A PRELIMINARY SURVEY ON SPECIES DIVERSITY AND HABITAT DISTRIBUTION OF AMPHIBIANS IN GANNORUWA FOREST RESERVE, KANDY, SRI LANKA

B. Pathirana[1], K.M.S. Ruvinda[2*], T. Kotigala[1], K.M. Gunatunga[1], S.B. Herath[1]

[1]*Dearptment of Zoology, Open University of Sri Lanka*
[2] *Department of Zoology & Environmental Management, University of Kelaniya, Sri Lanka*

INTRODUCTION

Tropical amphibians have undergone drastic population declines in the recent decades, where nearly 41% of the amphibian species on the planet are threatened with extinction (Hoffmann *et al.,* 2010), making them one of the most threatened groups of animals on earth (Hof *et al.,* 2011). Sri Lanka is known as a biodiversity hotspot in the revised hotspots of the world along with the Western Ghats of India (Mittermeier *et al.,* 1998). The amphibian fauna of Sri Lanka comprises of 120 species, including 105(~90.0%) endemic species (Batuwita *et al.,* 2019); thus, threats to amphibians which are increasing at an alarming rate remains a conservation concern (IUCN, 2007).

However, amphibian diversity, distribution, population viability, breeding biology, and behaviour in isolated and anthropogenically impacted landscapes remain a poorly addressed research focus in Sri Lanka (Batuwita *et al.,* 2019). Gannoruwa Forest Reserve (GFR), Kandy, Sri Lanka is a significant site where holotypes, paratypes, and neotypes of several amphibians and reptiles have been recorded. Even though some research on amphibians has been carried out in the GFR (Wijesena *et al*., 2005; Manamendara-Arachchi & Pethiyagoda, 2005; Pathirana *et al*., 2015), inadequate research studies have focused on their diversity and distribution. Considering these facts, the present study was conducted at GFR, to assess the amphibian diversity, habitat distribution, and anthropogenic impacts on them. Further, this study has attempted to recognize the threats to amphibian fauna and the immediate conservation interventions required to save these least studied but ecologically significant taxa and their existing habitats.

METHODOLOGY

Study site: Gannoruwa Forest Reserve is located (7° 17' N, 80° 36' E) in the Kandy District of the Central Province. The annual temperature in the area is 24.1°C with the lowest temperatures recorded in January and highest in April and receives a mean annual rainfall of 2,131 mm, derived from both the North-East and South-West monsoons (Basnayake, 1998; Rupasinghe *et al* 2021).

Survey method: The survey was conducted from December 2019 to October 2020 using the visual encounter survey technique in 18 pre-marked transects covering six major habitat types in GFR. The six major habitat types were naturalized abandoned plantation (AP), grassland (GL), mahogany plantation (MP), nutmeg plantation (GP), the natural forest on the summit (NF), and swamp area (SA). The survey was conducted in the morning and in night, to detect both diurnal and nocturnal species, covering the study area during both wet and dry seasons. The transects were selected equally based on the available habitat types (3 transects per habitat), with roughly 50m length, and were surveyed with a team of three members.

Data collection: Potential habitats of amphibian fauna, i.e., all microhabitats (rocks and grounds, dead and fallen logs, dense bushes and grass patches, rock and tree crevices, leaf litter, and water bodies) were thoroughly searched. Every individual specimen was noted and identified to the most specific taxonomic level possible. Identification of species was done using standard field guidebooks by Manamendra-Arachchi, K. and Pethiyagoda, R. (2006) and De Silva, A. (2009). Digital photographs taken during the field survey were

sent to experts to confirm the identity of the species. The elevation and geospatial location of each species was recorded using GPS (GARMIN GPS 72H). Anthropogenic impacts and other relevant conservation issues were recorded during each visit through observations and informal interviews with the neighbouring villagers.

Data analysis: The species diversity Shannon-Wiener diversity index, evenness, and the dominance were calculated (Magurran, 1988) for each habitat type using PAST software. Microsoft Excel software (version 2010) was used to calculate the percentage of occurrence of each species in the major habitat types.

RESULTS AND DISCUSSION

A total of 254 individuals of 13 Anuran species belonging to families of Rhacophoridae (7 species) Dicroglossidae (4 species), Bufonidae (1 species), and Microhylidae (1 species) were encountered. Caecilian species were not recorded from the study area during the fieldwork. Except for *D. melanostictus* and *M. Agricola*, all other 11 species (84.6%) were endemic to Sri Lanka. Out of all the species, *P. zorro* (55.1%) was the most abundant in the sample, followed by *P. popularis* (12.9%), and *P. rus* (9%). Furthermore, *P. zorro* records the highest relative abundance across all habitat types; AP 62.07%; GP 65.52%; SA 29.69%; GL 40%; MP 80.85%; and NF 60%. *H.gracilis*, *I. temporalis*, and *L. corrugatus* were recorded only in the SA; *P. cavirostris* and *P. furgusonianus* had one record each in the AP and the NF on the summit (Figure 01).

