

## Mark and Recapture method: A Traditional method for determination of population size of Amphibian Fauna

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### Abstract

The amphibians such as frogs have various roles in environment. It can directly show the effects of toxicants as well as changes in the water environment. As such, the present study evaluated the Frog population size with mark and recapture method in Thirukadaiyur Village ponds. Totally 907 individuals of selected frogs were captured and marked in the selected ponds of Thirukadaiyur village during study period ie. September 2020 to February 2021. Out of which, 323 individuals were recaptured. From that, the population size of the selected Frog species in selected ponds of Thirukadaiyur Village was estimated to be,  $864 \pm 58.45$  individuals.

**Keywords:** diversity index, frog, marking, mark and recapture, population size.

### Introduction

Amphibians are territory specific and highly sensitive animals. They are called indicator species of environment and also, they play an imperative role in ecological cycle of the agricultural fields (Cushman, 2006). Among amphibians, the order Anuran constitute the vast majority (88%) of living species of amphibians and the bulk of their genetic, physiological, ecological, and morphological diversity. The existing agricultural field and village ponds may not be suitable habitats for amphibian population in current trends due to environmental degradation.

In capture-mark-recapture (CMR) experiments, animals are captured, marked, released, and recaptured many times by repeated sampling. The result is a set of capture histories, one per observed animal, informative on survival requirement, and the size of the population. Mark and recapture is a method commonly used in ecology to estimate population size. This method is most valuable when a researcher fails to detect all individuals present within a population of interest every time that researcher visits the study area. Other names for this method, or closely related methods, include capture-recapture, capture-mark-recapture, mark-recapture, sight-resight, mark-release-recapture, multiple systems estimation and band recovery. Some of these methods had been used in conjunction with mark-recapture techniques to study population demographics, density, movement, and activity of selected species.

There is a large literature on mark-recapture methods (Begon, 1979; Seber, 1982; Krebs, 1989) following Donnelly and Guyer (1994), The assumptions are: (1) the initial sample was representative of the entire population and not biased by age or sex; (2) the marks were permanent and recorded correctly; (3) the marked animals were released and dispersed randomly in the population; and (4) marking does not affected the probability of recapture or survival (assumption of equal catchability). Marking is often problematic due to their small size and smooth, delicate skin. Generally, the most practical method for marking more than a few individuals is toe-clipping, and this has been used in the vast majority of studies in which individual-specific marks were required. However, because toes can regenerate rapidly, the marks are not necessarily permanent. In addition,

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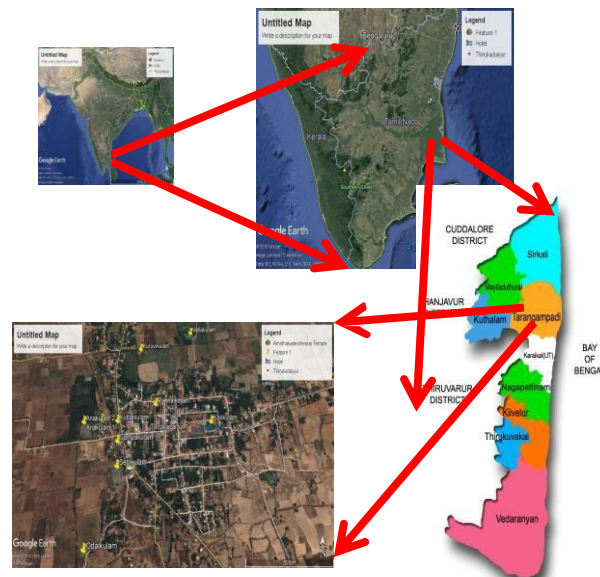
there was no work has been done on the effects of toe-clipping on the survival, behavior and recapture rates of amphibians. Some evidence suggests that adverse effects may be significant (Nishikawa and Service, 1988), and Clarke (1972) has shown that toe-clipping can reduce survivorship in Fowler's Toad (*Bufo woodhousei fowleri*). Golay and Durrer (1994) reported that toe-clipping of natter jack toads can lead to infection and necrosis, sometimes involving the entire limb. Nevertheless, toe-clipping is the recommended method for most amphibians.

