



Goa University
School of Biological Sciences and Biotechnology Zoology

“Faunal studies of Netravali and Cotigao Wildlife Sanctuary, Goa India”

Final Report





Report submitted to:
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Goa Forest Department
Government of Goa



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“Faunal studies of Netravali and Cotigao Wildlife Sanctuary”

Chapter I: Introduction

The Western Ghats, in Goa, extend along the entire eastern edge of the state, in north–south aligned arc that is about 125 km long. The southern portion of these Ghats, within Goa, juts out towards the Arabian Sea, at Cabo de Rama, and then curves inland. The central and southern regions of the Goa ghats have rounded peaks, and in the southern regions, they are covered with grass (Ali and Ripley, 1987) with densely forested slopes (Amirtharaj, 2016) like those in Uttar Kannada District (Karnataka). The northern portion of the Goa Ghats comprise formations of the Deccan Trap type (Apte, 2009) like those in southern Maharashtra (Watve, 2013), which are characterized by a horizontal top and vertical slopes, often referred to as tabletops. The Western Ghats together with Sri Lanka are identified as one of the 34 biodiversity hotspots occurring in the world (Roach, 2005; Synge 2005). They extend over c.1400 km and host one of the richest reservoirs of biodiversity. The complex topographic, high rainfall, relative inaccessibility and biogeography isolation have been responsible for the Western Ghats retaining their rich biodiversity (Roach, 2005; Synge 2005). The important vegetation of the range includes tropical wet evergreen forests, tropical moist deciduous forests, tropical dry deciduous forests, scrub jungles, montane sub-tropical forests and wet grasslands (Sawant and Shyama, 2007). Due to its mountainous character, often characterized by steep slopes that make part of it relatively

inaccessible, the range has remained undisturbed for much of human history (Sawant and Shyama, 2007).

Partly for this reason and also because of the unique ecosystem it represents, the Western Ghats today are acknowledged to be one of the 'hotspots' of biological diversity and endemism in the world (Sawant and Shyama, 2007). The total geographical area of the state is approximately 3,702km, it stretches out to a length of 105km from north to south and 60 km wide from east to west and is divided into two districts, North Goa and South Goa .

Physio-graphically, Goa is divided into three main regions, viz. i) the eastern Sahyadri's- sub-region of the Western Ghats, and covering 43% of the total state area, ii) the central uplands—the tract between the coast and the Ghats, consisting of rolling hills, slopes and valleys, which covers ~35% of the state area, and iii) the western coastal plains—the coastal belt which accounts for ~22% of the total area of the state(Jee0wan Singh Jalal, 2019, .Goa, being one of the states that contribute to the stretch of Western Ghats, has an amazing diversity of plant and animal life (Borkar and Komarpant, 2014). The entire east zone of this state is a part of any of the four wilderness Protected Areas, viz., Madhei Sanctuary, Bondla Sanctuary, Netravali Sanctuary and Cotigao Sanctuary (Borkar and Komarpant, 2014). Cotigao Wildlife Sanctuary is one of the highly diversified biodiversity zones of Goa. Declared as Wildlife Sanctuary in 1969 is located in Canacona taluka with a geographical area of 85.65 sq. kms (Nadaf, 2019).

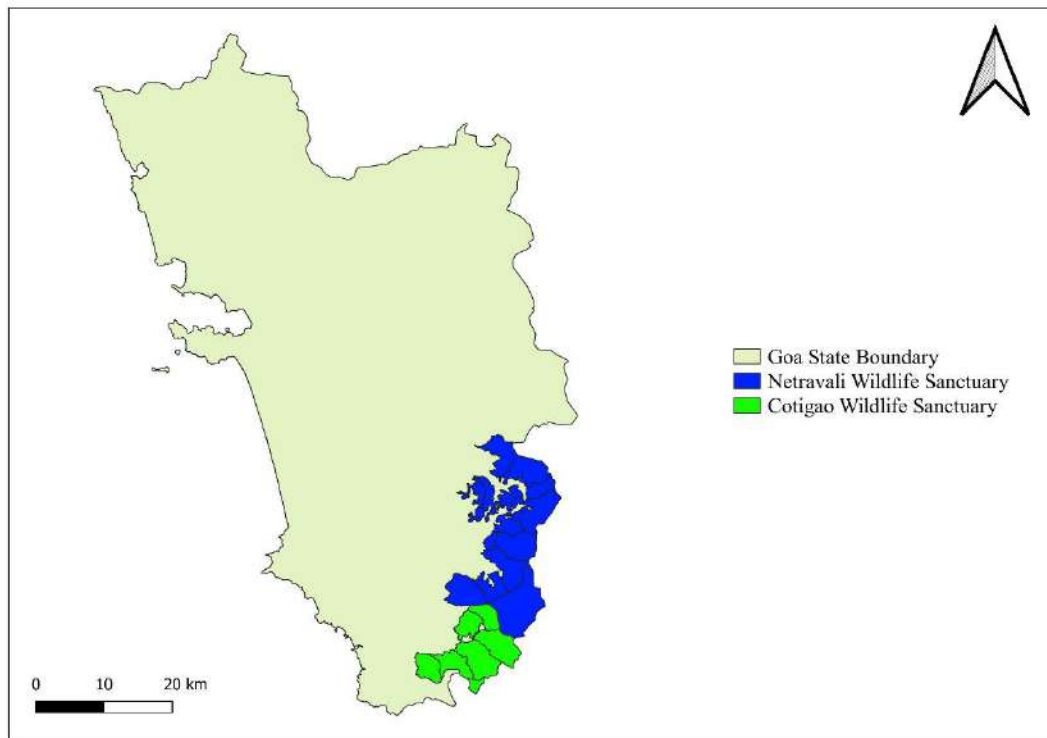


Figure 1: Map showing study area viz. Netravali wildlife sanctuary and Cotigao wildlife Sanctuary in the state of Goa

Objectives

To study the faunal diversity from the Netravali wildlife sanctuary and Cotigao wildlife sanctuary of Goa, India

1. Mammals
2. Aves
3. Reptiles
4. Amphibians
5. Lepidoptera
6. Odonata

Literature review

Goa is a small state in size as compared to the other Indian states, it exhibits varied habitat diversity ranging from marine ecosystem on western side to heavily forested mountainous tracts of Western Ghats on eastern side. The Western Ghats of India is one of the 34 biodiversity hotspots in the world (Myer et al. 2000). Goa (3702km²) occupies about 2% area of Western Ghats (Joshi and Janarthanam 2004) and its biodiversity is under threat due to deforestation (Myer 1990; Menon and Bawa 1997; Jha et al. 2000). Most of the protected areas of Goa lies in the Western ghat range passing from Goa. Goa lies in the lowermost region of Northern Western Ghats (Patel et al. 2018). The protected area network of Goa consists of six Wildlife Sanctuaries and one National Park accounting for a total area of 755.31 sq. km.

Mammals: Based on literature available and collections by Ellerman and Morrison-Scott 1951; Ellerman 1961; Tiwari et al. 1971; Agrawal 1972; Prater 1980; Agrawal et al. 1992; Corbet and Hill 1992; Roberts 1997; Wilson and Reeder 1993; CAMP Reports 1998, 2002, 2003 and 2005; Nalawade 1998; Kumaran 2000; Alfred et al. 2002, 2006 first inventory of 83 species of mammals in state of Goa was prepared by Zoological survey of India (Pradhan 2008), further which no inventory or reviewing work was done and published in the state of Goa. Post this studies Gad and Shyama had studied food, feeding habits and ecology of *Bos gaurus* from Bhagwan Mahaveer Wildlife Sanctuary and Mollem National Park (Gad and Shayma 2009; Gad 2012). Further which no detail studies were conducted and published on Mammals of protected areas including Netravali and Cotigao wildlife Sanctuary.

Aves: Birds of Goa are very well documented and published (Baidya and Bhagat 2018) and are being continuously monitored with the help of E-bird (<https://ebird.org>). Birds in Cotigao

Wildlife sanctuary are well documented (Baidya and Bhagat 2020) but the same lacks in Netravali Wildlife sanctuary.

Amphibians & Reptiles: When it comes to herpetological studies, the Southern Western Ghats area has been given prominence while the central and northern Western Ghats remains less studied (Giri et al. 2003; Ganesh et al. 2013). Very limited full-length studies have been carried out in the protected area network of Goa in comparison to its neighboring states (Sawant and Shayma 2007; Sawant et al. 2010; Jadhav et al. 2018), rest all studies done till date are description of new species from the protected areas (Sharma 1975; Giri et al. 2011; Modak et al. 2015; Dinesh et al. 2017) and check listing which only contains checklist and no supporting evidences (Sarkar and Ray 2004; Dinesh et al. 2015).

Lepidoptera: Gaonkar 1996 documented 251 species from the state. Subsequently, Pai and Mehndiratta 2001 have documented 52 species. Later Borkar and Komarpant 2004 reported 97 butterfly species from Bondla Wildlife Sanctuary. 90 common and a few rare species have been depicted by Rangnekar 2007. The State Fauna Series by Zoological Survey of India, Western Regional Station, Pune, follows the compilation by Gaonkar 1996 and enumerates 251 species of butterflies from Goa (Sharma and Borkar 2008). Further which three additions have been reported to the butterfly checklist of Goa making it to 254 species (Rangnekar and Dharwadkar 2009). Recently, Gaude and Janarthanam 2015 reported 33 butterfly species from four sacred groves of Goa, viz. Nirankarachi Rai, Alvatinichi Rai, Mharinginichi Rai and Azobachi Rai. No studies have been conducted in the Protected areas of Netravali and Cotigao Wildlife Sanctuary in the state of Goa.

Odonata: The order Odonata comprises of two suborders, Zygoptera or damselflies and the Anisoptera or true dragonflies (Kalkman et al. 2014). Currently there are 6,364 recognized species of Odonata in the world (Paulson et al. 2021) of which approximately 498 species occur in India with 186 species being endemic to this region (Joshi et al. 2022). Documentation of Odonate fauna from the state of Goa dates back to Prasad 1955 wherein 22 species were reported. Contributions by subsequent authors such as Kulkarni and Talmale 2008, Ragnekar et al. 2010, Subramanian et al. 2013, Ragnekar and Naik 2014 followed by Ragnekar et al. 2019 brought the tally to 88 species. Further 20 more species have been reported by Parag Ragnekar which are under consideration to be included in the published records. Odonates act as indicator species and studies focused on Odonates are crucial for maintaining a healthy ecosystem. Ragnekar and Naik 2014 stressed on the need for coordinated efforts from the Forest department and researchers to document the Odonate diversity of Goa.

Chapter II: Methodology

Study area

The study will be carried out in the protected area network of Netravali Wildlife Sanctuary (NWS) and Cotigao Wildlife Sanctuary (CWS) of Goa, India.

Cotigao Wildlife Sanctuary is located towards the south eastern border of the state within the Western Ghats ecosystems and was notified as Wildlife Sanctuary in 1958 (Naithani et al. 1997).

The topography of the sanctuary is largely flat, becoming undulated as it meets the Western Ghats. The sanctuary is surrounded by some of the highest hills in this region on the west, the Anshi National Park (Karnataka) to the southeast and the Netravali Wildlife Sanctuary to the Northwest. The sanctuary covers an area of 85.65 km² while large portions of the sanctuary show a forest crown density > 40%. The sanctuary is noted for its lofty tree cover, some trees attaining heights up to 20 m. This Sanctuary is known for thick and luxurious forest growth with many trees growing to a height of more than 30 meters (Alvaris, 2002). Forest of this sanctuary largely falls under the category of evergreen and it also supports semi-evergreen and moist deciduous trees. The undergrowth is mainly composed of the now familiar scourge, Eupatorium. The weed growth is particularly dense in the Eucalyptus and teak plantations (Alvaris, 2002).

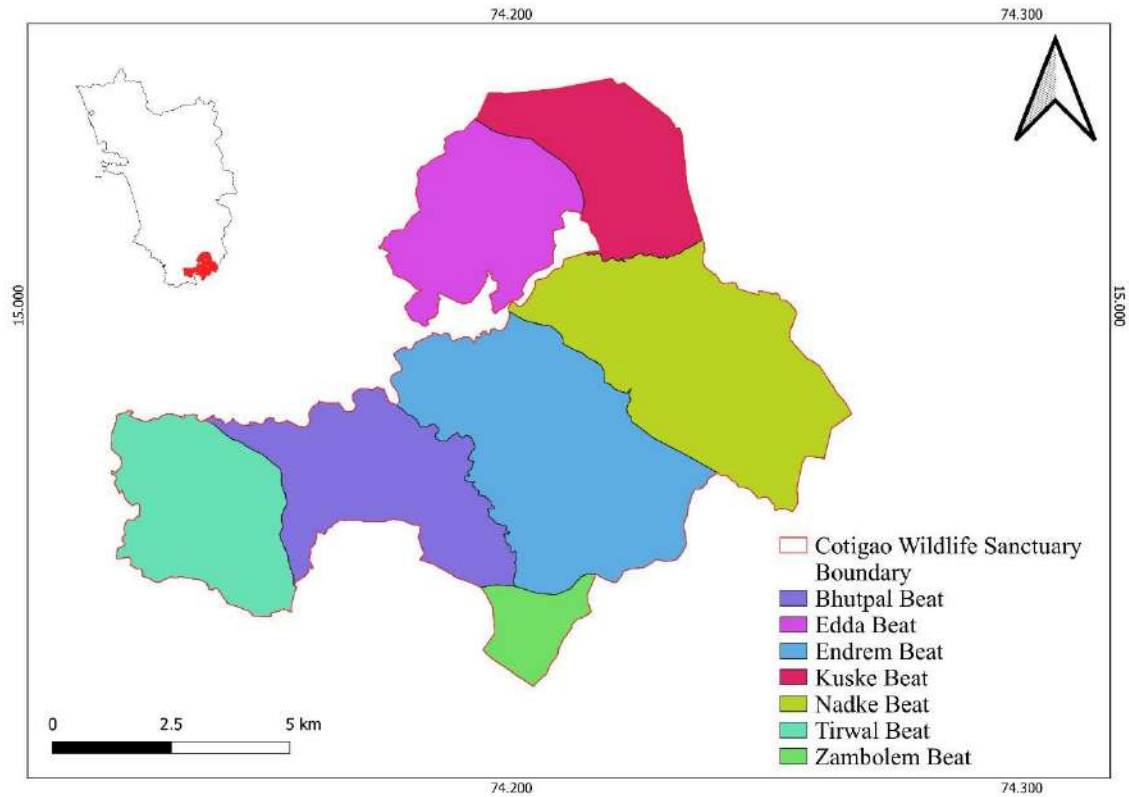


Figure 2: Beat map of Cotigao Wildlife Sanctuary

Cotigao Wildlife Sanctuary is divided into 7 beats; Tirwal, Bela, Endrem, Nadkem, Kuskem, Edda, Bhutpal and Zambolem (Figure 2, table 2). Majority of the beats are covered by Moist deciduous and Semi-evergreen Forest type. Tirwal, Edda, Nadke and Kuskem have moist deciduous forest types while Bhutpal, Zambolem and Endrem are dominated by semi-evergreen forests.

Cotigao Wildlife Sanctuary has a total area of 86.02 Sq. Km (Table 1) of which, 0.9 Sq. Km is agricultural land, 0.17 Sq. Km of land is human settlement, 1.62 Sq. Km of land is barren land, 0.9 Sq. Km of area is of plantation and major part is the forest cover *viz.* 83.29 Sq. Km of land (Figure 3, Table 1).

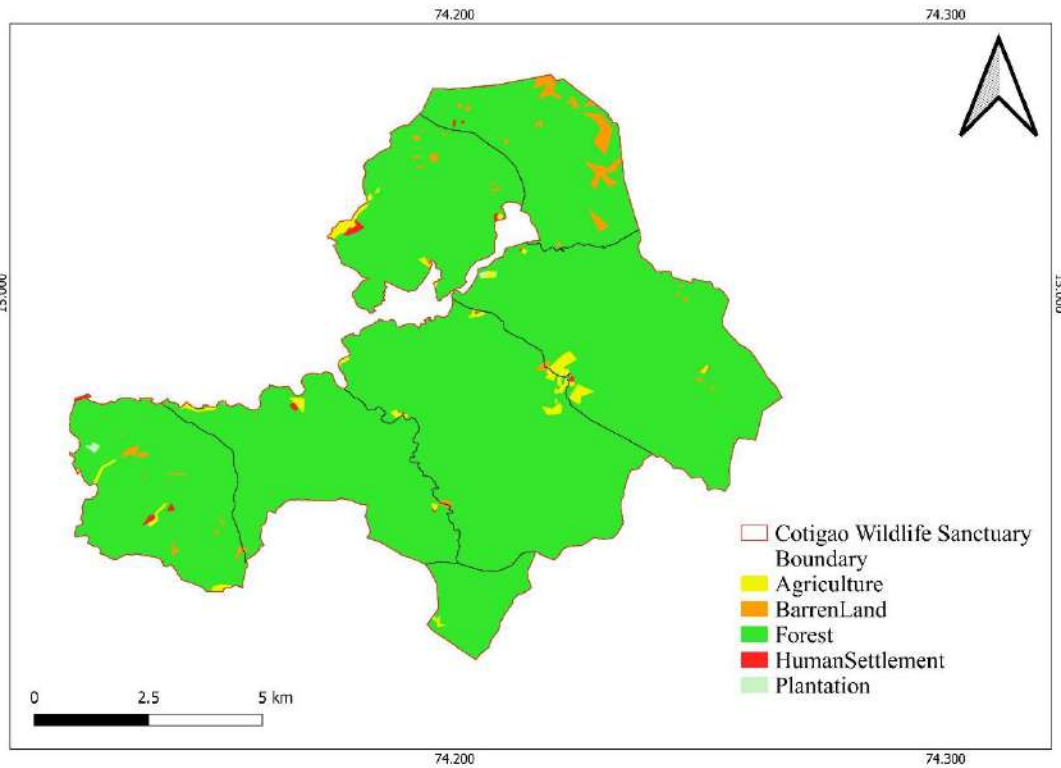


Figure 3: Land use and land cover map of Cotigao Wildlife Sanctuary

Netravali Wildlife Sanctuary is located in Sanguem taluka with a geographical area of 211.05 sq. kms. Natural Vegetation of this sanctuary mainly comprises of moist deciduous with a mix of semi-evergreen and evergreen forest (Nadaf 2019). Netravali Wildlife Sanctuary which is a vital component of Western Ghats is surrounded by Dandeli-Anshi Tiger Reserve of Karnataka on the east, Cotigao Wildlife Sanctuary, in the south and Mollem National Park and Bhagwan Mahaveer Sanctuary in north. Netravali Wildlife Sanctuary merges with Madei Wildlife Sanctuary, Bhimgad Wildlife Sanctuary of Karnataka (Nadaf 2019).

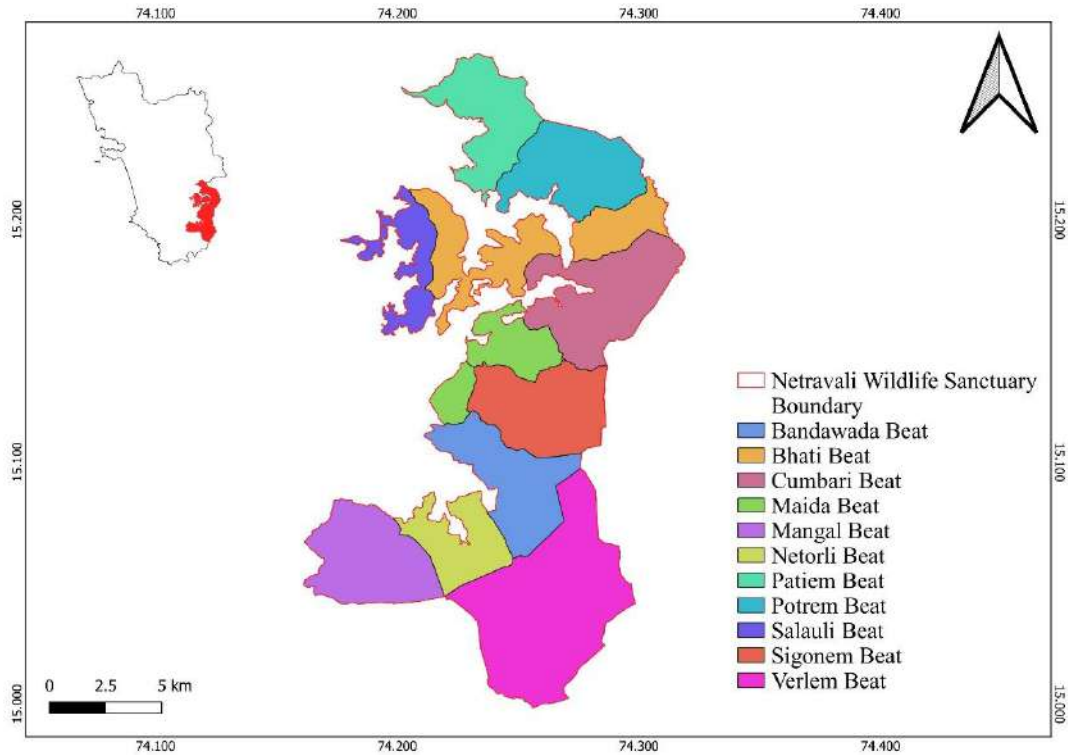


Figure 4: Beat map of Netravali Wildlife Sanctuary

Netravali Wildlife Sanctuary is divided into 13 beats; Mangaal, Neturlim, Verlem, Bandwada, Maida 1, Maida 2, Shigonem, Kumbari, Bhati 1, Bhati 2, Potrem, Salaulim and Patiem (Figure 4, Table 2). Major Forest type include Semi-evergreen Forest, Moist deciduous Forest, and Plantations. Semi-evergreen Forest patches are present in Mangaal, Neturlim, Verlem and Patiem. Bandwada, Maida, Shigonem, Bhati and Potrem have Moist Deciduous Forest patches while Plantations present in Salaulim beat (Figure 4).

Netravali Wildlife Sanctuary has a total area of 211.38 Sq. Km (Table 1) of which, 1.3 Sq. Km of land is agricultural land, 0.30 Sq. Km of land is human settlement, 3.44 Sq. Km of land is barren land, 0.55 Sq. Km of area is of plantation, 0.06 Sq. Km comprises of waterbody and 206.00 Sq. Km is a forest cover (Figure 5, Table 1).