The highest level of evenness was found in GL (E=0.92) indicating a near-equal distribution of abundance across the species, while the lowest level of evenness was indicated in AP (E=0.57). Mahogany plantation indicated the existence of a dominant species (0.68). Overall, SA indicated the highest richness (10 species) and highest number of species occurrence (64). Furthermore, SA indicates the highest diversity (H=2.07) among all habitat types. The Shannon- Wiener diversity index followed the decreasing order; SA (2.07) > GL (1.48) > NF (1.24) > AP (1.22) > NP (0.97) > MP (0.56), in surveyed habitats (Table 01).

Previous studies and personal communication revealed that the major threats to amphibians observed in GFR were habitat degradation due to anthropogenic impacts such as collecting of plant materials, setting fires to grassland to capture animals, and forest clearance in the borders. Furthermore, alien invasive plant species has an impact to enforce a possible threat by absorbing water resources that leads to drastic degradation of breeding habitats of amphibians. Lack of a stable water source at the GFR (except in the boarding area) may also seem to create an unavoidable problem for amphibians with climate change.

CONCLUSION/ RECOMMENDATION

This study provides foundational data that could be used to recognize local amphibian species' distribution patterns in different habitat types in GFR. Two species (*P. zorro* & *P. rus*) were found occupying all the six habitat types, relatively high species diversity was observed in the swamp area. A higher percentage abundance of amphibian distribution (76.9%) was observed from 500m to 550m altitude, which may indicate a correlation with the existence of SA. Further scientific research must be carried out to explore the existence of a correlation. Habitat degradation, habitat fragmentation, the threat of invasive alien plant species, and climatic impacts has been increasingly impacting amphibian fauna of GFR. Therefore, conservation decisions need to incorporate amphibians and emphasize the importance of habitat heterogeneity in any future conservation initiatives for their long-term survival in Gannoruwa Forest Reserve.

Table 01 Amphibian diversity parameters across different habitat types.

Family	Species	Habitat types*					
		AP	NP	SA	GL	MP	NF
Bufonidae	*Duttaphrynus melenostictus*	-	-	7.81	16.0	2.13	-
Dicroglossidae	*Hydrophylax gracilis*	-	-	3.13	-	-	-
	Indosylvirana temporalis	-	-	3.13	-	-	-
	Lankanectes corrugatus	-	-	6.25	-	-	-
	Minervarya agricola	-	-	7.81	16.0	-	-
Microhylidae	*Uperdon obscura*	-	-	7.81	-	-	11.67
Rhacophoridae	*Polypedates crusiger*	3.45	3.45	-	-	-	-
	Pseudophilautus cavirostris	3.45	-	-	-	-	-
	Pseudophilautus fergusonianus	-	-	-	-	-	1.67
	Pseudophilautus popularis	13.8	17.3	17.2	20.00	-	13.33
	Pseudophiautus rus	10.3	13.8	6.25	8.0	17.02	3.33
	Pseudophilautus schnideri	6.90	-	10.9	-	-	10.0
	Pseudophilautus zorro	62.1	65.5	29.7	40.0	80.9	60.0
Species richness		6	4	10	5	3	6
Total individuals sampled		29	29	64	25	47	60
Percentage occurrence of amphibians (%)		11.4	11.4	25.2	9.8	18.5	23.6
Dominance		0.42	0.48	0.16	0.26	0.68	0.40
Evenness		0.57	0.66	0.79	0.92	0.58	0.58
Shannon-Wiener diversity index		1.22	0.97	2.07	1.48	0.56	1.24

*Percentage occurrence of each species in given habitat.
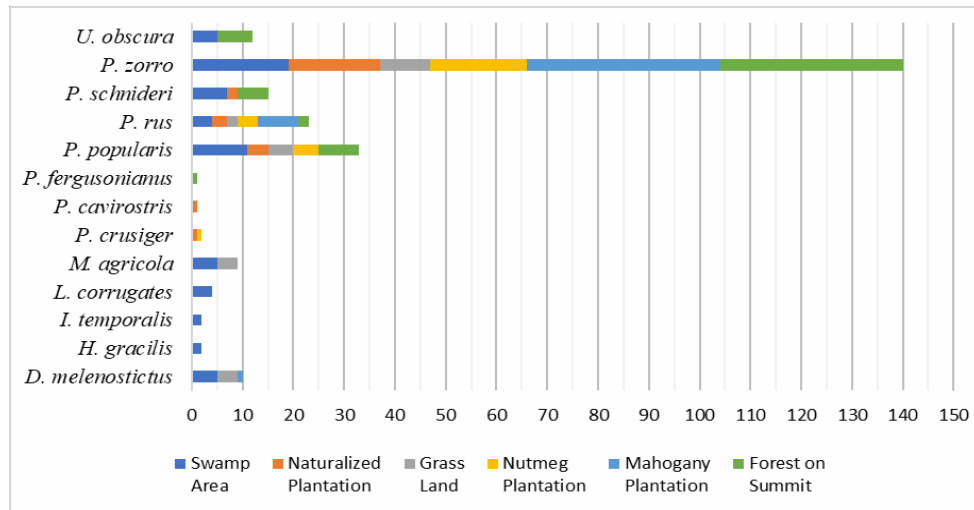

Figure 01 Number of amphibian species in the six habitat types in GFR.

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