The most commonly used mark-recapture estimate of population size is known as Lincoln Index (also known as the Petersen Index). This method assumes that the proportion of individuals which are marked in the population is the same as the proportion of individuals which are marked in a recaptured sample. For that above reason, this study was designed and carries out population of Amphibian in selected ponds of Thriukadaiyur Village, Mayiladuthurai District, Tamilnadu, India by using capture- mark-recapture method.

**Materials and Methods**

**Study area**

Thirukadaiyur is a place located near Bay of Bengal and Cauvery River. Thirukkadaiyur (Thirukadavur) is a temple town on the east coast of Tamil Nadu, about 300 km south of Chennai and 15 km north of Karaikal which co-ordinates 11°4'27"N79°48'31"E. The famous Amritaghataswarar- Abirami Temple of Thirukadaiyur is associated with the legends of Markandeya and Abirami Pattar, which is a replica. Thirukadaiyur has several ponds which has rich water source from the Cauvery River and their tributaries. Moreover, the area has rich cultivation area and vegetation. In the Thirukadaiyur Village, ten ponds were selected randomly for the population estimation of amphibian fauna during September 2020 to February 2021 ie. Sampakulam, Anakulam 1, Anakulam 2, Settikulam, Odaikulam, Kuruvikulam, Koilkulam, Kuttaikulam, Pannaikulam and Vellakulam (Fig 1).



**Fig 1. Study area map**

**Methods**

The study was designed and carried out various field surveys to capture-mark-recapture (CMR) experiments (Lincoln, 1930; Donnelly and Guyer, 1994) in selected ponds of Thirukadaiyur Village, Mayiladuthurai District.

$$N = \frac{\sum_{i=1}^m M_i C_i}{\sum_{i=1}^m R_i}$$

- Where, i= Time of capture
- N= Population size
- M<sub>i</sub> = the total number of previously marked animals at time i,
- C<sub>i</sub> = the number caught at time i,
- R<sub>i</sub> = the number of marked animals caught at time i.

**Statistical analysis**

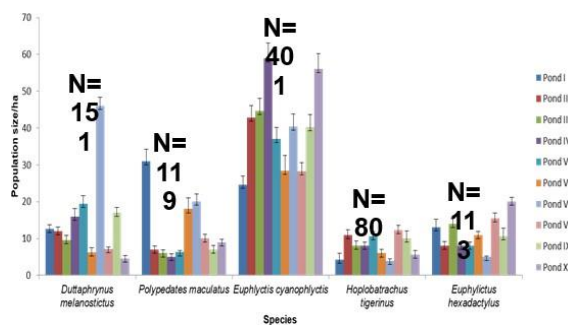
PAST Statistical software was used for diversity indices of species in different ponds. MS Excel was used for population size calculation and graphical representation of the results.

**Results and Discussion**

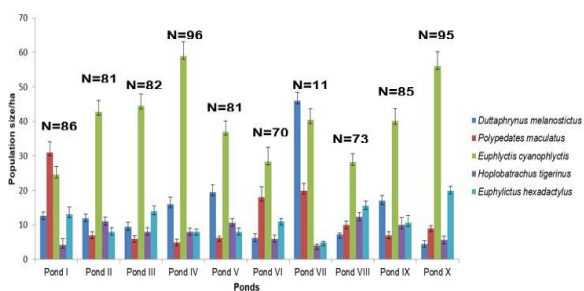
A total 907 individuals of selected amphibians were captured and marked in selected ponds of Thirukadiyur village during study period ie. September 2020 to February 2021. Out of which, 323 individuals were recaptured. Selected village