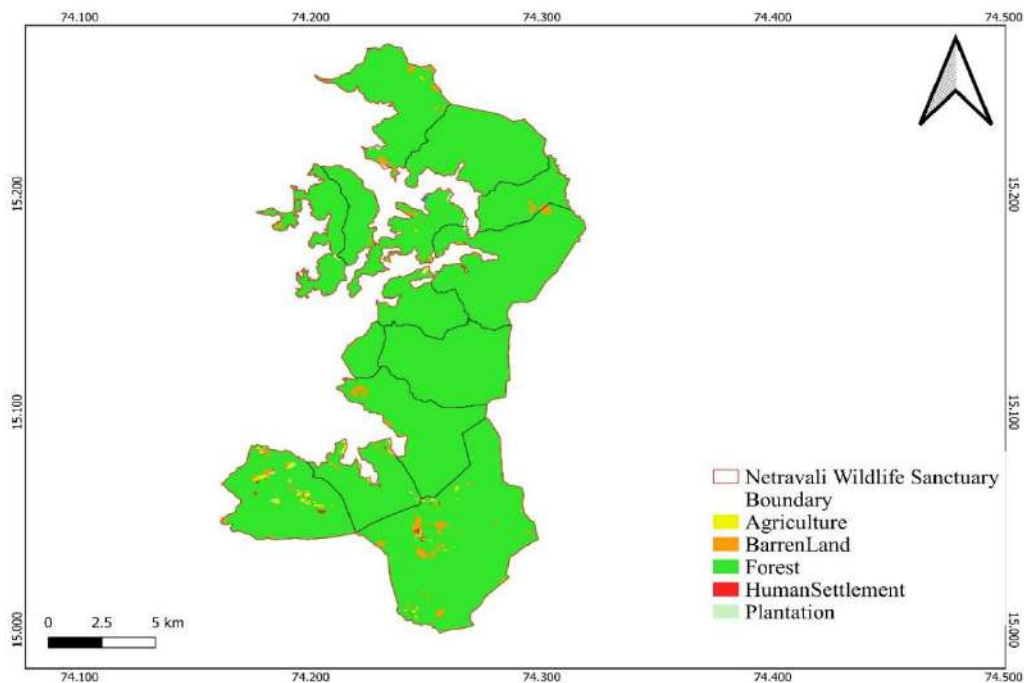


Figure 5: Land use and land cover map of Netravali Wildlife Sanctuary

Landuse type	Area (Sq. Km.)	
	CWS	NWS
Agriculture	0.93	1.03
Human Settlement	0.17	0.30
Forest	83.20	206.00
Barren land	1.62	3.44
Plantation	0.09	0.55
Waterbody	-	0.06
Total	86.02	211.38

Table 1: Table showing area of each landuse category in the study area

Sampling

The study was carried out from October 2022 to July 2023. Sampling was carried out by using both Visual encounter surveys method and Quadrant method (Burnham et al. 1981; Doan 2003; Anderson et al. 2015) during pre-monsoon (October – January), Monsoon (June – July) and post-monsoon (February – May). Surveying was carried out once in every month for the study tenure. Fixed transects of 1km in length were marked in NWS and CWS, having width of 50m on each side and height of 50m for birds and mammals. For amphibians, reptiles, odonates and lepidopterans same transects were surveyed but with a width of 10m on each side and height of 10m (suman et al. 2021). Birds were sampled using audio visual sampling method (Anderson et al.) along the line transects (Burnham et al.) lay. Mammals were surveyed using Visual encounter survey method, vocal call identification (Jones et al. 1996) and other indirect methods such as identification of dung and footprints (Lyra-Jorge et al. 2008). For amphibians, reptiles, odonates and butterflies Visual encounter survey method was employed (Crump 1994; Hutchens 2009). Diurnal surveys were carried out for Odonates and Lepidopterans, nocturnal surveys were carried out for amphibians and both were carried out for mammals, birds, reptiles. Data collection was based on the use of remotely set camera traps (CT), a non-invasive method that does not involve contact with the study species, nor interfere with their natural behaviour. Most CT inventories target wildlife-friendly sites, and are commonly placed towards wildlife trails in the Sanctuary, the choice of CT location relies on subjective criteria based on accessibility or expectations of wildlife occurrence. Along the 1km transect placed data pertaining to Aves (number of species and individuals) and mammals (number of species) was recorded till the end of the transect similarly while returning back data of amphibians, reptiles, odonates and lepidopterans (number of species and individuals), was recorded along the 1km transect. All the

sampling transacts were distributed in such a way that all the beat divisions of the study area get covered (Figure 6, 7)

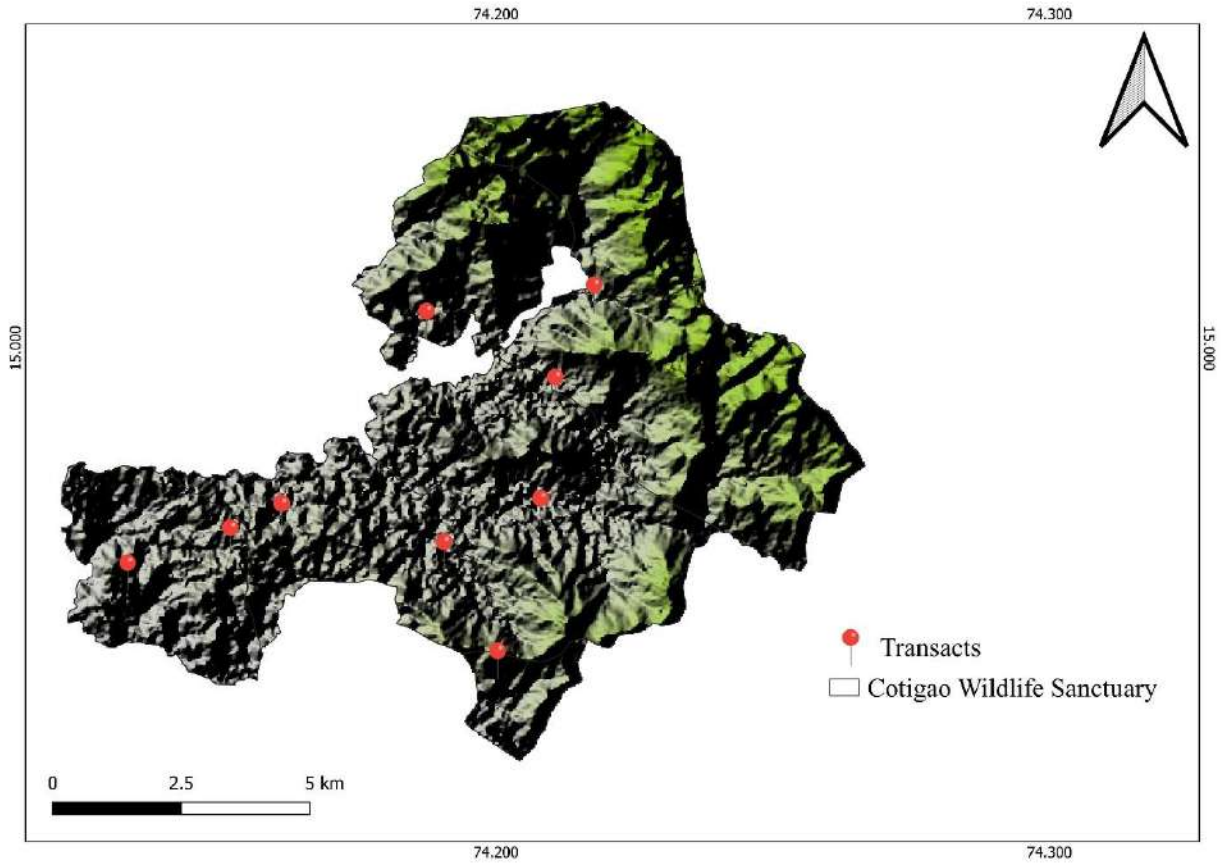


Figure 6: Map showing locations of sampling transacts in CWS

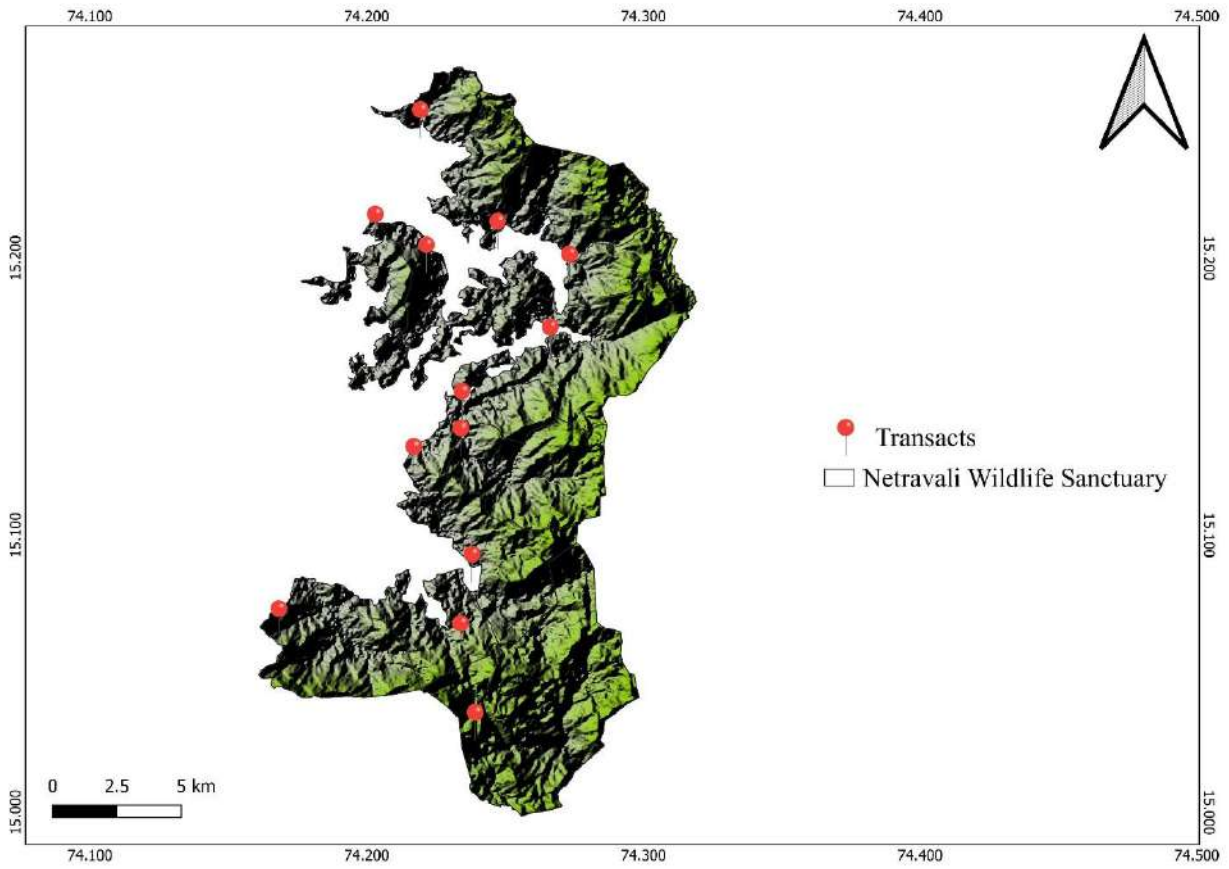


Figure 7: Map showing locations of sampling transects in NWS

NWS		CWS	
Transact number	Beat Name	Transact number	Beat Name
1	Verlem	1	Tirwal
2	Neturlim	2	Tirwal
3	Mangaal	3	Bhutpal
4	Bandwada	4	Bhutpal
5	Maida	5	Zambavlim
6	Sigonem	6	Endrem
7	Maida 2	7	Nadke
8	Cumari	8	Yeda
9	Bhati 2	9	Kuskem
10	Patiem		
11	Bhati 1		
12	Salaulim		
13	Potrem		

Table 2: Table showing locations of transacts laid in each beat of CWS and NWS

Keys for Identification

Identification and Confirmation of Avifaunal Species was carried out using field guides such as a “Checklist of the birds of Goa, India” by Baidya and Bhagat 2018, “The Book of Indian Birds” by Ali 1990, “A Pictorial Guide to the Birds of the Indian Subcontinent 2nd Edition” by Ali et al. 1996 and “The Birds of the Indian Subcontinent” by Richard Grimmet, Carl Inskipp and Tim Inskipp. Similarly, Identification of Lepidoptera’s was carried out using field guides such as “Butterflies of Western Ghats” by Kasambe 2018, “Photographic guide to butterflies of Goa” by Rangnekar and Borkar 2007 and “A Guide to Butterflies of Western Ghats India” by Bhakare and Ogale 2018. Identification of Mammals was carried out using field guides such as “A checklist of mammals of India with their distribution and conservation status” by Sharma et al. 2015 and “Field guide to Indian mammals” by Menon and Daniel 2003. Identification of Amphibians was carried out using field guide such as “Pictorial guide to frogs and toads of the

Western Ghats” by Gururaja 2012. Identification of Reptiles was carried out using field guide such as “Snakes of India” by Whitaker et al. 2004. Identification of Odonates was carried out using field guides such as “Additions to the Odonata (Insecta) of Goa” by Rangnekar et al. 2010.

Calculations

Shannon Diversity Index: It is sometimes called the Shannon-Wiener Index, is a way to measure the diversity of species in a community. Denoted as H , this index is calculated as:

$$H = -\sum p_i * \ln(p_i)$$

where:

Σ : A Greek symbol that means “sum”

\ln : Natural log

p_i : The proportion of the entire community made up of species i

The higher the value of H , the higher the diversity of species in a particular community. The lower the value of H , the lower the diversity. A value of $H = 0$ indicates a community that only has one species.

Simpson's Index (D): It measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species). The value of D ranges between 0 and 1. With this index, 1 represents infinite diversity and 0, no diversity. That is, the bigger the value of D , the higher the diversity. D is calculated using following formula

$$D = \sum (n / N)^2$$

Simpson's Index of Diversity = $1 - D$

where,

Σ : A Greek symbol that means “sum

n = the total number of organisms of a particular species

N = the total number of organisms of all species

D = Simpsons diversity index

Precautions

Precautions were followed to avoid disturbance to the habitat. Littering, damage to plants in any way like breaking of stems, plucking leaves, or uprooting the plant was not done. Slow walking along the transect with steady pace was maintained for observing and counting of the fauna. Same route was followed every time the survey was undertaken. To prevent any bias results stoppages along the transects were avoided. Precautionary measures like wearing full sleeves and track pants to protect ourselves from ticks. Wearing camouflaging and avoiding bright coloured clothes was practiced.

Chapter III: Results and Discussion

Cotigao Wildlife sanctuary

Mammals:

A total of 20 species of mammals were recorded in the CWS. Amongst the species recorded three species are listed as Near Threatened category viz. *Loris lydekkerianus*, *Panthera pardus*, *Ratufa indica* three species in Vulnerable category viz. *Loris lydekkerianus*, *Panthera pardus*, *Ratufa indica* and two species in Endangered category *Cuon alpinus*, *Manis crassicaudata* of IUCN red list (Table 3). The highest number of species of Mammals in CWS were observed in Pre – monsoon and the lowest number of species were in Monsoon (Figure 8, Table 10). Pre-monsoon and post-monsoon the indirect evidences stays intact, while in monsoon season the indirect evidences gets washed off, this can be the reason for low diversity in monsoon. The highest number of species of mammals were found in transact number 4 and the lowest were found in transact number 5 (Figure 9, Table 9). The transacts with high species richness can be used to promote eco-tourism in the sanctuary.

Sr. No.	Common Name	Scientific Name	Family	Order	IUCN	WPA Status
1	Bonnet Macaque	<i>Macaca radiata</i>	Cercopithecidae	Primata	LC	Schedule II
2	Malabar Gray Langur	<i>Semnopithecus hypoleucos</i>	Cercopithecidae	Primata	LC	Schedule II
3	Grey Slender Loris	<i>Loris lydekkerianus</i>	Lorisidae	Primata	NT	Schedule I
4	Sambar Deer	<i>Rusa unicolor</i>	Cervidae	Artiodactyla	VU	Schedule III
5	Spotted Deer	<i>Axis axis</i>	Cervidae	Artiodactyla	LC	Schedule III
6	Barking Deer	<i>Muntiacus muntjak</i>	Cervidae	Artiodactyla	LC	Schedule II

7	Indian Chevrotain	<i>Moschiola indica</i>	Tragulidae	Artiodactyla	LC	Schedule I
8	Gaur	<i>Bos gaurus</i>	Bovidae	Artiodactyla	VU	Schedule I
9	Indian Wild Boar	<i>Sus scrofa</i>	Suidae	Artiodactyla	LC	Schedule III
10	Common Leopard	<i>Panthera pardus</i>	Felidae	Carnivora	NT	Schedule I
11	Small Indian Civet	<i>Viverricula indica</i>	Viverridae	Carnivora	LC	Schedule II
12	Rudy Mongoose	<i>Erva smithii</i>	Herpestidae	Carnivora	LC	Schedule II
13	Sloth Bear	<i>Melurus ursinus</i>	Ursidae	Carnivora	VU	Schedule I
14	Dhole	<i>Cuon alpinus</i>	Canidae	Carnivora	EN	Schedule II
15	Indian Pangolin	<i>Manis crassicaudata</i>	Manidae	Pholidota	EN	Schedule I
16	Indian Crested Porcupine	<i>Hystrix indica</i>	Hystriidae	Rodentia	LC	Schedule IV
17	Indian Giant Flying Squirrel	<i>Petaurista philippensis</i>	Sciuridae	Rodentia	LC	Schedule II
18	Malabar Giant Squirrel	<i>Ratufa indica</i>	Sciuridae	Rodentia	NT	Schedule II
19	Three-striped Palm Squirrel	<i>Funambulus palmarum</i>	Sciuridae	Rodentia	LC	Unlisted
20	Indian Gerbil	<i>Tatera indica</i>	Muridae	Rodentia	LC	Unlisted

Table 3: Checklist of Mammals in CWS

NT: Near Threatened, VU: Vulnerable, EN: Endangered, LC: Least Concern

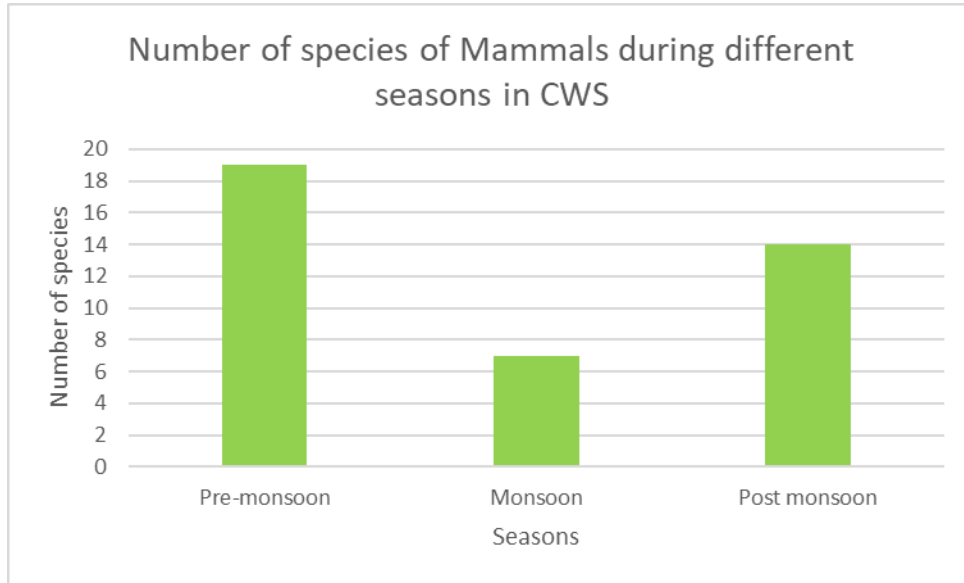


Figure 8: Graph showing number of species of Mammals during different seasons in CWS

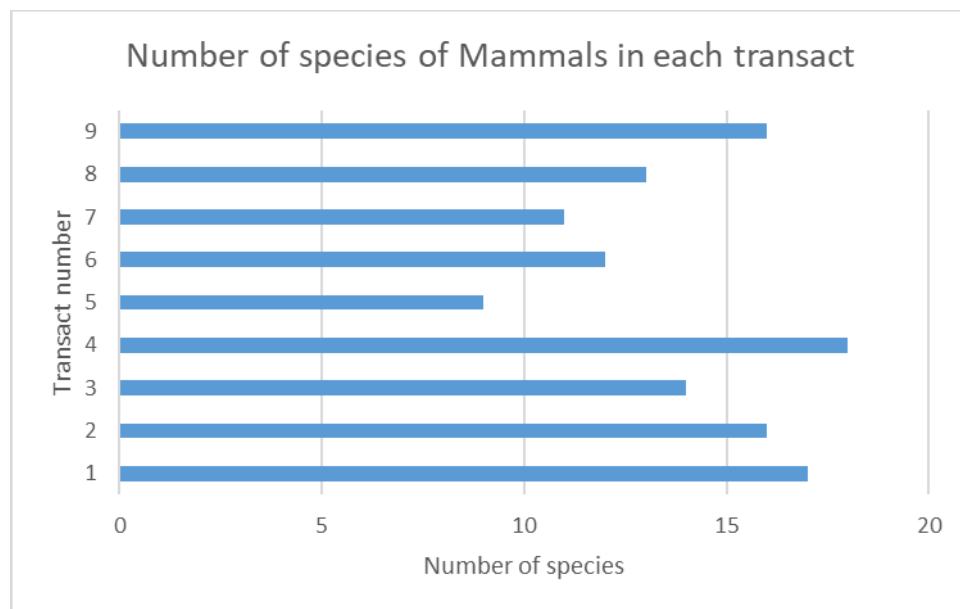


Figure 9: Graph showing number of species of Mammals in each transact in CWS

Aves:

A total of 104 species of Aves were recorded in CWS. Amongst the species recorded 10 species were Endemic to the western ghats of India, while one species was listed under Vulnerable category viz. *Columba elphinstonii* and two species were listed under Near Threatened category viz. *Anthracoceros albirostris*, *Brachypodius priocephalus* of the IUCN red list (Table 4). Eight species were listed as scheduled species under Wildlife protection act, India (Table 4). The highest number of species of Aves in CWS were recorded in Pre – monsoon and the lowest number of species were recorded in Monsoon (Figure 10, Table 10). The highest number of individuals of Aves were recorded in Pre – monsoon and the lowest was recorded in Monsoon (Figure 11, Table 10). The highest number of species of Aves were recorded in transact number 8 and the lowest were recorded in transact number 6 (Figure 12, Table 9). Transact number 4 recorded the highest number of individuals of Aves while, transact number 6 had the lowest (Figure 13, Table 9).

