survey and regular monitoring of amphibians in Cauvery delta regions is essential

- The degradation or alteration or conversion of habitats for the agriculture or residential purpose should be restricted.
- Details of the impacts and causes of water quality on amphibian needs to be studied for preventing severity of declining amphibian population
- Conservation of species from unprotected ponds should also be strengthening particularly the urban areas.
- Community and School based awareness programs should be conducted

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