ponds were regularly monitored for population size of the selected amphibian ie *Duttaphrynus melanostictus*, *Polypedates maculatus*, *Euphlyctis cyanophlyctis*, *Hoplobatrachus tigerinus* and *Euphlyctis hexadactylus*. The population size of the selected amphibian species were calculated in selected ponds of Thirukadaiyur Village shows that,  $864 \pm 58.45$  individuals/ ha. Among them, *Euphlyctis cyanophlyctis* was recorded in more number (401) followed by *Duttaphrynus melanostictus* (151), *Polypedates maculatus* (119), *Euphlyctis hexadactylus* (113) and *Hoplobatrachus tigerinus* (80) (Fig. 3). It might be due to the agricultural areas which are surrounded by the ponds. Various studies noted that, the above five species were common in Southern India. Particularly the above species which were studied are mostly aquatic in habitat in very rare occasions it may be in the shores of ponds (Khan et al., 2009).

**Fig. 3 Population size of the selected amphibian fauna in selected ponds of Thirukadaiyur Village during the study period - species wise (N=864±58.45)**



**Fig. 4 Population size of the selected amphibian fauna in selected ponds of Thirukadaiyur Village during the study period - pond wise (N=864)**



The population size was estimated as pond wise also, it indicates that maximum number of individuals were present in the pond VII (Koilkulam) (115) followed by pond IV (Setikulam) (96), pond X (Vellakulam) (95), pond I (86), pond IX (85) and rest of the ponds has less than 85 individuals. This is first information about the frog population estimated pond wise. It noted that, the highest number of frogs was observed Koilkulam. It may be due to the absence of fishing operations and absence of anthropogenic pressure in the pond. Moreover, the pond did not get water from agricultural areas which is may be contained chemical fertilizers, pesticides residues. For the above reason the Koilkulam might be have more number of frogs while compared other ponds (Krishna and Krishna, 2005). The pond I (Sampakulam) has large number of *Polypedates maculates*. It may be due to the agricultural land surrounded by the pond which has huge number trees and shrubs. Pond VII (Koilkulam) has occupied more individuals of *Duttaphrynus melanostictus*. It may be due to the *Duttaphrynus* sp. associated with human habitations. Rest of the ponds has large number individuals from the species of *Euphlyctis cyanophlyctis* (Fig.4).

**Table.1 Overall population size of the selected amphibian fauna in selected ponds of Thirukadaiyur Village during the study period.**

i	C <sub>i</sub>	R <sub>i</sub>	New mark	M <sub>i</sub>	C <sub>i</sub> *M <sub>i</sub>
Sep-20	118	0	118	0	0
Oct-20	96	25	71	118	11328
Nov-20	171	62	109	189	32319
Dec-20	182	60	122	298	54236
Jan-21	209	75	134	420	87780
Feb-21	131	66	65	554	72574
		ΣR <sub>i</sub> =288			258237/288
					<b>896.65</b>

Overall population size of the selected amphibian fauna in selected ponds of Thirukadaiyur Village shows that, 896.65 individual/ ha during the study period (Table 1). It indicates that, 907 individuals were marked during study period of six months and 323 individuals were captured and calculated the population size of the area. Pradel (1996) studied the utilization of Capture-Mark-Recapture for the study of Recruitment and Population Growth Rate and he concluded that, if one is interested in recruitment and has limited information on survival, or if the survival structure is complex, it might be better to use the recruitment-only approach.