Sr. No	Order	Family	Common Name	Scientific Name	IUCN	WPA status
1	Galliformes	Phasianidae	Indian Peafowl	<i>Pavo cristatus</i>		X
2		Phasianidae	Grey Junglefowl	<i>Gallus sonneratii</i>		
3	Columbiformes	Columbidae	Nilgiri Wood Pigeon	<i>Columba elphinstonii*</i>	VU	
4			Spotted Dove	<i>Spilopelia chinensis</i>		
5			Grey-fronted Green Pigeon	<i>Terron affinis</i>		
6			Emerald Dove	<i>Chalcophaps indica</i>		
7			Green Imperial Pigeon	<i>Ducula aenea</i>		
8			Mountain Imperial Pigeon	<i>Ducula badia*</i>		

9			Oriental Turtle Dove	<i>Streptopelia orientalis</i>		
10	Caprimulgiformes	Caprimulgidae	Jungle Nightjar	<i>Caprimulgus indicus</i>		
12		Apopidae	Crested Treeswift	<i>Hemiprocne coronata</i>		
13	Cuculiformes	Cuculidae	Greater Coucal	<i>Centropus sinensis</i>		
14			Blue-faced Malkoha	<i>Phaenicophaeus viridirostris</i>		
15			Asian Koel	<i>Eudynamis scolopaceus</i>		
16			Eurassian Cuckoo	<i>Cuculus stauratus</i>		
17	Ciconiiformes	Ciconiidae	Asian Openbill	<i>Anastomus oscitans</i>		
18	Pelecaniformes	Ardeidae	Cattle Egret	<i>Bubulcus ibis</i>		
19	Accipitriformes	Accipitridae	Oriental Honey Buzzard	<i>Pernis ptilorhynchus</i>		X
20			Crested Serpent Eagle	<i>Spilornis cheela</i>		X
21			Changeable Hawk-eagle	<i>Nisaetus cirrhatus</i>		X
22			Shikra	<i>Accipiter badius</i>		X
23			Brahminy Kite	<i>Haliastur indus</i>		X
24	Strigiformes	Strigidae	Oriental Scops Owl	<i>Otus sunia</i>		
25			Brown Wood Owl	<i>Strix leptogrammica</i>		
26			Brown Fish Owl	<i>Ketupa zeylonensis</i>		
27	Trogoniformes	Trogonidae	Malabar Trogon	<i>Harpactes fasciatus</i>		
28	Bucerotiformes	Bucerotidae	Malabar Pied Hornbill	<i>Anthracoceros albirostris</i>	NT	X
29			Malabar Grey Hornbill	<i>Ocyrceros grisues*</i>		X
30		Upupidae	Common Hoopoe	<i>Upupa epops</i>		
31	Piciformes	Picidae	Speckled Piculet	<i>Picumnus innominatus</i>		
32			Heart-spotted Woodpecker	<i>Hemicircus canente</i>		
33			Greater Flameback	<i>Chrysocolaptes guttacristatus</i>		
34			Black-rumped Flameback	<i>Dinopium benghalense</i>		
35			Rufous Woodpecker	<i>Micropternus brachyurus</i>		
36			White-bellied	<i>Dryocopus javensis</i>		

			Woodpecker		
37		Ramphastidae	White-cheeked Barbet	<i>Magalaima viridis</i>	
38			Malabar Barbet	<i>Psilopogon malabaricus*</i>	
39			Coppersmith Barbet	<i>Psilopogon haemacephalus</i>	
40	Coraciiformes	Meropidae	Green Bee-eater	<i>Merops orientalis</i>	
41			Chestnut-headed bee-eater	<i>Merops leschenaulti</i>	
42			Blue-tailed Bee-eater	<i>Merops philippinus</i>	
43		Alcedinidae	Blue-eared Kingfisher	<i>Alcedo meninting</i>	
44			White-throated Kingfisher	<i>Halcyon smyrnensis</i>	
45			Oriental Dwarf Kingfisher	<i>Ceyx erithaca</i>	
46	Psittaciformes	Psittaculidae	Rose-ringed Parakeet	<i>Psittacula krameri</i>	
47			Vernal Hanging Parrot	<i>Loriculus vernalis</i>	
48	Passeriformes	Pittidae	Indian Pitta	<i>Pitta brachyura</i>	
49		Campephagidae	Small Minivet	<i>Pericrocotus cinnamomeus</i>	
50			Orange Minivet	<i>Pericrocotus flammeus</i>	
51		Oriolidae	Black-hooded Oriole	<i>Oriolus xanthonus</i>	
52			Indian Golden Oriole	<i>Oriolus kundoo</i>	
53		Vangidae	Malabar Woodshrike	<i>Tephrodornis sylvicola*</i>	
54			Common Woodshrike	<i>Tephrodornis pondicerianus</i>	
55		Dicruridae	Ashy Drongo	<i>Dicrurus leucophaeus</i>	
56			Bronzed Drongo	<i>Dicrurus aeneus</i>	
57			Hair-crested Drongo	<i>Dicrurus hottentottus</i>	
58			Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>	
59		Rhipiduridae	White-browed Fantail	<i>Rhipidura aureola</i>	

60		Corvidae	Rufous Treepie	<i>Dendrocitta vagabunda</i>		
61			House Crow	<i>Corvus splendens</i>		
62			Large-billed Crow	<i>Corvus macrorhynchos</i>		
63		Monarchidae	Black-naped Monarch	<i>Hypothymis azurea</i>		
64			Indian Paradise Flycatcher	<i>Terpsiphone paradisi</i>		
65		Dicaeidae	Thick-billed Flowerpecker	<i>Dicaeum agile</i>		
66			Nilgiri Flowerpecker	<i>Dicaeum concolor*</i>		
67		Nectariniidae	Little Spiderhunter	<i>Arachnothera longirostra</i>		
68			Crimson-backed Sunbird	<i>Leptocoma minima</i>		
69			Purple Sunbird	<i>Cinnyris asiaticus</i>		
70		Irenidae	Asian Fairy-bluebird	<i>Irena puella</i>		
71		Chloropseidae	Jerdon's Leafbird	<i>Chloropsis jerdoni</i>		
72		Estrildidae	White-rumped munia	<i>Lonchura striata</i>		
73		Motacillidae	Forest Wagtail	<i>Dendronanthus indicus</i>		
74		Cisticolidae	Ashy Prinia	<i>Prinia socialis</i>		
75			Common Tailorbird	<i>Orthotomus sutorius</i>		
76		Acrocephalidae	Blyth's Reed Warbler	<i>Acrocephalus dumetorum</i>		
77		Hirundinidae	Red-rumped swallow	<i>Cecropis daurica</i>		
78		Pycnonotidae	Square-tailed Bulbul	<i>Hypsipetes ganeesa</i>		
79			Flame-throated Bulbul	<i>Rubigula gularis*</i>		
80			Red Whiskered Bulbul	<i>Pycnonotus jocosus</i>		
81			Red-vented Bulbul	<i>Pycnonotus cafer</i>		
82			Grey-headed Bulbul	<i>Brachypodius priocephalus*</i>	NT	
83			Yellow-browed Bulbul	<i>Acritillas indica</i>		

84		Phylloscopidae	Green Warbler	<i>Phylloscopus nitidus</i>		
85			Greenish Warbler	<i>Phylloscopus trochiloides</i>		
86			Large-billed Leaf Warbler	<i>Phylloscopus magnirostris</i>		
87		Timaliidae	Dark-fronted Babbler	<i>Dumetia atriceps</i>		
88			Puff-throated Babbler	<i>Pellorneum ruficeps</i>		
89		Leiothrichidae	Rufous Babbler	<i>Turdoides subrufa</i>		
90			Jungle Babbler	<i>Turdoides striata*</i>		
91		Alcippeidae	Brown-cheeked Fulvetta	<i>Alcippe poioicephala</i>		
92		Sittidae	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>		
93		Sturnidae	Malabar Starling	<i>Sturnia blythi</i>		
94		Muscicapidae	Indian Robin	<i>Copsychus fulicatus</i>		
95			Oriental Magpie Robin	<i>Copsychus saularis</i>		
96			White-rumped Shama	<i>Copsychus malabaricus</i>		
97			White-bellied blue Flycatcher	<i>Cyornis pallipes*</i>		
98			Tickell's Blue Flycatcher	<i>Cyornis tickelliae</i>		
99			Verditer Flycatcher	<i>Eumyias thalassinus</i>		
100			Indian Blue Robin	<i>Luscinia brunnea</i>		
101			Blue-caped Rock Thrush	<i>Monticola cinclorhyncha</i>		
102			Malabar Whistling Thrush	<i>Myophonus horsfieldii</i>		
103			Taiga Flycatcher	<i>Ficedula albicilla</i>		
104		Turdidae	Orange-headed Thrush	<i>Geokichla citrina</i>		

Table 4: Checklist of Aves in CWS

*Endemic to Western Ghats, NT: Near Threatened, VU: Vulnerable

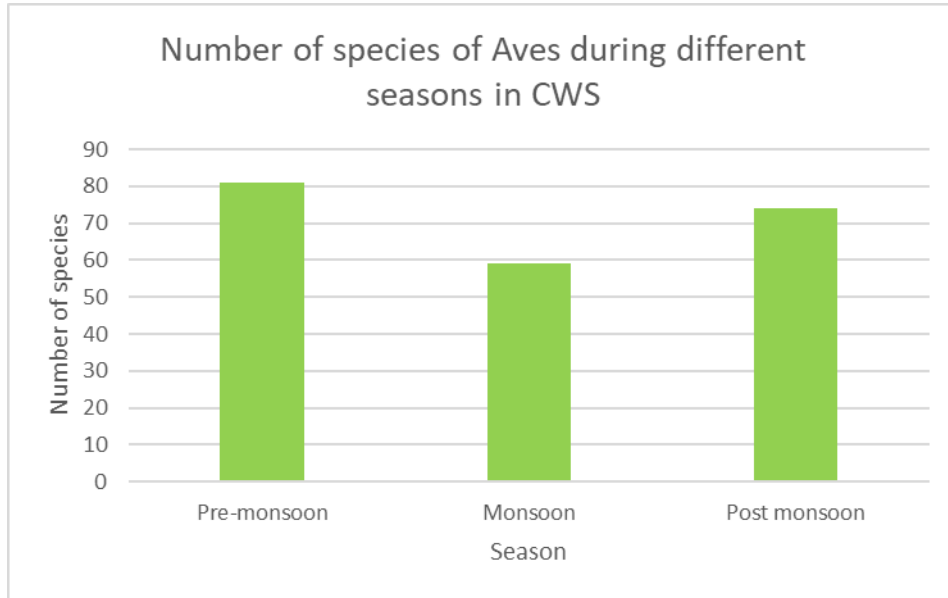


Figure 10: Graph showing number of species of Aves during different seasons in CWS

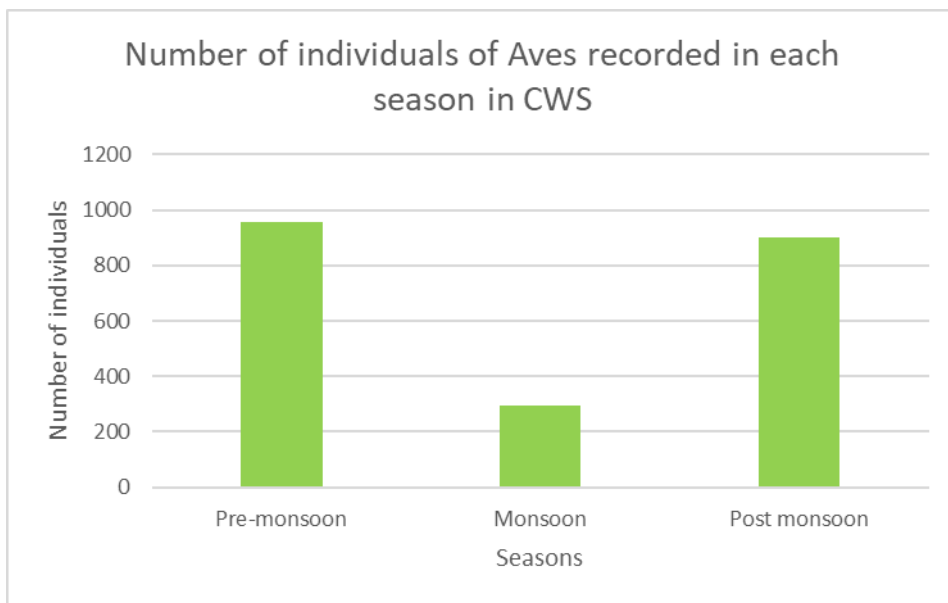


Figure 11: Graph showing number of individuals of Aves during different seasons in CWS

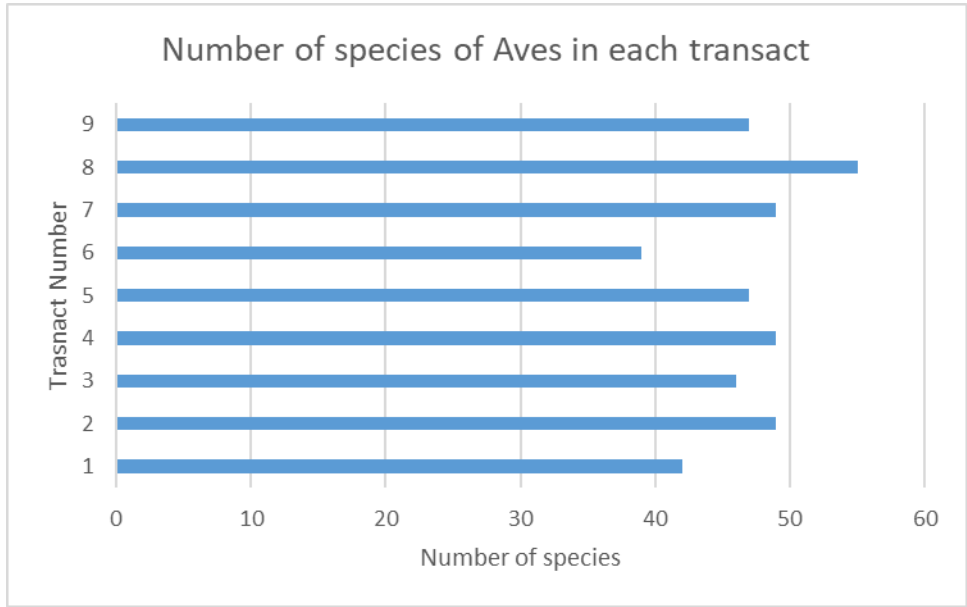


Figure 12: Graph showing number of species of Aves in each transect in CWS

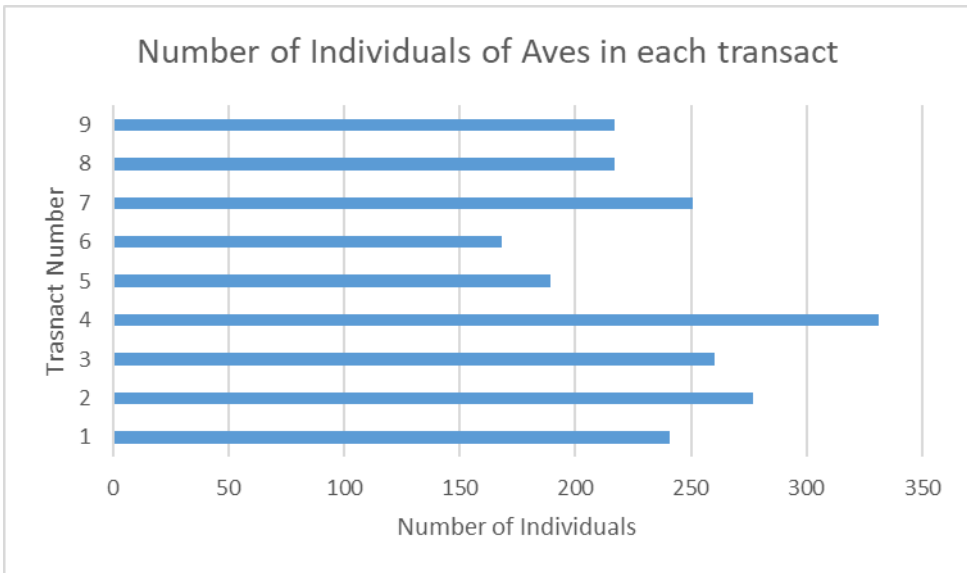


Figure 13: Graph showing number of individuals of Aves in each transect in CWS

Reptiles:

A total of 20 species of Reptiles were observed in CWS (Table 5). Highest number of species were recorded in Monsoon season while lower number of species were recorded in pre-monsoon and post-monsoon with almost negligible difference in number of species (Figure 14, Table 10). Monsoon is considered a breeding time for many of the reptiles and hence highest diversity was observed during monsoon. Also, certain reptiles need moisture, and feed on certain species which are active during monsoon and hence aids to the diversity during the season. The highest number of individuals were recorded in Pre-monsoon and the lowest was recorded in Monsoon season (Figure 15, Table 10). These findings are opposite to the findings with respect to the number of species recorded during each season. The highest number of species of Reptiles were recorded in transact number 8 and the lowest were recorded in transact number 6 (Figure 16, Table 9). Transact number 4 recorded the highest number of individuals of Reptiles while, transact number 6 had the lowest (Figure 17, Table 9). The transacts with highest species richness of reptiles can be used for eco-tourism purpose.

Sr.No	Family	Common Name	Scientific Name
1	Scincidae	Bronze Mabuya	<i>Eutropis macularia</i>
2	Scincidae	Keeled Indian Mabuya	<i>Eutropis carinata</i>
3	Gekkonidae	Goan Day Gecko	<i>Cnemaspis goaensis</i>
4	Gekkonidae	Termite Hill Gecko	<i>Hemidactylus triedrus</i>
5	Gekkonidae	Deccan Banded Gecko	<i>Cyrtodactylus deccanensis</i>
6	Boidae	Whitaker's Boa	<i>Eryx whitakeri</i>
7	Agamidae	Oriental Garden Lizard	<i>Calotes versicolor</i>
8	Agamidae	Roux's Forest Lizard	<i>Monilesaurus rouxii</i>
9	Agamidae	Southern Flying Lizard	<i>Draco dussumieri</i>
10	Colubridae	Checkedred Keelback	<i>Xenochrophis piscator</i>
11	Colubridae	Buff-striped Keelback	<i>Amphiesma stolatum</i>
12	Colubridae	Forsten's Cat Snake	<i>Boiga forsteni</i>
13	Colubridae	Indian Rat Snake	<i>Ptyas mucosa</i>

14	Colubridae	Green Vine Snake	<i>Ahaetulla borealis</i>
15	Colubridae	Bronzeback Tree Snake	<i>Dendrelaphis tristis</i>
16	Colubridae	Giri's Bronzeback Tree Snake	<i>Dendrelaphis giri</i>
17	Colubridae	Banded Racer	<i>Argyrogena fasciolata</i>
18	Viperidae	Malabar Pit Viper	<i>Craspedocephalus malabaricus</i>
19	Varanidae	Bengal Monitor Lizard	<i>Varanus bengalensis</i>
20	Viperidae	Hump Nosed Pit Viper	<i>Hypnale hypnale</i>

Table 5: Checklist of Reptiles in CWS

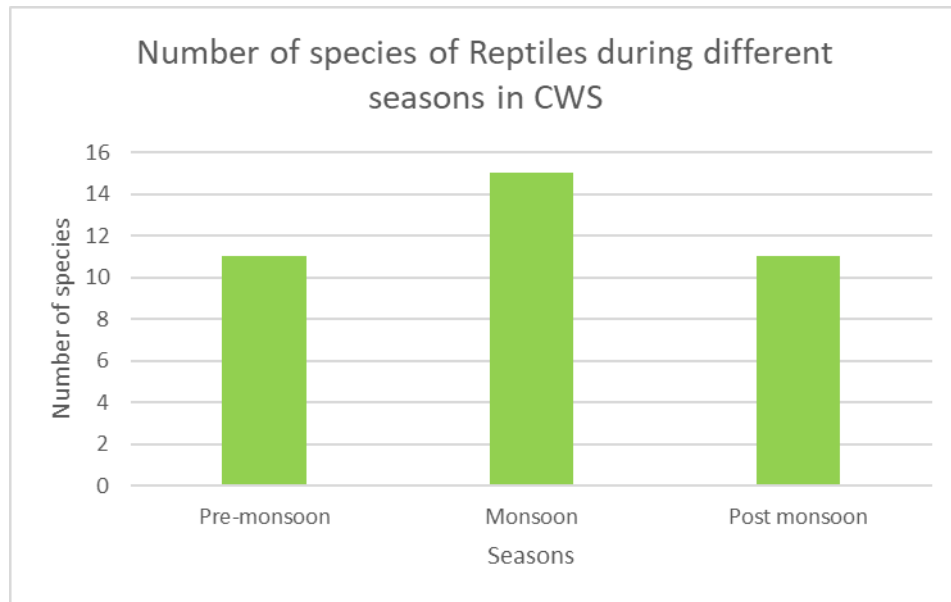


Figure 14: Graph showing number of species of Reptiles during different seasons in CWS

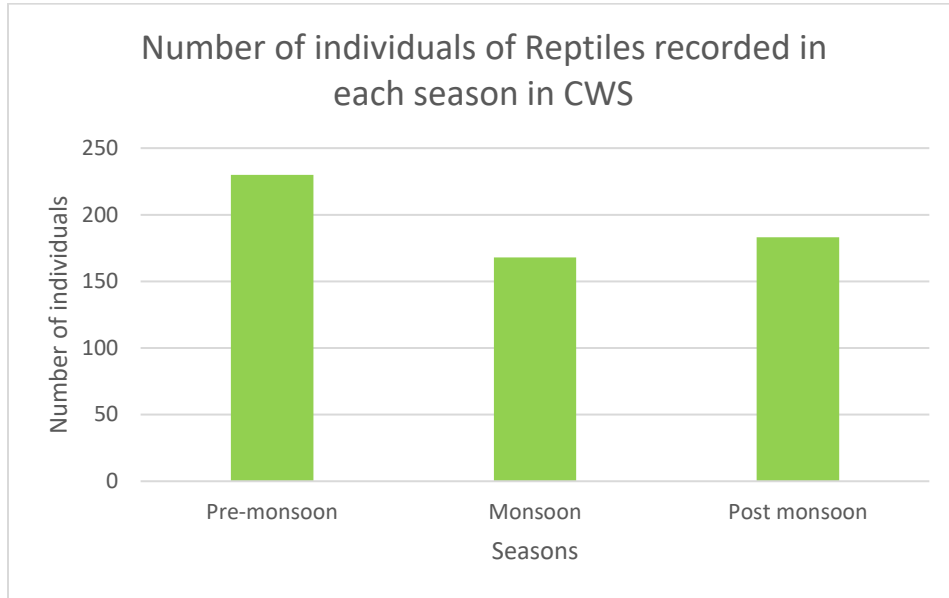


Figure 15: Graph showing number of individuals of Reptiles during different seasons in CWS

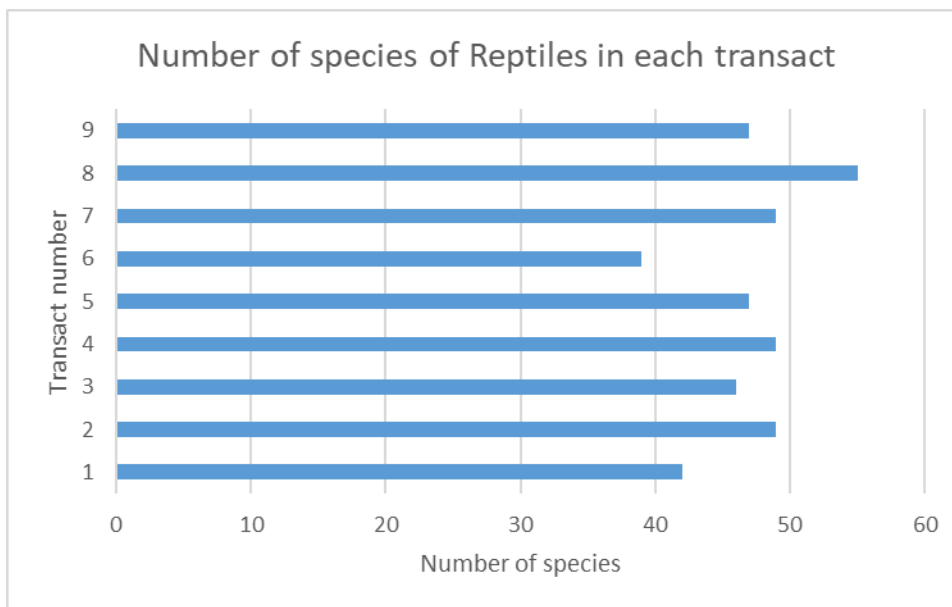


Figure 16: Graph showing number of species of Reptiles in each transact in CWS

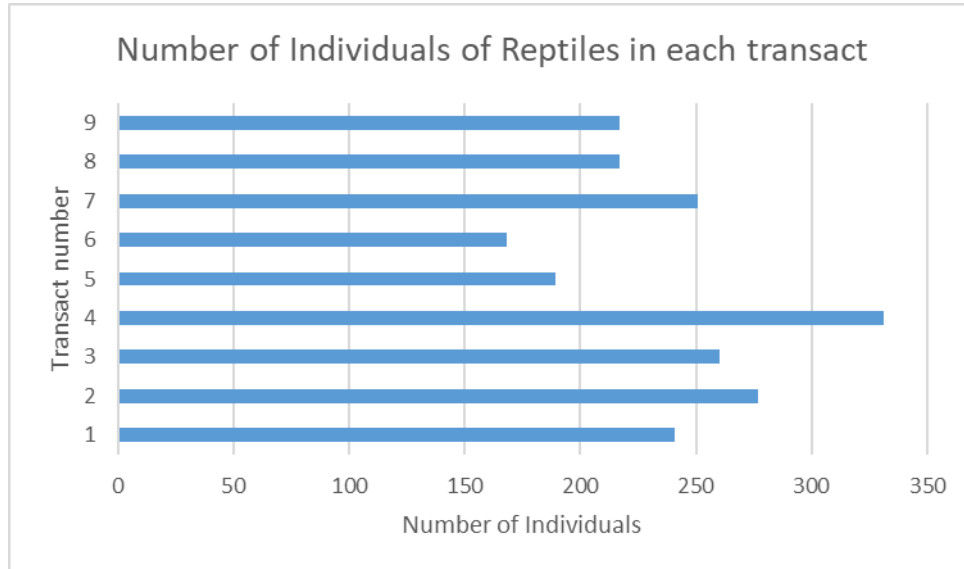


Figure 17: Graph showing number of individuals of Reptiles in each transact in CWS

Amphibians:

A total of 19 species of amphibians were recorded in CWS. Amongst the recorded species two species were listed under Near threatened category viz. *Clinotarsus curtipes*, *Indosylvirana temporalis* one was listed under Critically Endangered category viz. *Pseudophilautus amboli* one was listed under Vulnerable category viz. *Philautus bombayensis* and one was listed under Endangered category viz. *Pedostibes tuberculosus* of IUCN red list (Table 6). The highest number of species of Amphibians in CWS were recorded in Monsoon season while in pre-monsoon and post-monsoon season it was the lowest (Figure 18, Table 10). The highest number of individuals of Amphibians were recorded in Monsoon, followed by post-monsoon and the lowest was recorded in Pre- Monsoon (Figure 19, Table 10). This is since amphibians need moisture (rain) to carry out their life processes and only in monsoon they come in open to do that. Rest of the time the amphibian species either estivate or stay hidden to moist places and limit their activity, this reduces the spotting skill of field workers to spot them during pre-monsoon and post-monsoon. The highest number of species of Amphibians were recorded in

transact number 8 and the lowest were recorded in transact number 6 (Figure 20, Table 9). Transact number 3 recorded the highest number of individuals of Amphibians while, transact number 8 had the lowest (Figure 21, Table 9). The transacts with highest species richness of Amphibians can be used for eco-tourism purpose.

Sr No	Order	Family	Common Name	Scientific name	IUCN
1	Anura	Rhacophoridae	Amboli Bush Frog	<i>Pseudophilautus amboli</i>	CR
2	Anura	Rhacophoridae	Bombay Bush Frog	<i>Philautus bombayensis</i>	VU
3	Anura	Rhacophoridae	Indian Tree Frog	<i>Polypedates maculatus</i>	LC
4	Anura	Rhacophoridae	Malabar Gliding Frog	<i>Rhacophorus malabricus</i>	LC
5	Anura	Ranidae	Bicolored Frog	<i>Clinotarsus curtipes</i>	NT
6	Anura	Ranidae	Fungoid Frog	<i>Hydrophylax malabaricus</i>	LC
7	Anura	Ranidae	Bronzed Frog	<i>Indosylvirana temporalis</i>	NT
8	Anura	Nyctibatrachidae	Night Frog	<i>Nyctibatrachus spp.</i>	
9	Anura	Bufo	Asian Common Toad	<i>Duttaphrynus melanostictus</i>	LC
10	Anura	Bufo	Malabar Tree Toad	<i>Pedostibes tuberculosus</i>	EN
11	Anura	Ranixalidae	Netravali Leaping Frog	<i>Indirana salelakri</i>	
12	Anura	Ranixalidae	Amboli Leaping Frog	<i>Indirana chiravasi</i>	
13	Anura	Dicroglossidae	Reddish Burrowing Frog	<i>Minnervarya rufescens</i>	LC
14	Anura	Dicroglossidae	Indian Bullfrog	<i>Hoplobatrachus tigrinus</i>	LC
15	Anura	Dicroglossidae	Indian Burrowing Frog	<i>Sphaerotheca breviceps</i>	LC
16	Anura	Dicroglossidae	Common Skittering Frog	<i>Euphlyctis cyanophlyctis</i>	LC
17	Anura	Microhylidae	Indian Balloon Frog	<i>Uperodon globulosus</i>	LC
18	Anura	Microhylidae	Ornate Narrow-mouthed Frog	<i>Microhyla ornata</i>	LC
19	Gymnophiona	Ichthyophidae	Bombay Caecilian	<i>Ichthyophis bombayensis</i>	

Table 6: Checklist of Amphibians in CWS

NT: Near Threatened, VU: Vulnerable, EN: Endangered, LC: Least Concern, CR: Critically Endangered

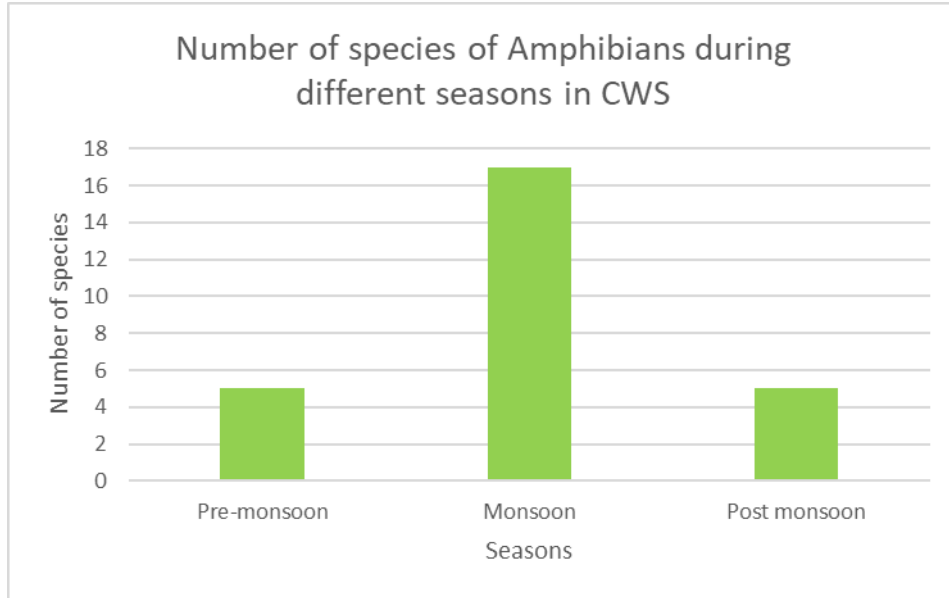


Figure 18: Graph showing number of species of Amphibians during different seasons in CWS

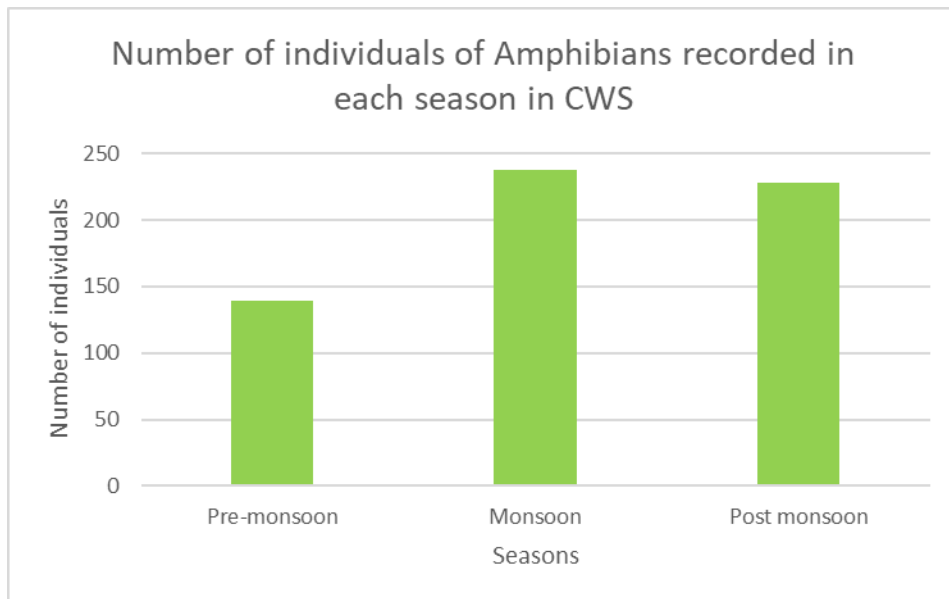


Figure 19: Graph showing number of individuals of Amphibians during different seasons in CWS

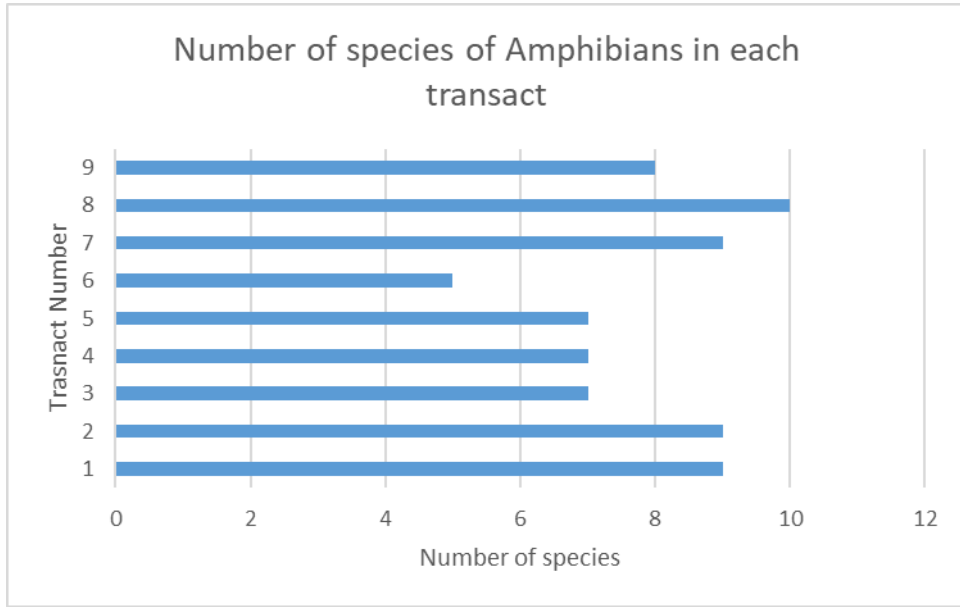


Figure 20: Graph showing number of species of Amphibians in each transect in CWS

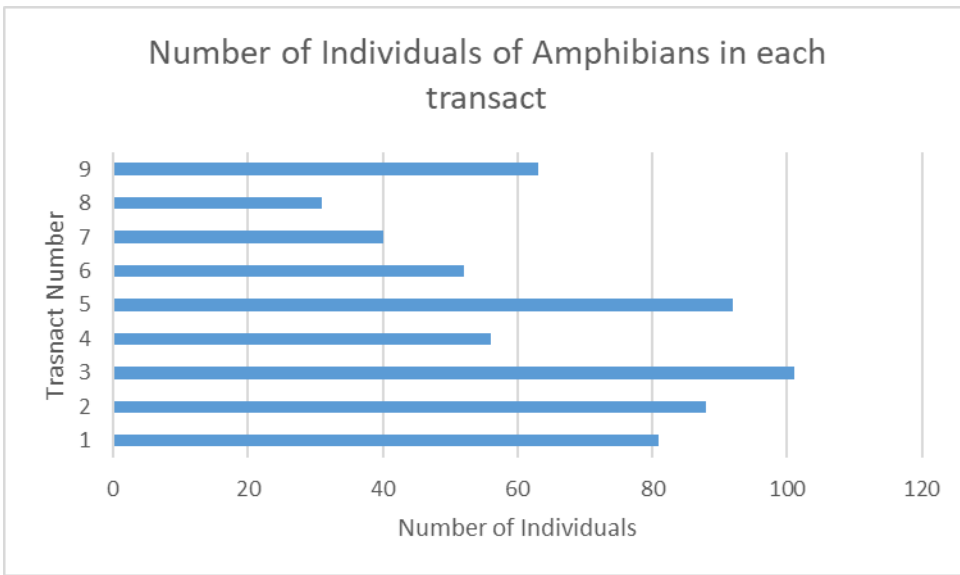


Figure 21: Graph showing number of Individuals of Amphibians in each transect in CWS

Lepidoptera:

A total of 96 species of lepidoptera were recorded in CWS (Table 7). Highest number of species of Lepidoptera were recorded in Pre-Monsoon season and the lowest recorded was in post-monsoon (Figure 22, Table 10). The highest number of individuals of Lepidoptera were in Pre-monsoon and the lowest was in Monsoon season (Figure 23, Table 10). This might have happened due to the fact that extended rains were lashed during onset of post-monsoon season. The highest number of species of Lepidoptera were recorded in transact number 8 and the lowest were recorded in transact number 9 (Figure 24, Table 9). Transact number 1 recorded the highest number of individuals of Lepidoptera while, transact number 5 had the lowest (Figure 25, Table 9). The transacts with highest species richness of Lepidopterans can be used to promote eco-tourism in the sanctuary.

Sr.No.	Family	Common Name	Scientific Name
1	Lycaenidae	Common Pierrot	<i>Castalius rosimon</i>
2	Lycaenidae	Plane	<i>Bindahara phocides</i>
3	Lycaenidae	Yamfly	<i>Loxura atymnus</i>
4	Lycaenidae	Common Cerulean	<i>Jamides celeno</i>
5	Lycaenidae	Centaur Oakblue	<i>Arhopala centaurus</i>
6	Lycaenidae	Slate Flash	<i>Rapala manea</i>
7	Lycaenidae	Tailess Line Blue	<i>Prosotas dubiosa</i>
8	Lycaenidae	Tiny Grass Blue	<i>Zizula hylax</i>
9	Lycaenidae	Common Imperial	<i>Cheritra freja</i>
10	Lycaenidae	Monkey Puzzle	<i>Rathinda amor</i>
11	Lycaenidae	Purple Leaf Blue	<i>Amblypodia anita</i>
12	Lycaenidae	Banded BluePierrot	<i>Discolampa ethion</i>
13	Lycaenidae	Quaker	<i>Neopithecops zalmora</i>
14	Lycaenidae	Gram Blue	<i>Euchrysops cnejus</i>
15	Lycaenidae	Angled Pierrot	<i>Caleta decidia</i>
16	Lycaenidae	Opaque Six-lineblue	<i>Nacaduba beroe</i>
17	Lycaenidae	Plains Cupid	<i>Chilades pandava</i>
18	Lycaenidae	Zebra Blue	<i>Leptotes plinius</i>

19	Lycaenidae	Common Hedge Blue	<i>Acytolepis puspa</i>
20	Lycaenidae	Transparent Six-lineblue	<i>Nacaduba kurava</i>
21	Lycaenidae	Purple Leaf Blue	<i>Amblypodia anita</i>
22	Nymphalidae	Great Eggfly	<i>Hypolimnus bolina</i>
23	Nymphalidae	Glassy Tiger	<i>Parantica aglea</i>
24	Nymphalidae	Tawny Coster	<i>Acraea terpsicore</i>
25	Nymphalidae	Gladeye Bushbrown	<i>Mycalesis spatnia</i>
26	Nymphalidae	Common Four-ring	<i>Ypthima huebneri</i>
27	Nymphalidae	Tamil Yeoman	<i>Cirrochora thias</i>
28	Nymphalidae	Rustic	<i>Cupha erymanthis</i>
29	Nymphalidae	Common Evening Brown	<i>Melanitis leda</i>
30	Nymphalidae	Common Map	<i>Cyrestis thyodamas</i>
31	Nymphalidae	Cruiser	<i>Vindula erota</i>
32	Nymphalidae	Tamil Lacewing	<i>Cethosia nietneri</i>
33	Nymphalidae	Blue Oakleaf	<i>Kallima horsfieldi</i>
34	Nymphalidae	Chocolate Pansy	<i>Junonia iphita</i>
35	Nymphalidae	Common Treebrown	<i>Lethe rohria</i>
36	Nymphalidae	Bamboo Treebrown	<i>Lethe europa</i>
37	Nymphalidae	Common Baron	<i>Euthalia aconthea</i>
38	Nymphalidae	Common Crow	<i>Euploea core</i>
39	Nymphalidae	Common Leopard	<i>Phalanta phalantha</i>
40	Nymphalidae	Clipper	<i>Parthenos sylvia</i>
41	Nymphalidae	Common Lascar	<i>Pantoporia hordonia</i>
42	Nymphalidae	Grey Count	<i>Tanaecia lepidea</i>
43	Nymphalidae	Chestnut-Streaked Sailor	<i>Neptis jumbah</i>
44	Nymphalidae	Tailed Palmfly	<i>Elymnias caudata</i>
45	Nymphalidae	Lemon Pansy	<i>Junonia lemonias</i>
46	Nymphalidae	Common Five-ring	<i>Ypthima baldus</i>
47	Nymphalidae	Grey Pansy	<i>Junonia atlites</i>
48	Nymphalidae	Blackvein Sergeant	<i>Athyma ranga</i>
49	Nymphalidae	Malabar Tree Nymph	<i>Idea malabarica</i>
50	Nymphalidae	Redspot Duke	<i>Dophla evelina</i>
51	Nymphalidae	Blue Tiger	<i>Tirumala limniace</i>
52	Nymphalidae	Common Bushbrown	<i>Mycalesis perseus</i>
53	Nymphalidae	Medus Brown	<i>Orsotriaena medus</i>
54	Nymphalidae	Plain Tiger	<i>Danaus chrysippus</i>
55	Nymphalidae	Danaid Eggfly	<i>Hypolimnas misippus</i>
56	Nymphalidae	Commander	<i>Moduza procris</i>
57	Nymphalidae	Common Sailer	<i>Neptis hylas</i>
58	Nymphalidae	Stripped Tiger	<i>Danaus genutia</i>

59	Hesperiidae	Tricoloured Pied Flat	<i>Coladenia indrani</i>
60	Hesperiidae	Indian Dartlet	<i>Oriens goloides</i>
61	Hesperiidae	Coon	<i>Psolos fuligo</i>
62	Hesperiidae	Brown Awl	<i>Badamia exclamationis</i>
63	Hesperiidae	Bush Hopper	<i>Ampittia dioscorides</i>
64	Hesperiidae	Common Dartlett	<i>Oriens gola</i>
65	Hesperiidae	Indian Skipper	<i>Spialia galba</i>
66	Hesperiidae	Common Redye	<i>Matapa aria</i>
67	Hesperiidae	Golden Angle	<i>Caprona ransonnettii</i>
68	Hesperiidae	Water Snowflat	<i>Tagiades litigiosa</i>
69	Hesperiidae	Fulvous Pied Flat	<i>Pseudocoladenia dan</i>
70	Hesperiidae	Common Spotted Flat	<i>Celaenorrhinus leucocera</i>
71	Hesperiidae	Restricted Demon	<i>Notocryptac urvifascia</i>
72	Hesperiidae	Chestnut Bob	<i>Iambrix salsala</i>
73	Hesperiidae	Giant Redeye	<i>Gangara thyrsis</i>
74	Hesperiidae	Suffused Snow Flat	<i>Tagiades gana</i>
75	Hesperiidae	Grass Demon	<i>Udaspes folus</i>
76	Pieridae	Common Grass Yellow	<i>Eurema hecabe</i>
77	Pieridae	Three-spot Grass Yellow	<i>Eurema blanda</i>
78	Pieridae	Common Wanderer	<i>Pareronia valeria</i>
79	Pieridae	Common Emigrant	<i>Catopsilia pomona</i>
80	Pieridae	Common Jezebel	<i>Delias eucharis</i>
81	Pieridae	Psyche	<i>Leptosia nina</i>
82	Pieridae	Mottled Emigrant	<i>Catopsilia pyranthe</i>
83	Pieridae	Common Albatross	<i>Appias albina</i>
84	Papilionidae	Common Jay	<i>Graphium doson</i>
85	Papilionidae	Common Rose	<i>Pachliopta aristolochiae</i>
86	Papilionidae	Malabar Banded Peacock	<i>Papilio buddha</i>
87	Papilionidae	Blue Mormon	<i>Papilio polymnestor</i>
88	Papilionidae	Crimson Rose	<i>Atrophaneura hector</i>
89	Papilionidae	Tailed Jay	<i>Graphium agamemnon</i>
90	Papilionidae	Common Bluebottle	<i>Graphium sarpedon</i>
91	Papilionidae	Red Helen	<i>Papilio helenus</i>
92	Papilionidae	Common Mormon	<i>Papilio polytes</i>
93	Papilionidae	Southern Birdwing	<i>Troides minos</i>
94	Papilionidae	Spot Swordtail	<i>Graphium nomius</i>
95	Papilionidae	Malabar Raven	<i>Papilio dravidarum</i>
96	Riodinidae	Double-banded Judy	<i>Abisara bifasciata</i>

Table 7: Checklist of Lepidopterans in CWS

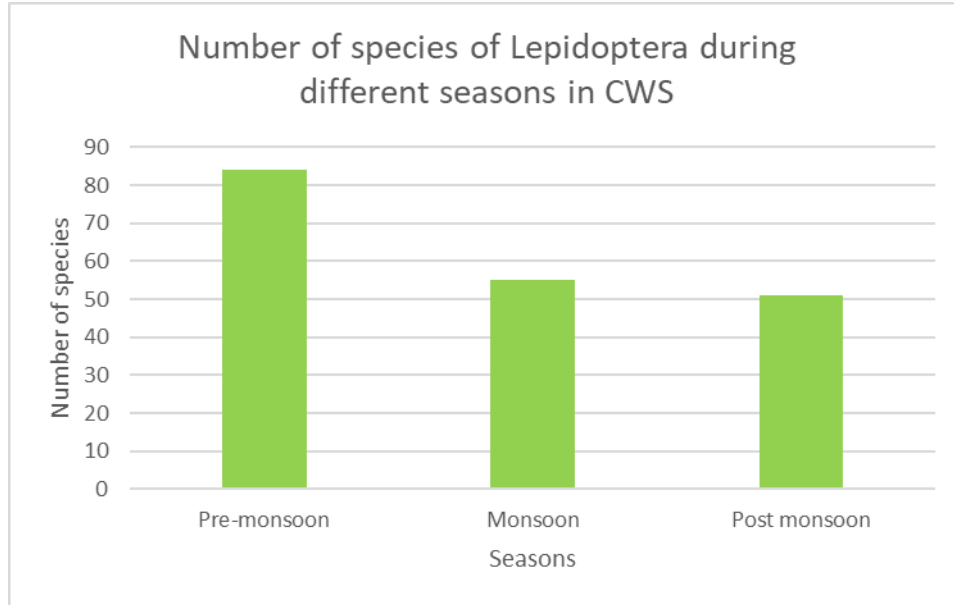


Figure 22: Graph showing number of species of Lepidoptera during different seasons in CWS

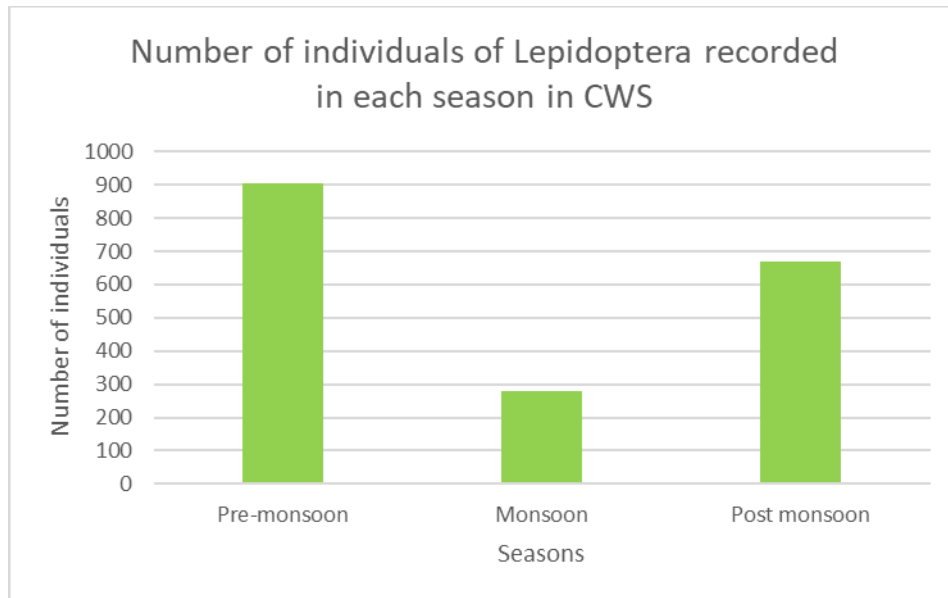


Figure 23: Graph showing number of individuals of Lepidoptera during different seasons in CWS

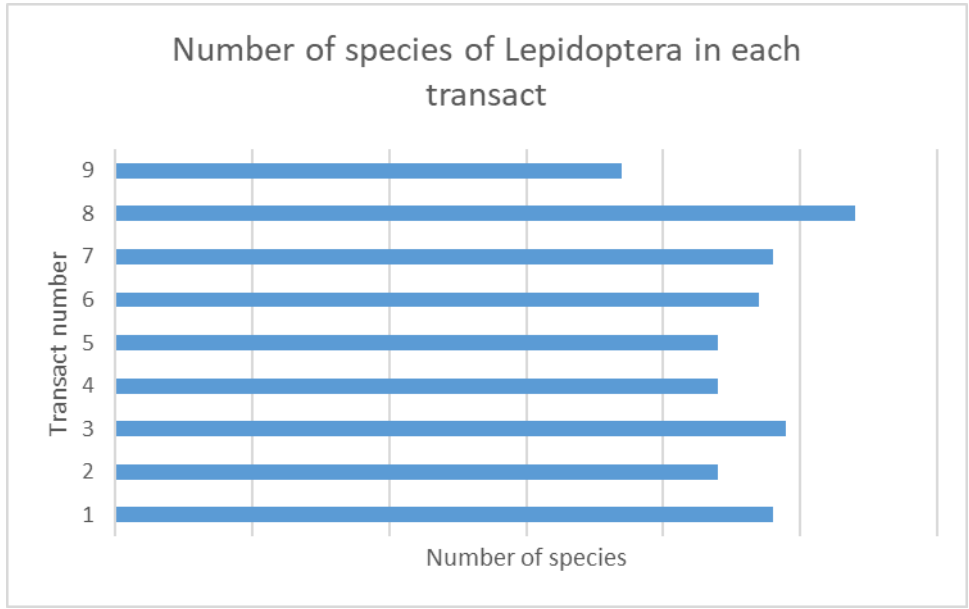


Figure 24: Graph showing number of species of Lepidoptera in each transect in CWS

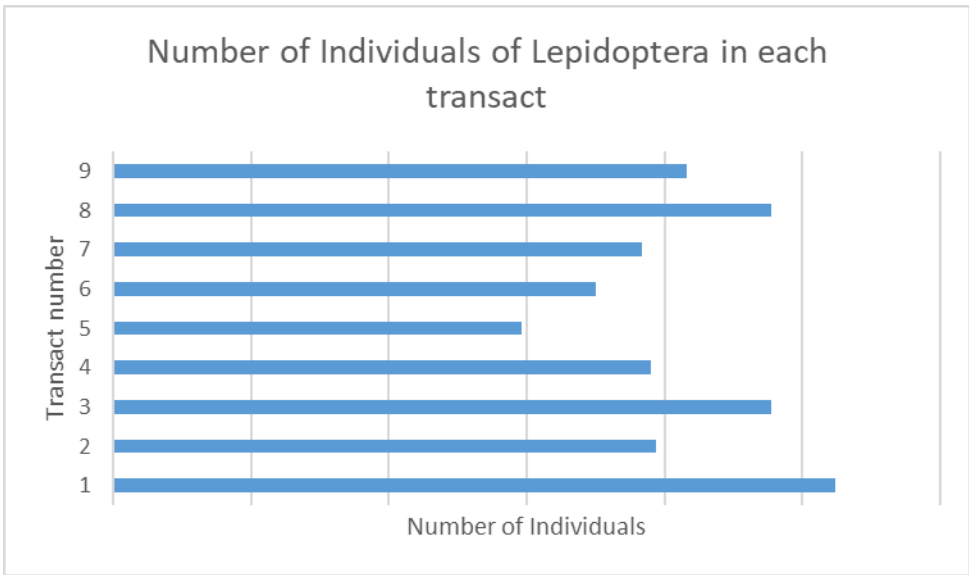


Figure 25: Graph showing number of individuals of lepidoptera in each transect in CWS

Odonata:

A total of 17 species of odonates were recorded in CWS (Table 8). The total number of species of Odonata were the highest in both pre-monsoon and monsoon, and lowest was in post-monsoon (Figure 26, Table 10). The highest number of individuals of Odonata were in Pre-monsoon and the lowest was in Monsoon season (Figure 27, Table 10). High species richness of odonates suggest good water quality and adequate quantity of vascular plant richness in the area (Afnitha, 2021). The highest number of species of Odonatas were recorded in transact number 4 and the lowest were recorded in transact number 7 (Figure 28, Table 9). Transact number 9 recorded the highest number of individuals of Odonata while, transact number 7 had the lowest (Figure 29, Table 9).