**Table.2 Diversity indices for selected amphibian fauna in selected ponds of Thirukadaiyur Village during the study period (N=864)**

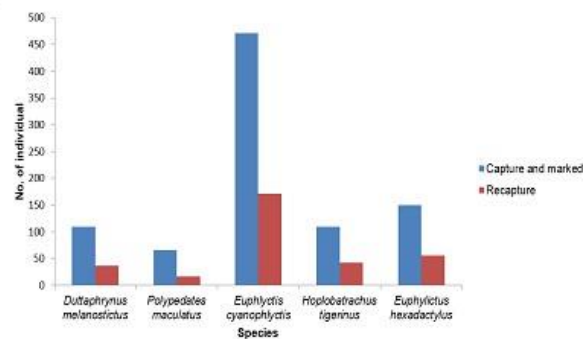
	Taxa	Individuals	Dominance index	Simpson Diversity Index	Shannon H index	Evenness e <sup>AH/S</sup>
Pond I	5	85.5	0.262	0.738	1.444	0.847
Pond II	5	80.8	0.339	0.662	1.332	0.758
Pond III	5	82.1	0.352	0.648	1.301	0.734
Pond IV	5	96.0	0.422	0.578	1.166	0.642
Pond V	5	81.4	0.297	0.703	1.392	0.805
Pond VI	5	69.6	0.274	0.726	1.434	0.839
Pond VII	5	115.4	0.315	0.685	1.290	0.727
Pond VIII	5	73.3	0.250	0.750	1.495	0.892
Pond IX	5	84.8	0.301	0.699	1.394	0.806
Pond X	5	95.2	0.406	0.594	1.173	0.647

Table 2 shows the diversity indices of species in ten ponds from the Thirukadaiyur Village during September 2020 to February 2021. All the five ponds have equal species richness and individual of amphibians was high in pond VII followed by pond IV, pond X, pond I. In rest of the ponds the individual population was less than 85 (Table 2). Dominance index was high in Pond IV followed by pond X, pond III, pond II, pond VII, pond IX, pond V, pond VI, pond I and pond VIII. Simpson diversity index was high in the pond of VII followed by pond I, pond VI, pond V, pond IX and pond VII. Rest of the ponds has less the 0.685 diversity index. Shannon Wiener index showed the diversity between the range of 1.3 to 1.5 in the ponds which were studied. Fauth et al., (1989) reported that amphibians were significantly

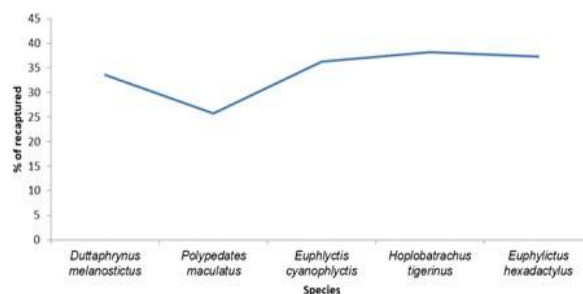
encountered in leaf litters, as leaf litters may provide a wider range of microhabitats, allowing more individuals and more species to coexist in the litter microhabitat.

Overall capture of *Duttaphrynus melanostictus* in all the ponds was 110 individuals and recaptured was 37 i.e., around 34% only was recaptured. Likewise for *Polypedates maculatus* 66 individuals were captured and the recaptured was 17 (26%) individuals during the study period. Capture of *Euphlyctis cyanophlyctis* was highest among the species (471) and its recapture was 171 (36%) individuals during the study period. In *Hoplobatrachus tigerinus* 110 individuals were captured and 42 individuals were recaptured which was 38 %. In the species *Euphlyctis hexadactylus* 150 individuals were captured and the recapture was 56 (37%) (Figs. 5 & 6).

**Fig. 5 Capture- mark and recapture of selected amphibian fauna in selected ponds of Thirukadaiyur Village during the study period (N=864)**



**Fig. 6 Percentage of recapture of selected amphibian fauna in selected ponds of Thirukadaiyur Village during the study period (N=323)**



## Conclusion

The study concluded that, frog population directly indicates that qualities of water environment. The mark and recapture is a old and traditional methodology for studying population of organism. Now a day's researchers are involving various methods to study the population estimations of organisms. But the present investigation was carried out by using old method to study the population in various ponds to compare the population size of the individuals. It yielded good results.

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