Sr. No.	Infra-order	Common name	Scientific Name
1	Anisoptera	Scarlet skimmer	<i>Crocothemis servilia</i>
2		Black-marsh Skimmer	<i>Indothemis carnatica</i>
3		Ground Skimmer	<i>Diplacodes trivialis</i>
4		Fulvous Forest Skimmer	<i>Neurothemis fulvia</i>
5		Common Picture Wing	<i>Rhyothemis variegata</i>
6		Green Marsh Hawk	<i>Orthetrum sabina</i>
7		Wandering Glider	<i>Pantala flavescens</i>
8		Coral-tailed Cloudwing	<i>Tholymis tillarga</i>
9		Pied Paddy Skimmer	<i>Neurothemis tullia</i>
10		Orange-Tailed Marsh Hawk	<i>Ceriagrion cerinorubellum</i>
11		Crimson-tailed Marsh Hawk	<i>Orthetrum pruinosum</i>
12		Emerald-banded Skimmer	<i>Cratilla lineata</i>
13		Scarlet Marsh Hawk	<i>Aethriamanta brevipennis</i>
14		Asiatic Bloodtail	<i>Lathrecista asiatica</i>
15	Zygoptera	Clear-winged Forest Glory	<i>Vestalis gracilis</i>
16		Stream Ruby	<i>Heliocypha biignata</i>
17		River Heliodor	<i>Libellago liniata</i>

Table 8: Checklist of Odonates in CWS

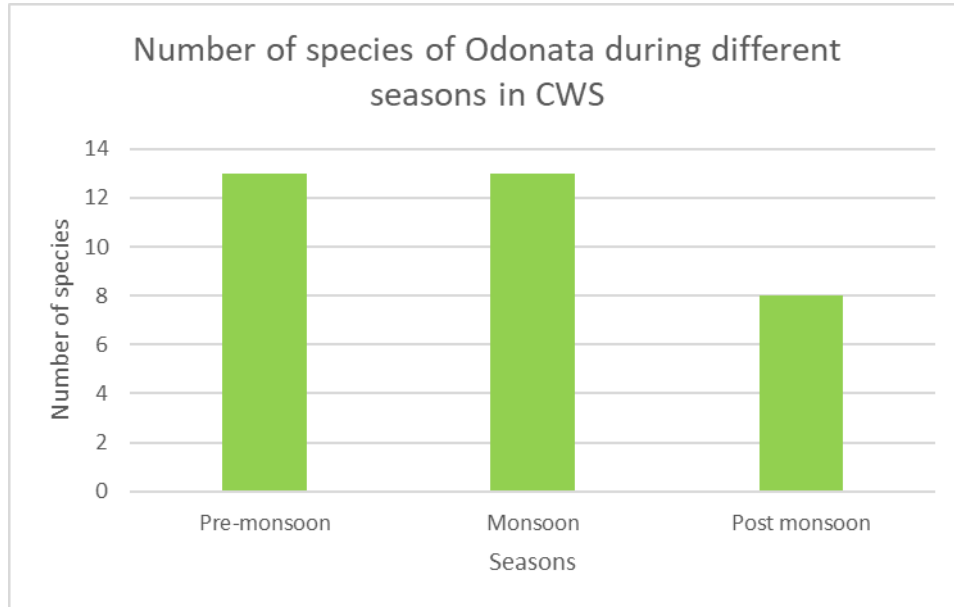


Figure 26: Graph showing number of species of Odonata during different seasons in CWS

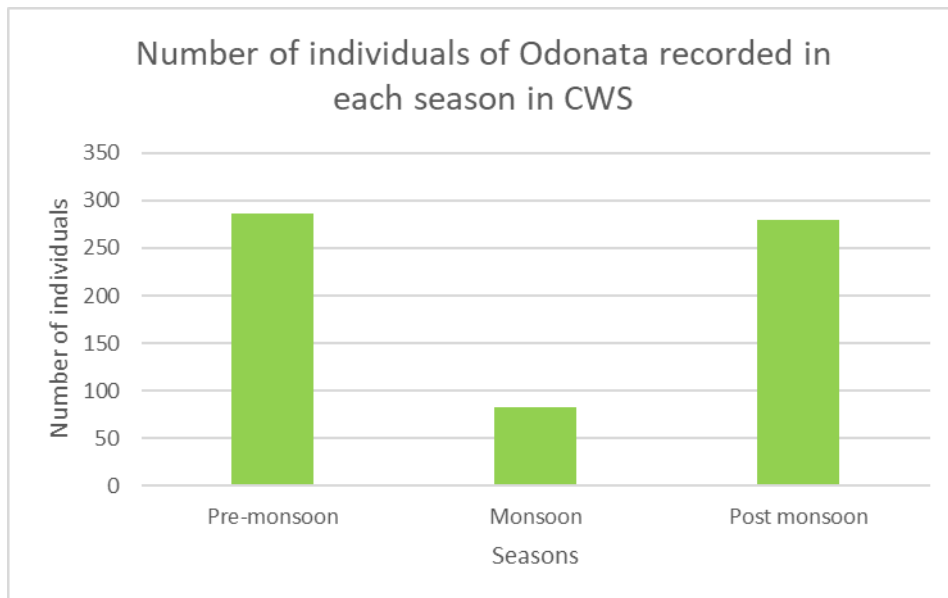


Figure 27: Graph showing number of individuals of Odonata during different seasons in CWS

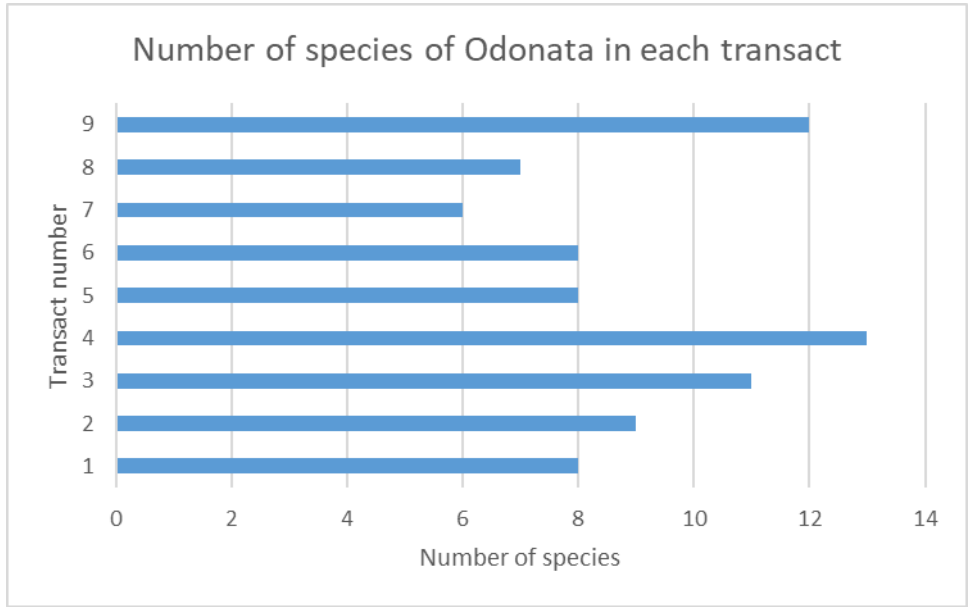


Figure 28: Graph showing number of species of Odonata in each transect in CWS

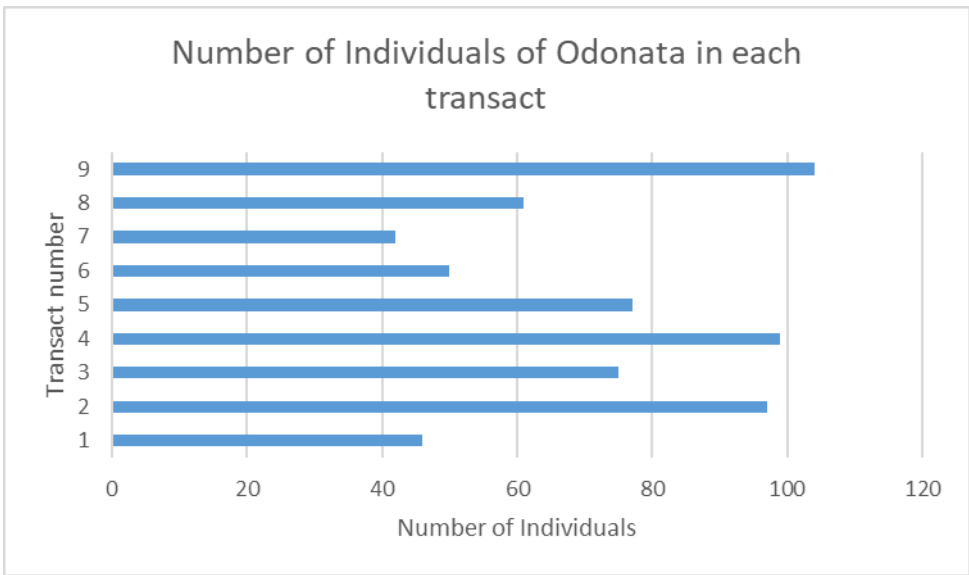


Figure 29: Graph showing number of individuals of Odonata in each transect in CWS

Transact	Aves		Mammals	Reptiles		Amphibians		Lepidoptera		Odonata	
	Sp.	Ind.	Sp.	Sp.	Ind.	Sp.	Ind.	Sp.	Ind.	Sp.	Ind.
1	42	241	17	42	241	9	81	48	262	8	46
2	49	277	16	49	277	9	88	44	197	9	97
3	46	260	14	46	260	7	101	49	239	11	75
4	49	331	18	49	331	7	56	44	195	13	99
5	47	189	9	47	189	7	92	44	148	8	77
6	39	168	12	39	168	5	52	47	175	8	50
7	49	251	11	49	251	9	40	48	192	6	42
8	55	217	13	55	217	10	31	54	239	7	61
9	47	217	16	47	217	8	63	37	208	12	104

Table 9: Table showing number of species and individuals in each transact of each taxon in CWS, Sp. : Species, Ind. :Individuals

Taxa		Pre-monsoon	Monsoon	Post monsoon
Mammals	Species	19	7	14
	Individuals	-	-	-
Aves	Species	81	59	74
	Individuals	958	294	899
Reptiles	Species	11	15	11
	Individuals	230	168	183
Amphibians	Species	5	17	5
	Individuals	139	238	228
Lepidoptera	Species	84	55	51
	Individuals	906	280	670
Odonata	Species	13	13	8
	Individuals	287	82	280

Table 10: Table showing number of species and individuals of each taxon recorded during each season in CWS

Netravali Wildlife Sanctuary

Mammals:

A total of 19 species of mammals were recorded in the CWS. Amongst the species recorded three species are listed as Near Threatened category viz. *Loris lydekkerianus*, *Panthera pardus*, *Ratufa indica* three species in Vulnerable category viz. *Rusa unicolor*, *Bos gaurus*, *Melurus ursinus* and one species in Endangered category *Manis crassicaudata* of IUCN red list (Table 12). The highest number of species of Mammals in CWS were observed in Pre-monsoon and post-monsoon and the lowest number of species were in Monsoon (Figure 30, Table 17). Pre-monsoon and post-monsoon the indirect evidences stay intact, while in monsoon season the indirect evidences gets washed off, this can be the reason for low diversity in monsoon. The highest number of species of mammals were found in transact number 4 and the lowest were found in transact number 9 (Figure 31, Table 18).

Sr. No.	Common Name	Scientific Name	Family	Order	IUCN	WPA Status
1	Bonnet Macaque	<i>Macaca radiata</i>	Cercopithecidae	Primata	LC	Schedule II
2	Malabar Gray Langur	<i>Semnopithecus hypoleucos</i>	Cercopithecidae	Primata	LC	Schedule II
3	Grey Slender Loris	<i>Loris lydekkerianus</i>	Lorisidae	Primata	NT	Schedule I
4	Sambar Deer	<i>Rusa unicolor</i>	Cervidae	Artiodactyla	VU	Schedule III
5	Spotted Deer	<i>Axis axis</i>	Cervidae	Artiodactyla	LC	Schedule III
6	Barking Deer	<i>Muntiacus muntjak</i>	Cervidae	Artiodactyla	LC	Schedule II
7	Indian Chevrotain	<i>Moschiola indica</i>	Tragulidae	Artiodactyla	LC	Schedule I
8	Gaur	<i>Bos gaurus</i>	Bovidae	Artiodactyla	VU	Schedule I
9	Indian Wild Boar	<i>Sus scrofa</i>	Suidae	Artiodactyla	LC	Schedule III

10	Common Leopard	<i>Panthera pardus</i>	Felidae	Carnivora	NT	Schedule I
11	Asian Palm Civet	<i>Paradoxurus hermaphroditus</i>	Viverridae	Carnivora	LC	Schedule II
12	Brown Palm Civet	<i>Paradoxurus jerdoni</i>	Viverridae	Carnivora	LC	Schedule II
13	Small Indian Civet	<i>Viverricula indica</i>	Viverridae	Carnivora	LC	Schedule II
14	Sloth Bear	<i>Melurus ursinus</i>	Ursidae	Carnivora	VU	Schedule I
15	Indian Crested Porcupine	<i>Hystrix indica</i>	Hystriidae	Rodentia	LC	Schedule IV
16	Malabar Giant Squirrel	<i>Ratufa indica</i>	Sciuridae	Rodentia	NT	Schedule II
17	Three-striped Palm Squirrel	<i>Funambulus palmarum</i>	Sciuridae	Rodentia	LC	Unlisted
18	Indian Pangolin	<i>Manis crassicaudata</i>	Manidae	Pholidota	EN	Schedule I
19	Black-naped Hare	<i>Lepus nigricollis</i>	Leporidae	Lagomorpha	LC	Schedule IV

Table 11: Checklist of Mammals in NWS

NT: Near Threatened, VU: Vulnerable, EN: Endangered, LC: Least Concern

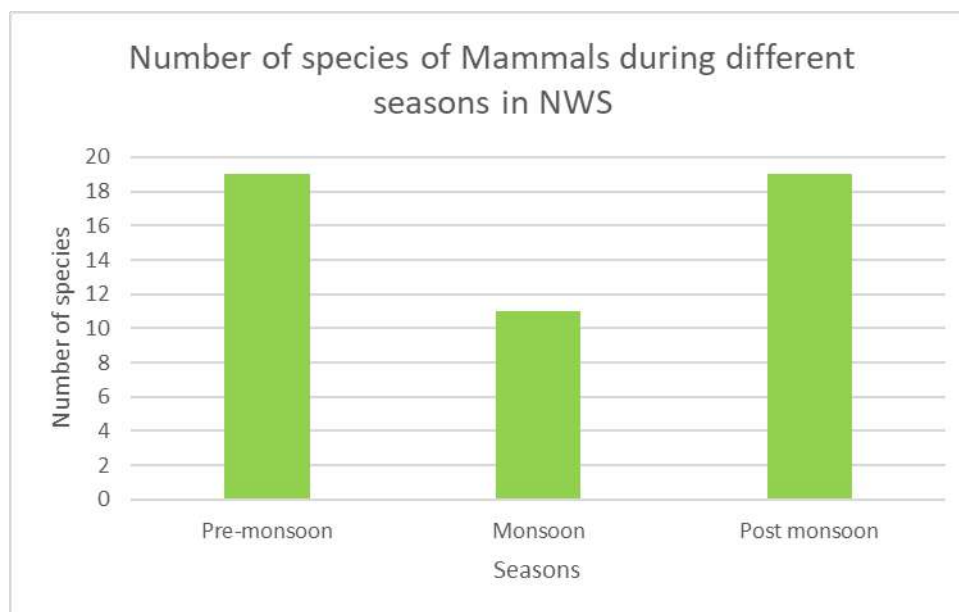


Figure 30: Graph showing number of species of Mammals during different seasons in NWS

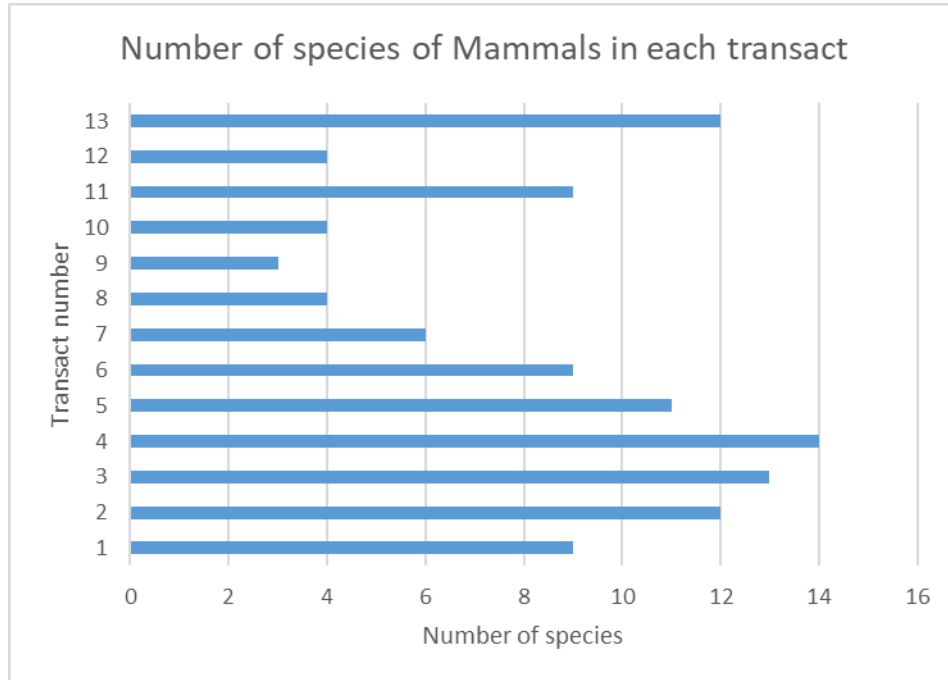


Figure 31: Graph showing number of species of Mammals in each transact in NWS

Aves:

A total of 116 species of Aves were recorded in CWS. Amongst the species recorded 9 species were Endemic to the western ghats of India, while two species were listed under Near Threatened category viz. *Anthracoceros albirostris*, *Brachypodius priocephalus* of the IUCN red list (Table 12). Eight species were listed as scheduled species under Wildlife protection act, India (Table 12). The highest number of species of Aves in CWS were recorded in Pre-monsoon and the lowest number of species were recorded in Monsoon (Figure 32, Table 18). The highest number of individuals of Aves were recorded in post-monsoon and the lowest was recorded in Monsoon (Figure 33, Table 18). The highest number of species of Aves were recorded in transact number 3 and the lowest were recorded in transact number 12 (Figure 34, Table 17). Transact number 5 recorded the highest number of individuals of Aves while, transact number 12 had the lowest (Figure 35, Table 17).

Sr. No	Order	Family	Common Name	Scientific Name	IU CN	WPA Status
1	Galliformes	Phasianidae	Indian Peafowl	<i>Pavo cristatus</i>		X
2		Phasianidae	Grey Junglefowl	<i>Gallus sonneratii</i>		
3			Red Spurfowl	<i>Galloperdix spadicea</i>		
4	Columbiformes	Columbidae	Spotted Dove	<i>Spilopelia chinensis</i>		
5			Grey-fronted Green Pigeon	<i>Terron affinis</i>		
6			Green Imperial Pigeon	<i>Ducula aenea</i>		
7			Emerald Dove	<i>Chalcophaps indica</i>		
8	Caprimulgiformes	Apopidae	Crested Treeswift	<i>Hemiprocne coronata</i>		
9			Little Swift	<i>Apus affinis</i>		
10	Cuculiformes	Cuculidae	Greater Coucal	<i>Centropus sinensis</i>		
11			Asian Koel	<i>Eudynamys scolopaceus</i>		
12			Fork-tailed Drongo Cuckoo	<i>Surniculus dicruroides</i>		
13			Fork-tailed Drongo Cuckoo	<i>Surniculus dicruroides</i>		
14	Pelecaniformes	Ardeidae	Cattle Egret	<i>Bubulcus ibis</i>		
15	Accipitriformes	Accipitridae	Crested Serpent Eagle	<i>Spilornis cheela</i>		X
16			Changeable Hawk-eagle	<i>Nisaetus cirrhatus</i>		X
17			Black Eagle	<i>Ictinaetus malaiensis</i>		X
18			Shikra	<i>Accipiter badius</i>		X
19			Brahminy Kite	<i>Haliastur indus</i>		X
20			Black Kite	<i>Milvus migrans</i>		
21	Strigiformes	Strigidae	Jungle Owlet	<i>Glaucidium radiatum</i>		
22			Brown Wood Owl	<i>Strix leptogrammica</i>		
23			Brown Fish Owl	<i>Ketupa zeylonensis</i>		
24	Trogoniformes	Trogonidae	Malabar Trogon	<i>Harpactes fasciatus</i>		

25	Bucerotiformes	Bucerotidae	Great Hornbill	<i>Buceros bicornis</i>		
26			Malabar Pied Hornbill	<i>Anthracoceros albirostris</i>	NT	X
27			Malabar Grey Hornbill	<i>Ocyrceros grisues*</i>		X
28	Piciformes	Picidae	Speckled Piculet	<i>Picumnus innominatus</i>		
29			Heart-spotted Woodpecker	<i>Hemicircus canente</i>		
30			Black-rumped Flameback	<i>Dinopium benghalense</i>		
31			Greater Flameback	<i>Chrysocolaptes guttacristatus</i>		
32			Rufous Woodpecker	<i>Micropternus brachyurus</i>		
33			White-bellied Woodpecker	<i>Dryocopus javensis</i>		
34		Ramphastidae	Brown-headed barbet	<i>Magalaima zeylanica</i>		
35			White-cheeked Barbet	<i>Magalaima viridis</i>		
36			Malabar Barbet	<i>Psilopogon malabaricus*</i>		
37			Coppersmith Barbet	<i>Psilopogon haemacephalus</i>		
38	Coraciiformes	Meropidae	Blue-bearded Bee-eater	<i>Nyctyornis athertoni</i>		
39			Green Bee-eater	<i>Merops orientalis</i>		
40			Chestnut-headed bee-eater	<i>Merops leschenaulti</i>		
41			Blue-tailed Bee-eater	<i>Merops philippinus</i>		
42		Alcedinidae	Oriental Dwarf Kingfisher	<i>Ceyx erithaca</i>		
43			Blue-eared Kingfisher	<i>Alcedo meninting</i>		
44			Common Kingfisher	<i>Alcedo atthis</i>		
45			White-throated Kingfisher	<i>Halcyon smyrnensis</i>		
46	Psittaciformes	Psittaculidae	Malabar Parakeet	<i>Psittacula columboides*</i>		
47			Vernal Hanging	<i>Loriculus vernalis</i>		

			Parrot			
48	Passeriformes	Pittidae	Indian Pitta	<i>Pitta brachyura</i>		
49		Campephagidae	Small Minivet	<i>Pericrocotus cinnamomeus</i>		
50			Orange Minivet	<i>Pericrocotus flammeus</i>		
51		Oriolidae	Black-hooded Oriole	<i>Oriolus xanthonus</i>		
52			Indian Golden Oriole	<i>Oriolus kundoo</i>		
53		Vangidae	Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>		
54			Malabar Woodshrike	<i>Tephrodornis sylvicola*</i>		
55			Common Woodshrike	<i>Tephrodornis pondicerianus</i>		
56		Aegithinidae	Common Iora	<i>Aegithina tiphia</i>		
57		Dicruridae	Ashy Drongo	<i>Dicrurus leucophaeus</i>		
58			Bronzed Drongo	<i>Dicrurus aeneus</i>		
59			Greater Racket-tailed Drongo	<i>Dicrurus paradiseus</i>		
60		Rhipiduridae	Spot-breasted Fantail	<i>Rhipidura aureola</i>		
61		Laniidae	Brown Shrike	<i>Lanius cristatus</i>		
62		Corvidae	Rufous Treepie	<i>Dendrocitta vagabunda</i>		
63			House Crow	<i>Corvus splendens</i>		
64			Large-billed Crow	<i>Corvus macrorhynchos</i>		
65		Monarchidae	Black-naped Monarch	<i>Hypothymis azurea</i>		
66			Indian Paradise Flycatcher	<i>Terpsiphone paradisi</i>		
67		Dicaeidae	Thick-billed Flowerpecker	<i>Dicaeum agile</i>		
68			Pale-billed Flowerpecker	<i>Dicaeum erythrorhynchos</i>		
69			Nilgiri Flowerpecker	<i>Dicaeum concolor*</i>		
70		Nectariniidae	Little Spiderhunter	<i>Arachnothera longirostra</i>		

71			Crimson-backed Sunbird	<i>Leptocoma minima</i>		
72			Purple Sunbird	<i>Cinnyris asiaticus</i>		
73		Irenidae	Asian Fairy-bluebird	<i>Irena puella</i>		
74		Chloropseidae	Golden-fronted Leafbird	<i>Chloropsis aurifrons</i>		
75			Jerdon's Leafbird	<i>Chloropsis jerdoni</i>		
76		Estrildidae	White-rumped munia	<i>Lonchura striata</i>		
77		Passeridae	Yellow-throated Sparrow	<i>Petronia xanthocollis</i>		
78		Motacillidae	Forest Wagtail	<i>Dendronanthus indicus</i>		
79			Grey Wagtail	<i>Motacilla cinerea</i>		
80		Cisticolidae	Ashy Prinia	<i>Prinia socialis</i>		
81			Common Tailorbird	<i>Orthotomus sutorius</i>		
82		Acrocephalidae	Blyth's Reed Warbler	<i>Acrocephalus dumetorum</i>		
83		Hirundinidae	Red-rumped swallow	<i>Cecropis daurica</i>		
84			Wire-tailed Swallow	<i>Hirundo smithii</i>		
85		Pycnonotidae	Square-tailed Bulbul	<i>Hypsipetes ganeesa</i>		
86			Flame-throated Bulbul	<i>Rubigula gularis*</i>		
87			Red Whiskered Bulbul	<i>Pycnonotus jocosus</i>		
88			Red-vented Bulbul	<i>Pycnonotus cafer</i>		
89			Grey-headed Bulbul	<i>Brachypodius priocephalus*</i>	NT	
90			Yellow-browed Bulbul	<i>Acritillas indica</i>		
91		Phylloscopidae	Green Warbler	<i>Phylloscopus nitidus</i>		
92			Greenish Warbler	<i>Phylloscopus trochiloides</i>		
93			Large-billed Leaf Warbler	<i>Phylloscopus magnirostris</i>		
94			Western Crowned Warbler	<i>Phylloscopus occipitalis</i>		

95		Zosteropidae	Indian White-eye	<i>Zosterops palpebrosus</i>		
96		Timaliidae	Scimitar Babbler	<i>Pomatorhinus horsfieldii</i>		
97			Dark-fronted Babbler	<i>Dumetia atriceps</i>		
98			Puff-throated Babbler	<i>Pellorneum ruficeps</i>		
99		Leiothrichidae	Jungle Babbler	<i>Turdoides striata*</i>		
100		Alcippeidae	Brown-cheeked Fulvetta	<i>Alcippe poioicephala</i>		
101		Sittidae	Velvet-fronted Nuthatch	<i>Sitta frontalis</i>		
102		Sturnidae	Chestnut-tailed Starling	<i>Sturnia malabarica</i>		
103			Malabar Starling	<i>Sturnia blythi</i>		
104			Southern Hill Myna	<i>Gracula indica</i>		
105		Muscicapidae	Oriental Magpie Robin	<i>Copsychus saularis</i>		
106			White-rumped Shama	<i>Copsychus malabaricus</i>		
107			Asian Brown Flycatcher	<i>Muscicapa latirostris</i>		
108			Brown-breasted Flycatcher	<i>Muscicapa muttui</i>		
109			White-bellied blue Flycatcher	<i>Cyornis pallipes*</i>		
110			Tickell's Blue Flycatcher	<i>Cyornis tickelliae</i>		
111			Verditer Flycatcher	<i>Eumyias thalassinus</i>		
112			Indian Blue Robin	<i>Luscinia brunnea</i>		
113			Malabar Whistling Thrush	<i>Myophonus horsfieldii</i>		
114			Taiga Flycatcher	<i>Ficedula albicilla</i>		
115			Blue-capped rock thrush	<i>Monticola cinclorhynchus</i>		
116		Turdidae	Orange-headed Thrush	<i>Geokichla citrina</i>		

Table 12: Checklist of Aves in NWS

*Endemic to Western Ghats, NT: Near Threatened, VU: Vulnerable

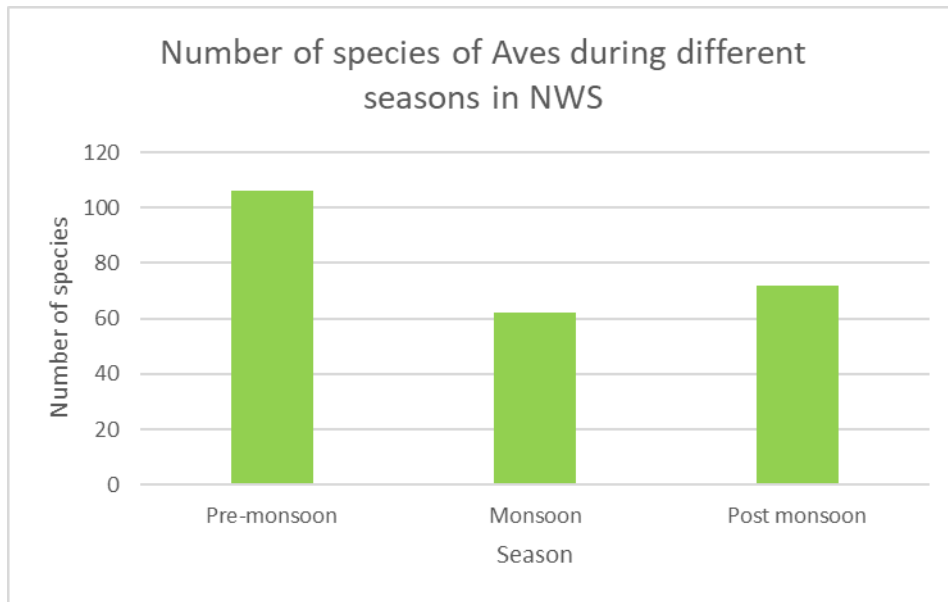


Figure 32: Graph showing number of species of Aves during different seasons in NWS

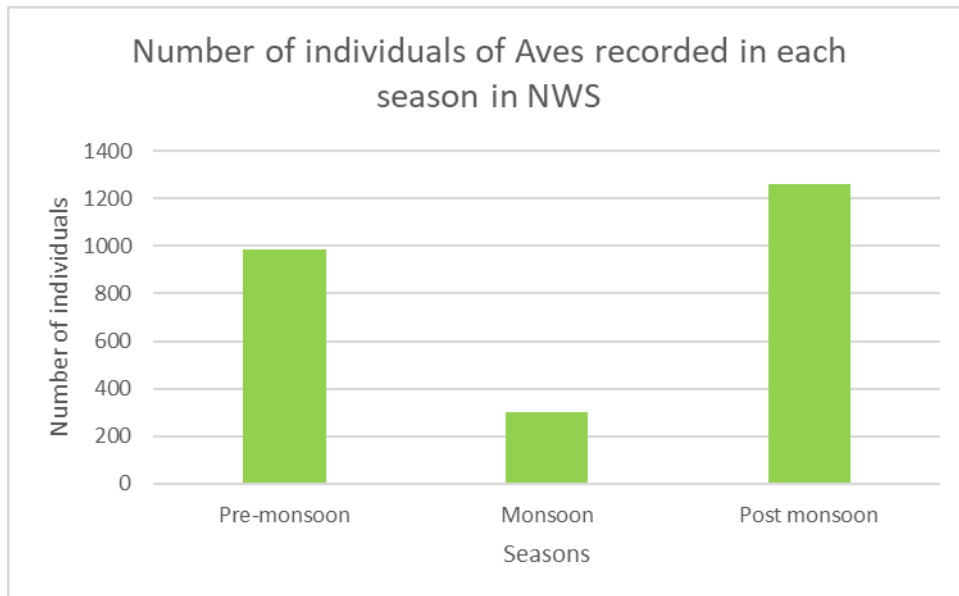


Figure 33: Graph showing number of individuals of Aves during different seasons in NWS

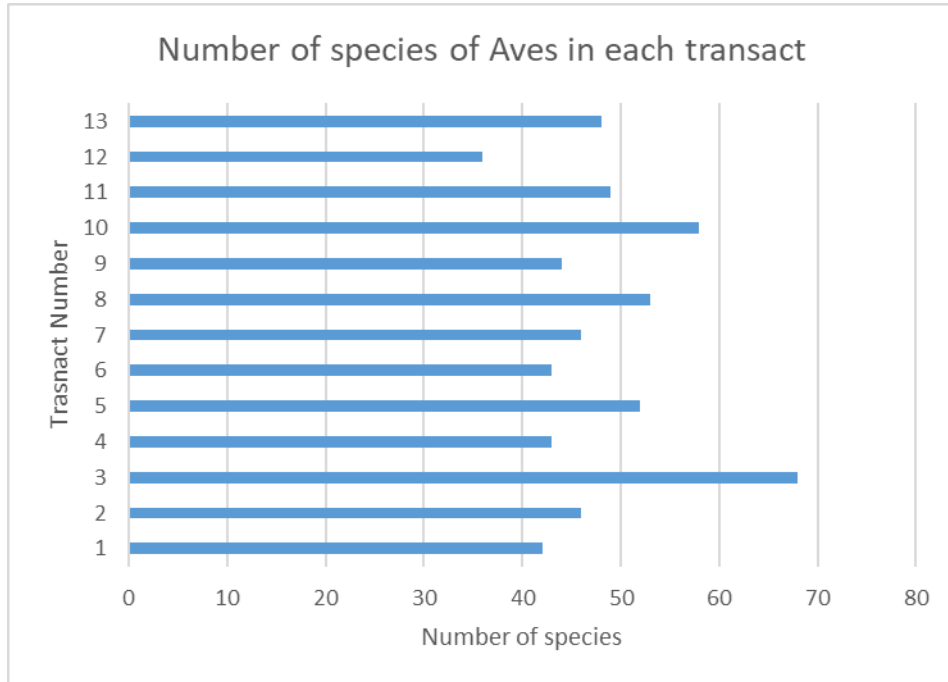


Figure 34: Graph showing number of species of Aves in each transect in NWS

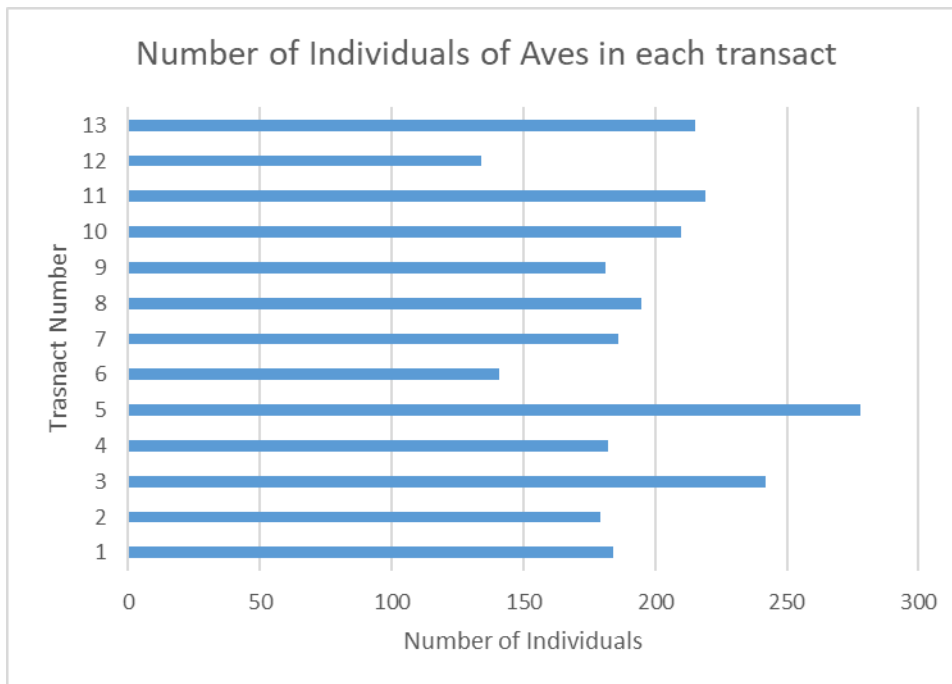


Figure 35: Graph showing number of individuals of Aves in each transect in NWS

Reptiles:

A total of 27 species of Reptiles were observed in CWS (Table 13). Highest number of species were recorded in Monsoon season while lower number of species were recorded in post-monsoon (Figure 36, Table 18). This is since most of the species of reptiles breed during monsoon season as plenty of feed will be available for young ones to survive, and for breeding these adult reptiles comes out from their hidings. The highest number of individuals were recorded in Pre-monsoon and the lowest was recorded in Monsoon season (Figure 37, Table 18). The highest number of species of Reptiles were recorded in transact number 3 and the lowest were recorded in transact number 12 (Figure 38, Table 17). Transact number 5 recorded the highest number of individuals of Reptiles while, transact number 12 had the lowest (Figure 39, Table 17). The transacts with high species richness can be used to promote eco-tourism in the sanctuary.

Sr.No	Family	Common Name	Scientific Name
1	Scincidae	Bronze Mabuya	<i>Eutropis macularia</i>
2	Scincidae	Keeled Indian Mabuya	<i>Eutropis carinata</i>
3	Gekkonidae	Goan Day Gecko	<i>Cnemaspis goaensis</i>
4	Gekkonidae	Termite Hill Gecko	<i>Hemidactylus triedrus</i>
5	Gekkonidae	Prashad's Gecko	<i>Hemidactylus prashadi</i>
6	Gekkonidae	Deccan Banded Gecko	<i>Cyrtodactylus deccanensis</i>
7	Elapidae	King Cobra	<i>Ophiophagus hannah</i>
8	Elapidae	Spectacled Cobra	<i>Naja naja</i>
9	Elapidae	Common Krait	<i>Bungarus caeruleus</i>
10	Boidae	Whitaker's Boa	<i>Eryx whitakeri</i>
11	Agamidae	Oriental Garden Lizard	<i>Calotes versicolor</i>
12	Agamidae	Roux's Forest Lizard	<i>Monilesaurus rouxii</i>
13	Agamidae	Southern Flying Lizard	<i>Draco dussumieri</i>
14	Colubridae	Checkered Keelback	<i>Xenochrophis piscator</i>
15	Colubridae	Common Wolf Snake	<i>Lycodon capucinus</i>
16	Colubridae	Ornate Flying Snake	<i>Chrysopelea ornata</i>

17	Colubridae	Forsten's Cat Snake	<i>Boiga forsteni</i>
18	Colubridae	Indian Rat Snake	<i>Ptyas mucosa</i>
19	Colubridae	Green Vine Snake	<i>Ahaetulla borealis</i>
20	Colubridae	Giri's Bronzeback Tree Snake	<i>Dendrelaphis girii</i>
21	Colubridae	Banded Racer	<i>Argyrogena fasciolata</i>
22	Viperidae	Malabar Pit Viper	<i>Craspedocephalus malabaricus</i>
23	Varanidae	Bengal Monitor Lizard	<i>Varanus bengalensis</i>
24	Viperidae	Hump Nosed Pit Viper	<i>Hypnale hypnale</i>
25	Viperidae	Bamboo pit viper	<i>Craspedocephalus gramineus</i>
26	Uropeltidae	Khaire's Shieldtail	<i>Melanophidium kharei</i>
27	Geoemydidae	Indian Black Turtle	<i>Melanochelys trijuga</i>

Table 13: Checklist of Reptiles in NWS

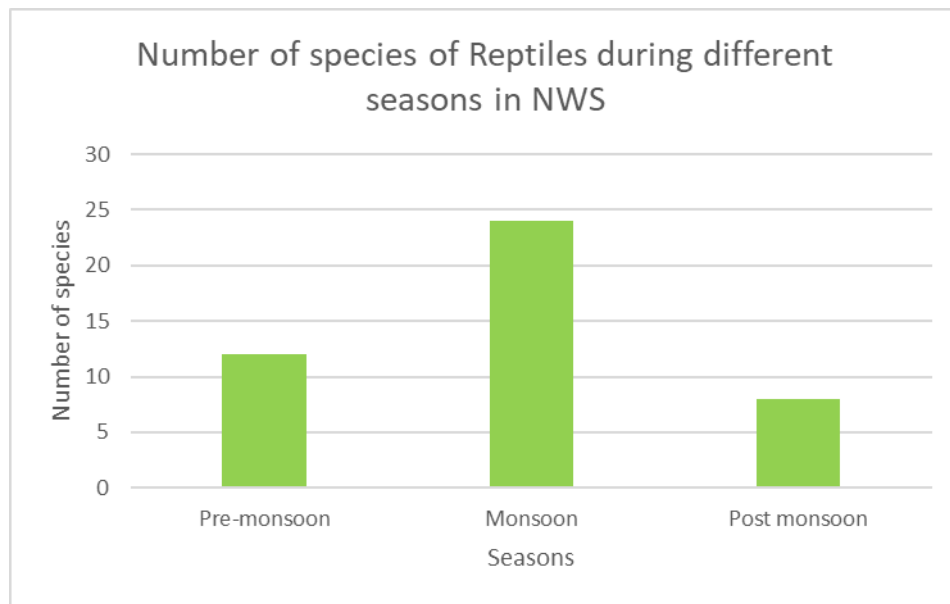


Figure 36: Graph showing number of species of Reptiles during different seasons in NWS

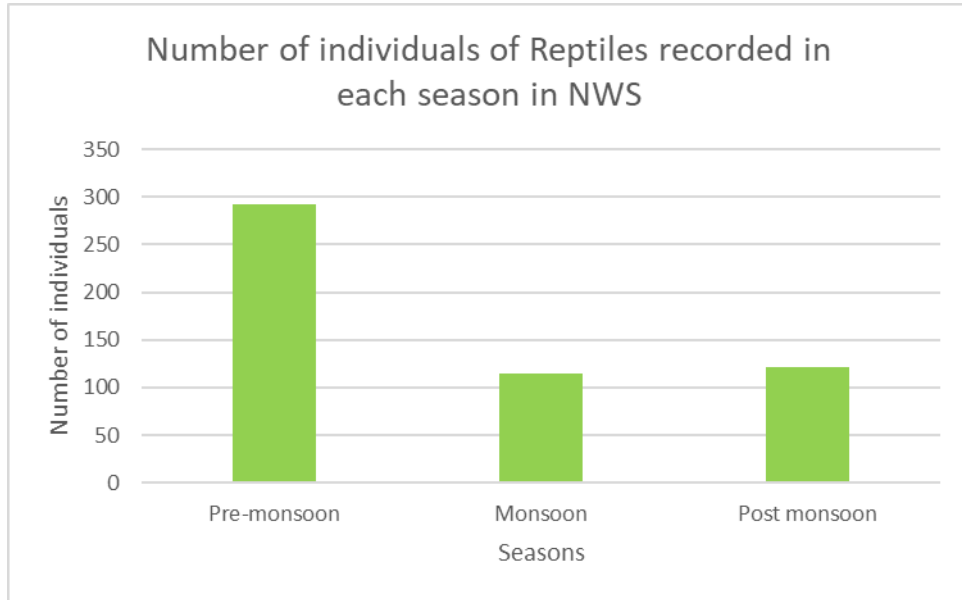


Figure 37: Graph showing number of individuals of Reptiles during different seasons in NWS

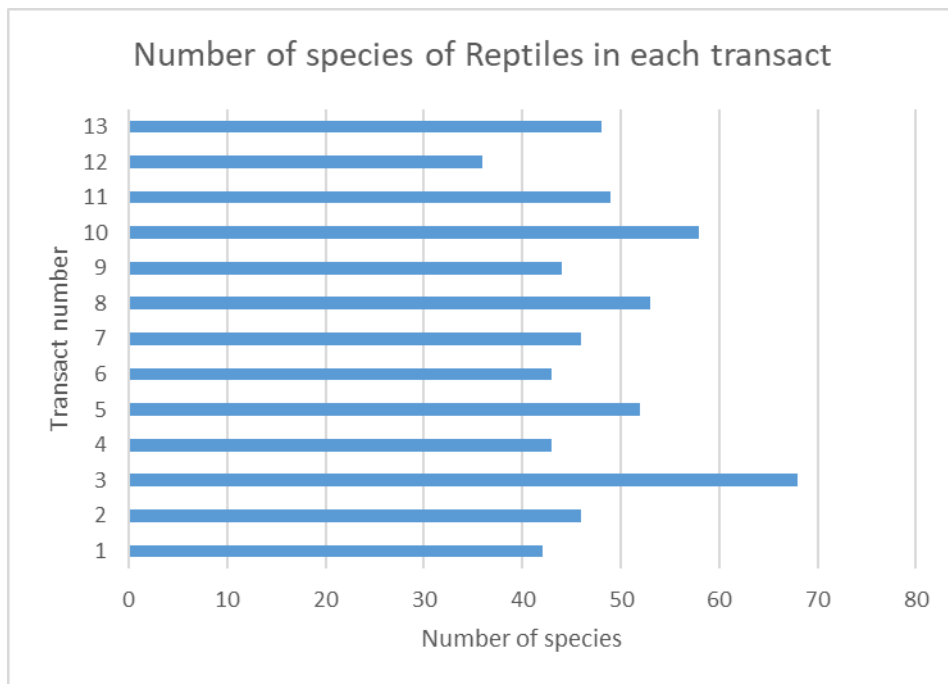


Figure 38: Graph showing number of species of Reptiles in each transact in NWS

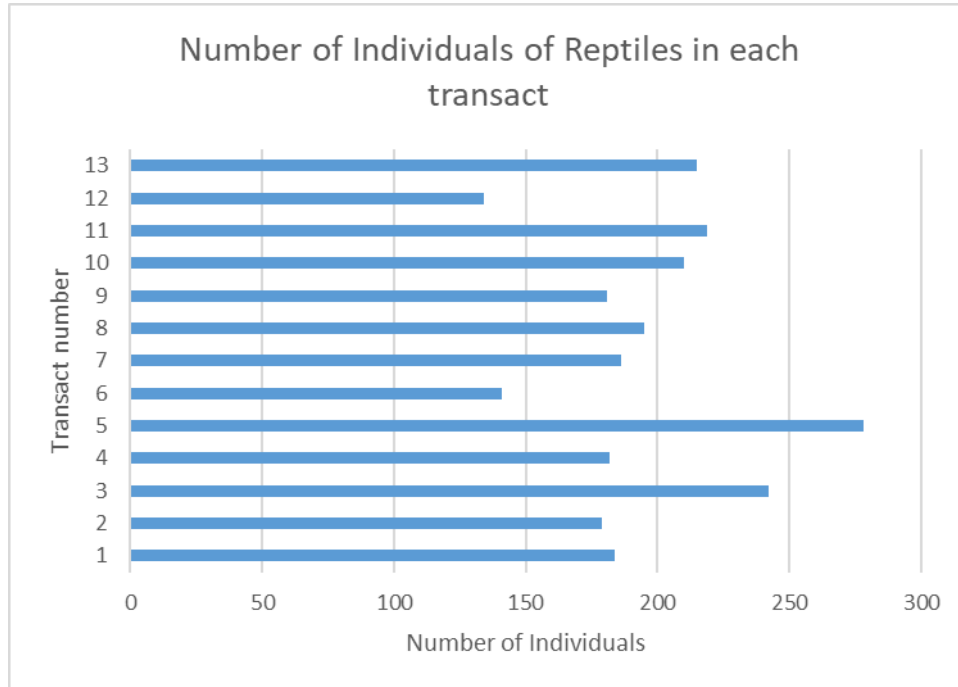


Figure 39: Graph showing number of individuals of Reptiles in each transact in NWS

Amphibians:

A total of 21 species of amphibians were recorded in CWS (Table 14). The highest number of species of Amphibians in CWS were recorded in Monsoon season while in pre-monsoon and post-monsoon season it was the lowest (Figure 40, Table 18). This is since amphibians need moisture (rain) to carry out their life processes and only in monsoon they come in open to do that. Rest of the time the amphibian species either estivate or stay hidden to moist places and limit their activity, this reduces the spotting skill of field workers to spot more species during pre-monsoon and post-monsoon. The highest number of individuals of Amphibians were recorded in post-monsoon, followed by monsoon and the lowest was recorded in Pre- Monsoon (Figure 41, Table 18). As amphibian species breed during monsoon season, during post monsoon its usually their young ones which are found abundantly in the study area. The highest number of

species of Amphibians were recorded in transact number 1 and the lowest were recorded in transact number 8 (Figure 42, Table 17). Transact number 4 recorded the highest number of individuals of Amphibians while, transact number 9 had the lowest (Figure 43, Table 17). The transacts with high species richness can be used to promote eco-tourism in the sanctuary.

Sr No	Order	Family	Common Name	Scientific name
1	Anura	Rhacophoridae	Amboli Bush Frog	<i>Pseudophilautus amboli</i>
2	Anura	Rhacophoridae	Bombay Bush Frog	<i>Philautus bombayensis</i>
3	Anura	Rhacophoridae	Common Tree Frog	<i>Polypedates maculatus</i>
4	Anura	Rhacophoridae	Malabar Gliding Frog	<i>Rhacophorus malabricus</i>
5	Anura	Ranidae	Bicolored Frog	<i>Clinotarsus curtipes</i>
6	Anura	Ranidae	Fungoid Frog	<i>Hydrophylax malabaricus</i>
7	Anura	Nyctibatrachidae	Night Frog	<i>Nyctibatrachus spp.</i>
8	Anura	Bufo nidae	Asian Common Toad	<i>Duttaphrynus melanostictus</i>
9	Anura	Bufo nidae	Malabar Tree Toad	<i>Pedostibes tuberculosus</i>
10	Anura	Ranixalidae	Netravali Leaping Frog	<i>Indirana salelakri</i>
11	Anura	Dicroglossidae	Reddish Burrowing Frog	<i>Minnervarya rufescens</i>
12	Anura	Dicroglossidae	Indian Bullfrog	<i>Hoplobatrachus tigrinus</i>
13	Anura	Dicroglossidae	Indian Burrowing Frog	<i>Sphaerotheca breviceps</i>
14	Anura	Dicroglossidae	Goan Cricket Frog	<i>Minnervarya goemchi</i>
15	Anura	Dicroglossidae	Common Skittering Frog	<i>Euphlyctis cyanophlyctis</i>
16	Anura	Dicroglossidae	Goan Fejervarya	<i>Minnervarya gomantaki</i>
17	Anura	Dicroglossidae	Burrowing Frog	<i>Sphaerotheca paschima</i>
18	Anura	Microhylidae	Jerdon's Narrow-mouthed Frog	<i>Uperodon montanus</i>
19	Anura	Microhylidae	Indian Balloon Frog	<i>Uperodon globulosus</i>
20	Anura	Microhylidae	Ornate Narrow-mouthed Frog	<i>Microhyla ornata</i>
21	Gymnophion ia	Ichthyophidae	Bombay Caecilian	<i>Ichthyophis bombayensis</i>

Table 14: Checklist of Amphibians in NWS

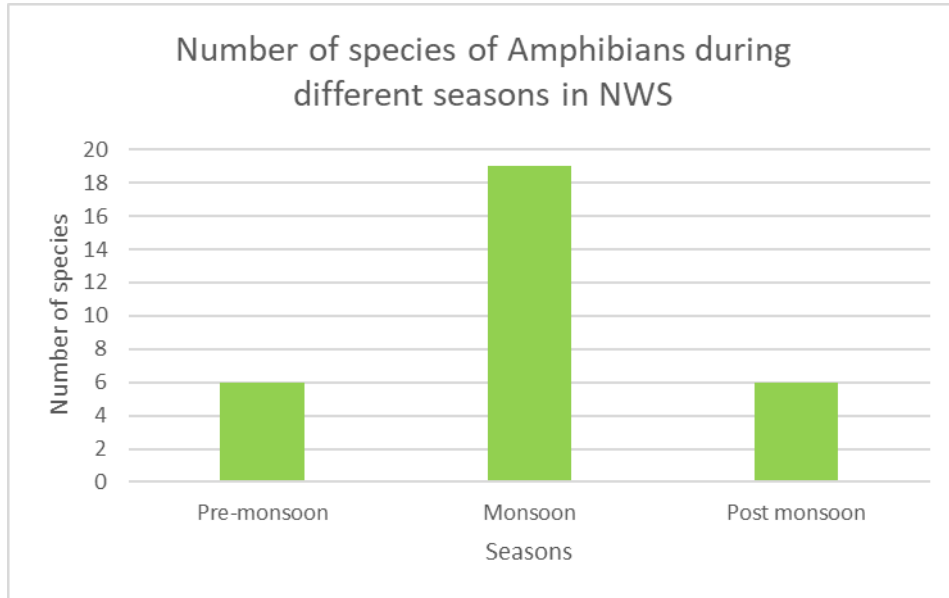


Figure 40: Graph showing number of species of Amphibians during different seasons in NWS

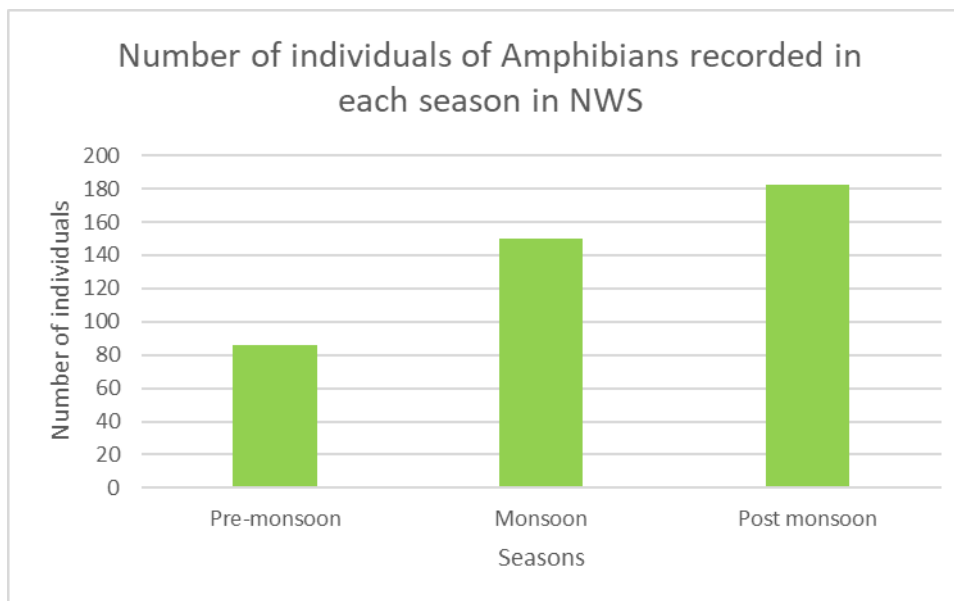


Figure 41: Graph showing number of individuals of Amphibians during different seasons in NWS

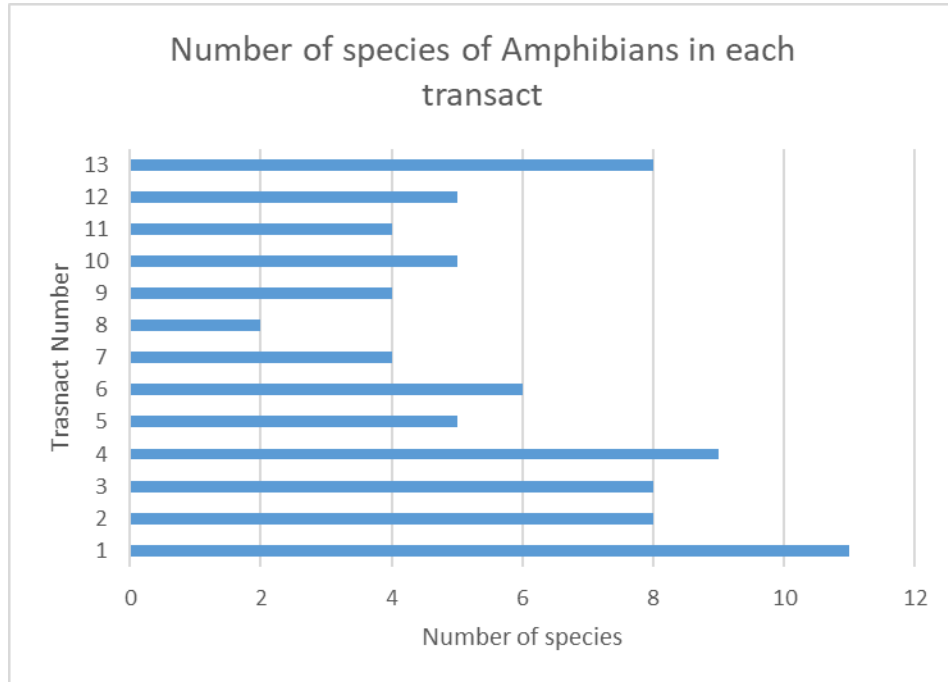


Figure 42: Graph showing number of species of Amphibians in each transect in NWS

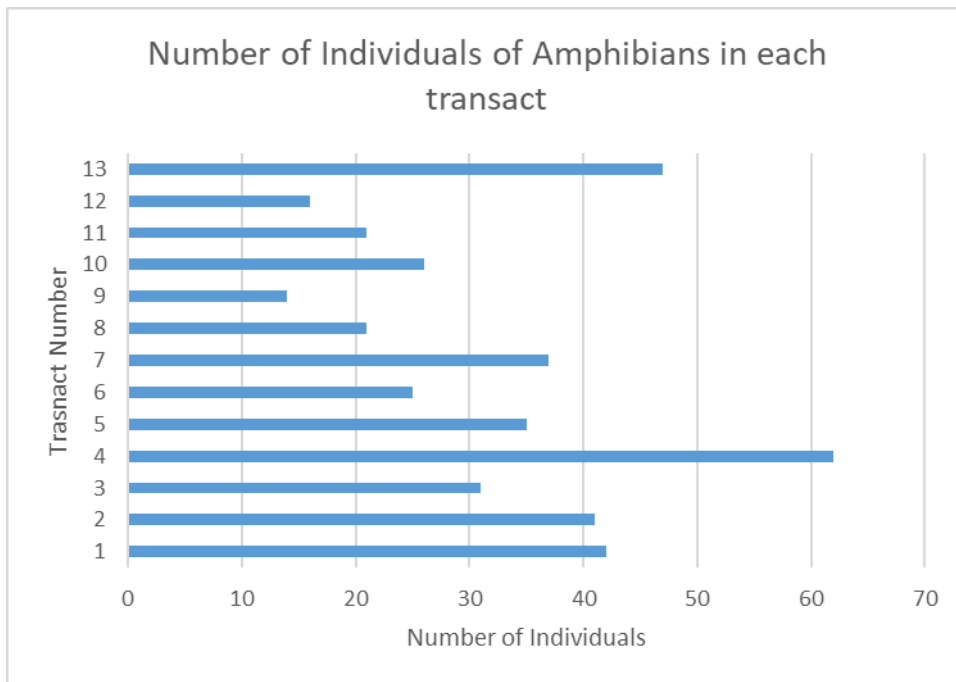


Figure 43: Graph showing number of individuals of Amphibians in each transect in NWS

Lepidoptera:

A total of 101 species of lepidoptera were recorded in CWS (Table 15). Highest number of species of Lepidoptera were recorded in Pre-Monsoon season and the lowest recorded was in post-monsoon (Figure 44, Table 18). Low species richness during post-monsoon is due to the fact that extended rains lashed during the onset of the post-monsoon season. The highest number of individuals of Lepidoptera were in Pre-monsoon and the lowest was in Monsoon season (Figure 45, Table 18). The warmth of the sun and dried streams during pre-monsoon was ideal habitat for many species because of which high individuals were recorded during pre-monsoon season. The highest number of species of Lepidoptera were recorded in transact number 3 and the lowest were recorded in transact number 9 (Figure 46, Table 17). Transact number 3 recorded the highest number of individuals of Lepidoptera while, transact number 4 had the lowest (Figure 47, Table 17). The transacts with high species richness can be used to promote eco-tourism in the sanctuary.

Sr.No.	Family	Common Name	Scientific Name
1	Lycaenidae	Common Pierrot	<i>Castalius rosimon</i>
2	Lycaenidae	Plane	<i>Bindahara phocides</i>
3	Lycaenidae	Yamfly	<i>Loxura atymnus</i>
4	Lycaenidae	Common Cerulean	<i>Jamides celeno</i>
5	Lycaenidae	Malabar Flash	<i>Rapala lankana</i>
6	Lycaenidae	Slate Flash	<i>Rapala manea</i>
7	Lycaenidae	Tailless Line Blue	<i>Prosotas dubiosa</i>
8	Lycaenidae	Tiny Grass Blue	<i>Zizula hylax</i>
9	Lycaenidae	Fluffy Tit	<i>Zeltus amasa</i>
10	Lycaenidae	Monkey Puzzle	<i>Rathinda amor</i>
11	Lycaenidae	Purple Leaf Blue	<i>Amblypodia anita</i>
12	Lycaenidae	Banded Blue Pierrot	<i>Discolampa ethion</i>
13	Lycaenidae	Gram Blue	<i>Euchrysopsc nejus</i>
14	Lycaenidae	Dingy Lineblue	<i>Petrelaea dana</i>
15	Lycaenidae	Pointed Ciliate Blue	<i>Anthene lycaenina</i>
16	Lycaenidae	Angled Pierrot	<i>Caleta decidia</i>

17	Lycaenidae	Common Lineblue	<i>Prosotas nora</i>
18	Lycaenidae	Plains Cupid	<i>Chilades pandava</i>
19	Lycaenidae	Zebra Blue	<i>Leptotes plinius</i>
20	Lycaenidae	Common Hedge Blue	<i>Acytolepis puspa</i>
21	Lycaenidae	Opaque Six-lineblue	<i>Nacaduba beroe</i>
22	Lycaenidae	Common Imperial	<i>Cheritra freja</i>
23	Lycaenidae	Purple Leaf Blue	<i>Amblypodia anita</i>
24	Nymphalidae	Great Eggfly	<i>Hypolimnus bolina</i>
25	Nymphalidae	Glassy Tiger	<i>Parantica aglea</i>
26	Nymphalidae	Tawny Coster	<i>Acraea terpsicore</i>
27	Nymphalidae	Peacock Pansy	<i>Junonia almanac</i>
28	Nymphalidae	Tamil Treebrown	<i>Lethe drypetis</i>
29	Nymphalidae	Gladeye Bushbrown	<i>Mycalesi spatnia</i>
30	Nymphalidae	Common Four-ring	<i>Ypthima huebneri</i>
31	Nymphalidae	Common Five-ring	<i>Ypthima baldus</i>
32	Nymphalidae	Tamil Yeoman	<i>Cirrochora thias</i>
33	Nymphalidae	Rustic	<i>Cupha erymanthis</i>
34	Nymphalidae	Common Evening Brown	<i>Melanitis leda</i>
35	Nymphalidae	Common Map	<i>Cyrestis thyodamas</i>
36	Nymphalidae	Dark Blue Tiger	<i>Tirumala septentrionis</i>
37	Nymphalidae	Cruiser	<i>Vindula erota</i>
38	Nymphalidae	Common Lascar	<i>Pantoporia cnacalis</i>
39	Nymphalidae	Common Nawab	<i>Polyura athamas</i>
40	Nymphalidae	Tamil Lacewing	<i>Cethosia nietneri</i>
41	Nymphalidae	Blue Oakleaf	<i>Kallima horsfieldi</i>
42	Nymphalidae	Chocolate Pansy	<i>Junonia iphita</i>
43	Nymphalidae	Common Crow	<i>Euploea core</i>
44	Nymphalidae	Common Leopard	<i>Phalanta phalantha</i>
45	Nymphalidae	Clipper	<i>Parthenos sylvia</i>
46	Nymphalidae	Common Castor	<i>Ariadne merione</i>
47	Nymphalidae	Common Sailor	<i>Neptis hylas</i>
48	Nymphalidae	Grey Count	<i>Tanaecia lepidea</i>
49	Nymphalidae	Chestnut-Streaked Sailor	<i>Neptis jumbah</i>
50	Nymphalidae	Tailed Palmfly	<i>Elymnias caudata</i>
51	Nymphalidae	Lemon Pansy	<i>Junonia lemonias</i>
52	Nymphalidae	Grey Pansy	<i>Junonia atlites</i>
53	Nymphalidae	Common Treebrown	<i>Lethe rohria</i>
54	Nymphalidae	Blackvein Sergeant	<i>Athyma ranga</i>
55	Nymphalidae	Malabar Tree Nymph	<i>Idea malabarica</i>
56	Nymphalidae	Redspot Duke	<i>Dophla evelina</i>

57	Nymphalidae	Blue Tiger	<i>Tirumala limniace</i>
58	Nymphalidae	Common Bushbrown	<i>Mycalesis perseus</i>
59	Nymphalidae	Medus Brown	<i>Orsotriaena medus</i>
60	Nymphalidae	Plain Tiger	<i>Danaus chrysippus</i>
61	Nymphalidae	Danaid Eggfly	<i>Hypolimnys misippus</i>
62	Nymphalidae	Commander	<i>Moduza procris</i>
63	Nymphalidae	Common Sailer	<i>Neptis hylas</i>
64	Nymphalidae	Common Baron	<i>Euthalia aconthea</i>
65	Nymphalidae	Stripped Tiger	<i>Danaus genutia</i>
66	Hesperiidae	Water Snowflat	<i>Tagiades litigiosa</i>
67	Hesperiidae	Chestnut Angle	<i>Odontoptilum angulate</i>
68	Hesperiidae	Restricted Demon	<i>Notocryptac urvifascia</i>
69	Hesperiidae	Chestnut Bob	<i>Iambrix salsala</i>
70	Hesperiidae	Giant Redeye	<i>Gangara thyrsis</i>
71	Hesperiidae	Suffused Snow Flat	<i>Tagiades gana</i>
72	Hesperiidae	Grass Demon	<i>Udaspes folus</i>
73	Hesperiidae	Common-banded Demon	<i>Notocrypta paralysos</i>
74	Hesperiidae	Coon	<i>Psolos fuligo</i>
75	Hesperiidae	Common Spotted Flat	<i>Celaenorrhinus leucocera</i>
76	Hesperiidae	Pygmy-scrub Hopper	<i>Aeromachus pygmaeus</i>
77	Hesperiidae	Tricolour Pied Flat	<i>Coladenia indrani</i>
78	Hesperiidae	Pea Blue	<i>Lampides boeticus</i>
79	Pieridae	Common Grass Yellow	<i>Eurema hecabe</i>
80	Pieridae	Common Wanderer	<i>Pareronia valeria</i>
81	Pieridae	Common Emigrant	<i>Catopsilia pomona</i>
82	Pieridae	Common Jezebel	<i>Delias eucharis</i>
83	Pieridae	Psyche	<i>Leptosia nina</i>
84	Pieridae	Mottled Emigrant	<i>Catopsilia pyranthe</i>
85	Pieridae	Common Albatross	<i>Appias albina</i>
86	Pieridae	Common Gull	<i>Cepora nerissa</i>
87	Pieridae	Chocolate Albatross	<i>Appiaslyncida</i>
88	Pieridae	Dark Wanderer	<i>Pareronia ceylanica</i>
89	Papilionidae	Common Jay	<i>Graphium doson</i>
90	Papilionidae	Common Rose	<i>Pachliopta aristolochiae</i>
91	Papilionidae	Malabar Banded Peacock	<i>Papilio buddha</i>
92	Papilionidae	Blue Mormon	<i>Papilio polymnestor</i>
93	Papilionidae	Common Lime	<i>Papilio demoleus</i>
94	Papilionidae	Crimson Rose	<i>Atrophaneura hector</i>
95	Papilionidae	Tailed Jay	<i>Graphium agamemnon</i>
96	Papilionidae	Common Bluebottle	<i>Graphium sarpedon</i>

97	Papilionidae	Common Mormon	<i>Papilio polytes</i>
98	Papilionidae	Southern Birdwing	<i>Troides minos</i>
99	Papilionidae	Spot Swordtail	<i>Graphium nomius</i>
100	Papilionidae	Malabar Raven	<i>Papilio dravidarum</i>
101	Riodinidae	Double-banded Judy	<i>Abisara bifasciata</i>

Table 15: Checklist of Lepidoptera in NWS

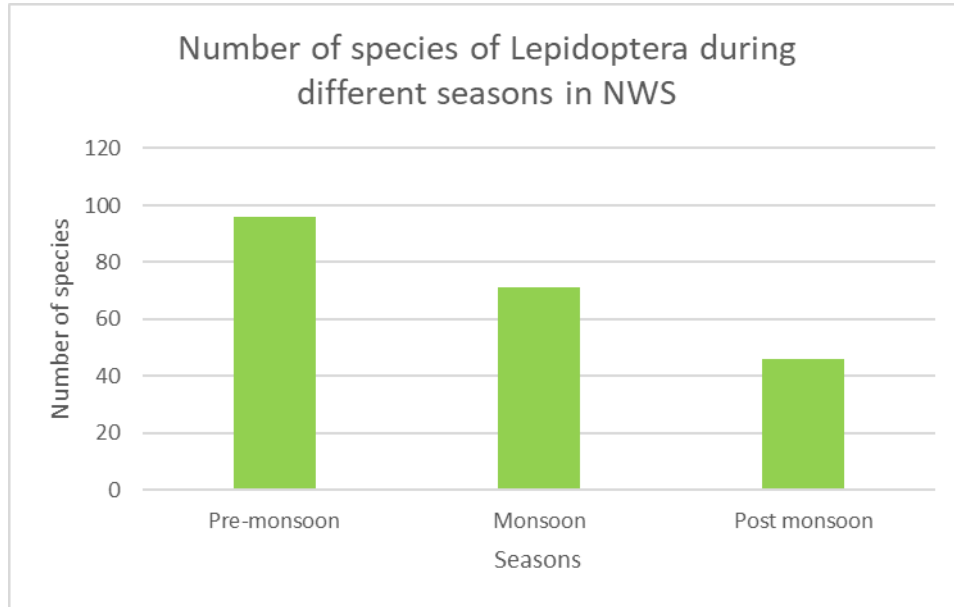


Figure 44: Graph showing number of species of Lepidoptera during different seasons in NWS

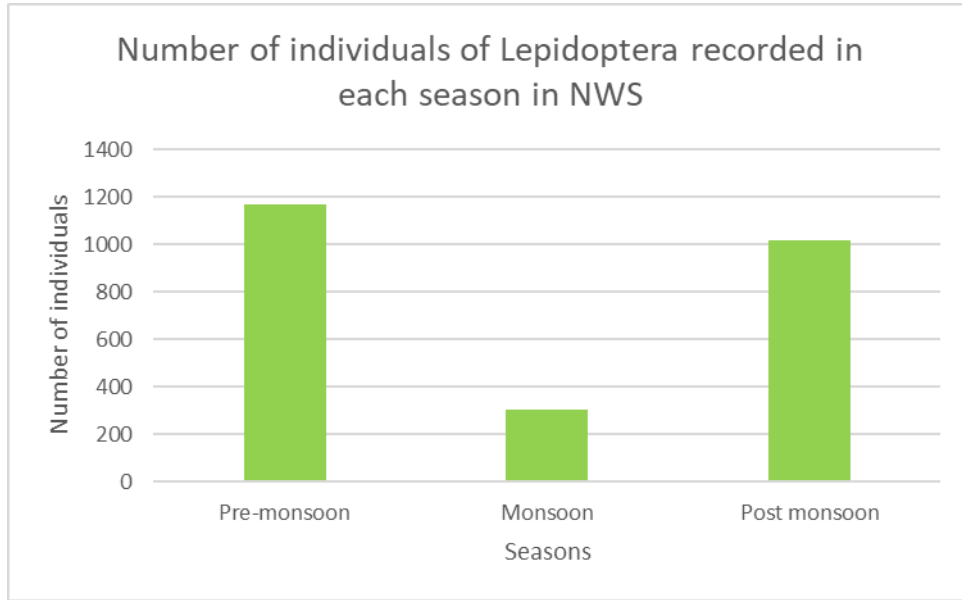


Figure 45: Graph showing number of individuals of Lepidoptera during different seasons in NWS

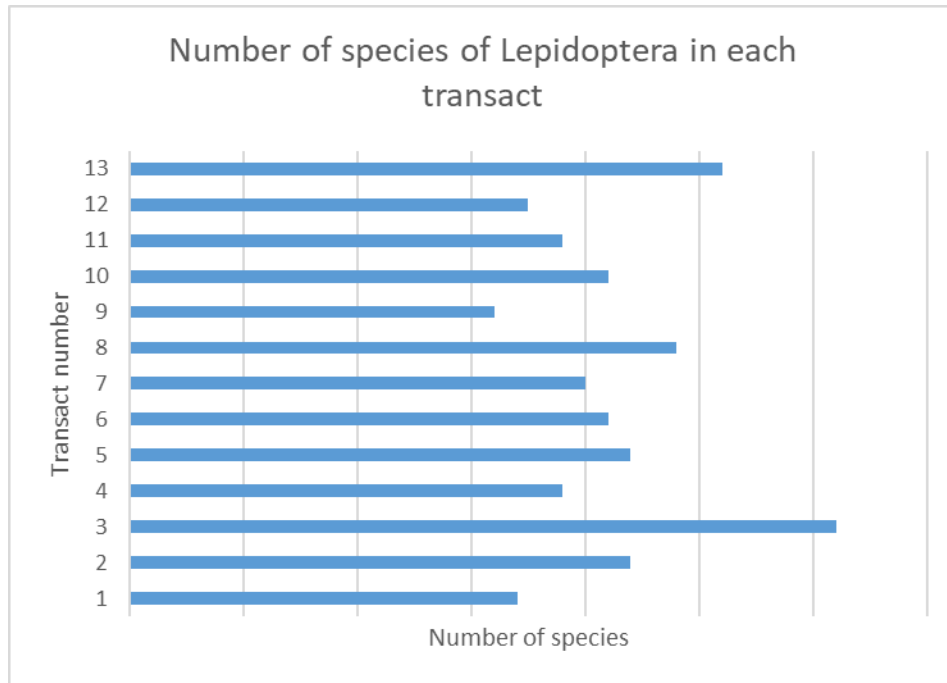


Figure 46: Graph showing number of species of Lepidoptera in each transact in NWS

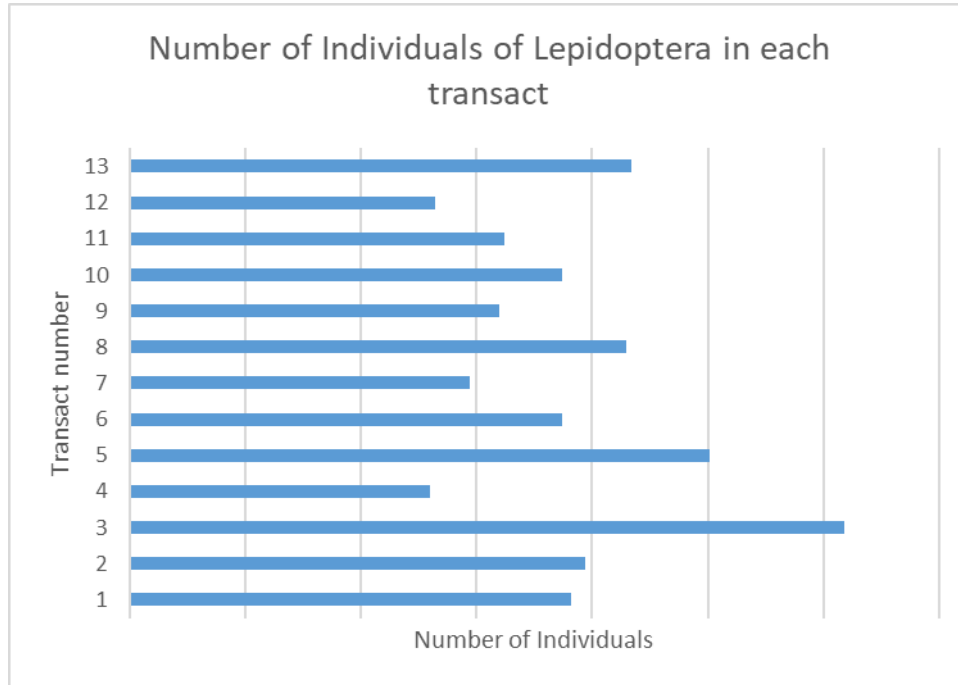


Figure 47: Graph showing number of individuals of Lepidoptera in each transact in NWS

Odonata:

A total of 17 species of odonates were recorded in CWS (Table 16). The total number of species of Odonata were the highest in monsoon and lowest was in post-monsoon (Figure 48, Table 18). The highest number of individuals of Odonata were in post-monsoon and the lowest was in Monsoon season (Figure 49, Table 18). High species richness of odonates suggest good water quality and adequate quantity of vascular plant richness in the area (Afnitha, 2021). The highest number of species of Odonatas were recorded in transact number 2 and 3 and the lowest were recorded in transact number 6 (Figure 50, Table 17). Transact number 3 recorded the highest number of individuals of Odonata while, transact number 6 and 8 had the lowest (Figure 51, Table 17). The transacts with high species richness can be used to promote eco-tourism in the sanctuary.

Sr. No.	Infra-order	Common name	Scientific Name
1	Anisoptera	Scarlet skimmer	<i>Crocothemis servilia</i>
2		Black-marsh Skimmer	<i>Indothemis carnatica</i>
3		Ground Skimmer	<i>Diplacodes trivialis</i>
4		Fulvous Forest Skimmer	<i>Neurothemis fulvia</i>
5		Green Marsh Hawk	<i>Orthetrum sabina</i>
6		Wandering Glider	<i>Pantala flavescens</i>
7		Coral-tailed Cloudwing	<i>Tholymis tillarga</i>
8		Pied Paddy Skimmer	<i>Neurothemis tullia</i>
9		Orange-Tailed Marsh Hawk	<i>Ceriagrion cerinorubellum</i>
10		Crimson-tailed Marsh Hawk	<i>Orthetrum pruinatum</i>
11		Granite Ghost	<i>Bradinopyga geminata</i>
12		Asiatic Bloodtail	<i>Lathrecista asiatica</i>
13	Zygoptera	Malabar Torrent Dart	<i>Euphaea fraseri</i>
14		Stream Glory	<i>Neurobasis chinensis</i>
15		Clear-winged Forest Glory	<i>Vestalis gracilis</i>
16		Stream Ruby	<i>Heliocypha biignata</i>
17		Red spot Reedtail	<i>Protosticta sanguinostigma</i>

Table 16: Checklist of Odonates in NWS

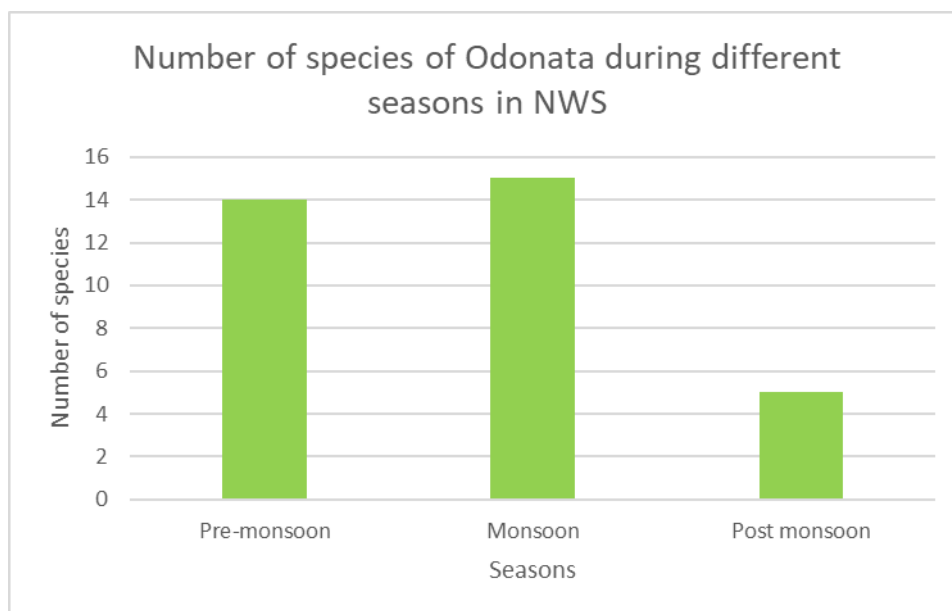


Figure 48: Graph showing number of species of Odonata during different seasons in NWS

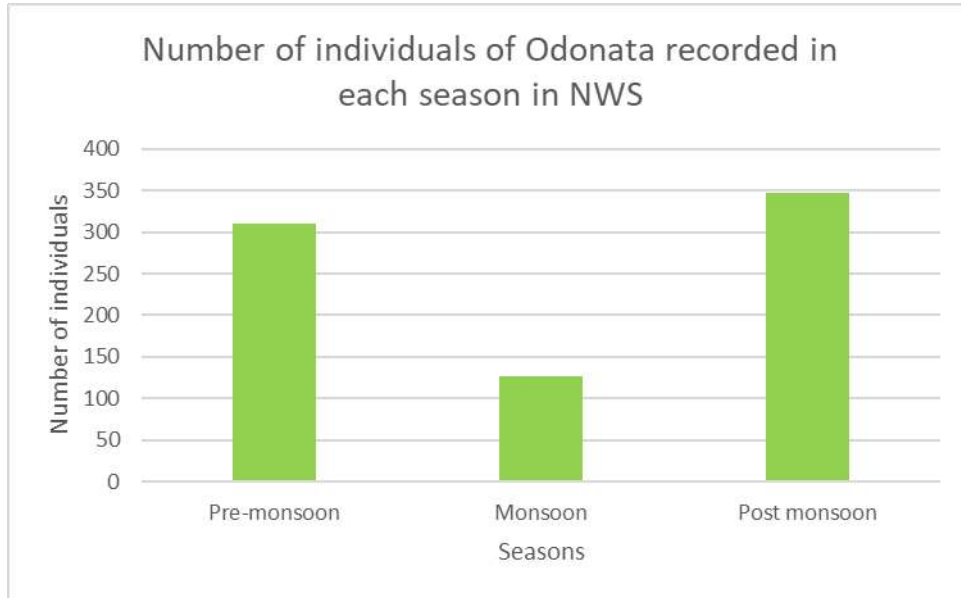


Figure 49: Graph showing number of individuals of Odonata during different seasons in NWS

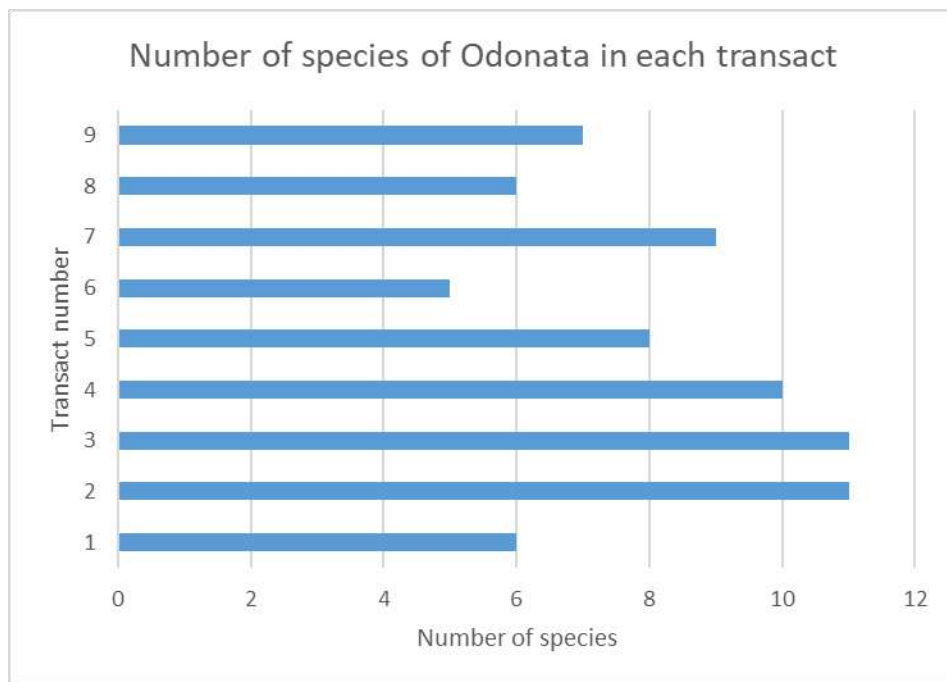


Figure 50: Graph showing number of species of Odonata in each transect in NWS

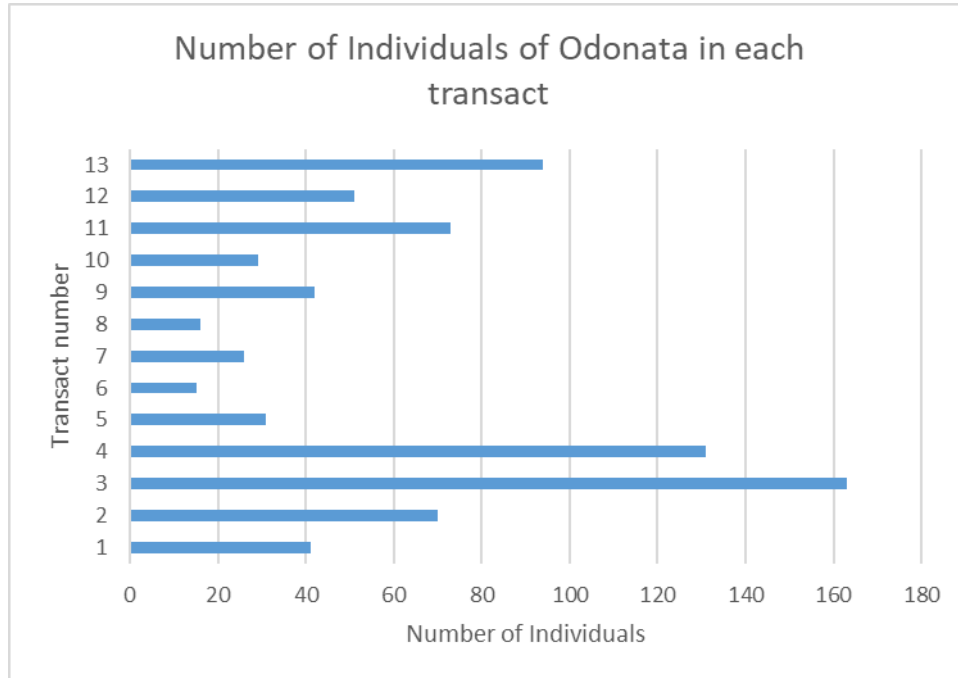


Figure 51: Graph showing number of individuals of Odonata in each transect in NWS

Transect	Aves		Mammals		Reptiles		Amphibians		Lepidoptera		Odonata	
	Sp.	Ind.	Sp.	Sp.	Ind.	Sp.	Ind.	Sp.	Ind.	Sp.	Ind.	
1	42	184	9	42	184	11	42	34	191	6	41	
2	46	179	12	46	179	8	41	44	197	11	70	
3	68	242	13	68	242	8	31	62	309	11	163	
4	43	182	14	43	182	9	62	38	130	10	131	
5	52	278	11	52	278	5	35	44	251	8	31	
6	43	141	9	43	141	6	25	42	187	5	15	
7	46	186	6	46	186	4	37	40	147	9	26	
8	53	195	4	53	195	2	21	48	215	6	16	
9	44	181	3	44	181	4	14	32	160	7	42	
10	58	210	4	58	210	5	26	42	187	7	29	
11	49	219	9	49	219	4	21	38	162	8	73	
12	36	134	4	36	134	5	16	35	132	5	51	
13	48	215	12	48	215	8	47	52	217	8	94	

Table 17: Table showing number of species and individuals in each transect of each taxon in NWS, Sp. :Species, Ind. :Individuals

Taxa		Pre-monsoon	Monsoon	Post monsoon
Mammals	Species	19	11	19
	Individuals			
Aves	Species	106	62	72
	Individuals	985	300	1261
Reptiles	Species	12	24	8
	Individuals	292	114	121
Amphibians	Species	6	19	6
	Individuals	86	150	182
Lepidoptera	Species	96	71	46
	Individuals	1167	304	1015
Odonata	Species	14	15	5
	Individuals	310	126	348

Table 18: Table showing number of species and individuals of each taxon recorded during each season in NWS

Shanon Diversity Index (H)

Aves: On calculating the shanon diversity (H) index of Aves in CWS highest H index was observed during pre-monsoon while lowest was observed in post-monsoon, similarly H index of Aves in NWS was found to be highest in pre-monsoon while it was lowest in post monsoon (Figure 52, Table 19). Overall higher H index of Aves was seen in NWS in comparison to CWS during pre-monsoon and Monsoon but was relatively same during post monsoon (Figure 52, Table 19).

Reptiles: On calculating the shanon diversity (H) index of Reptiles in CWS highest H index was observed during monsoon while lowest was observed in pre-monsoon and post-monsoon, similarly H index of reptiles in NWS was found to be highest in monsoon while it was lowest in pre-monsoon and post monsoon (Figure 53, Table 19). Overall higher H index of Reptiles was seen in NWS in comparison to CWS during monsoon season but no difference was observed in H index during pre-monsoon and post monsoon (Figure 53, Table 19).

Amphibians: On calculating the shanon diversity (H) index of Amphibians in CWS highest H index was observed during monsoon followed by post-monsoon and lowest was observed in pre-monsoon, similarly H index of Amphibians in NWS was found to be highest in monsoon followed by pre-monsoon and lowest was observed in post monsoon (Figure 54, Table 19).

Overall higher H index of Reptiles was seen in NWS in comparison to CWS during monsoon and pre-monsoon season but during post monsoon season higher H index was seen in CWS in comparison to NWS (Figure 54, Table 19).

Lepidoptera: On calculating the shanon diversity (H) index of Lepidoptera it was observed that H index in CWS was highest in pre-monsoon, while there was no much difference during monsoon and post-monsoon season, similar trend H index was observed in NWS (Figure 55, Table 19). Comparing H index of both CWS and NWS there was no visible difference in terms of diversity in both (Figure 55, Table 19).

Odonata: On calculating the shanon diversity (H) index of Odonata it was observed that H index in CWS was highest in monsoon, followed by pre-monsoon and post-monsoon similar trend of H index was observed in NWS (Figure 56, Table 19). Comparing H index of both CWS and NWS there was no visible difference in terms of diversity in both during each season (Figure 56, Table 19)

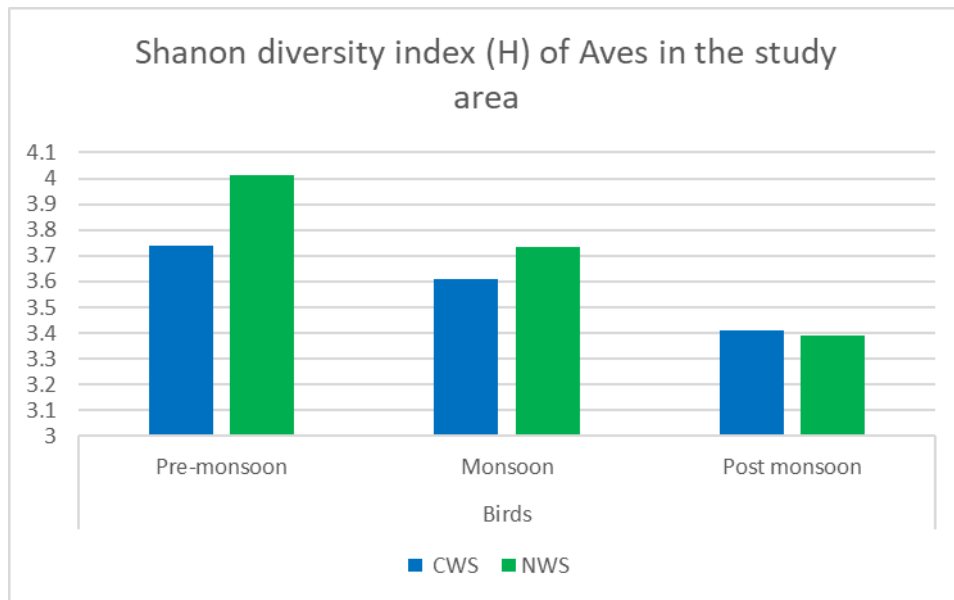


Figure 52: Graph showing Shanon diversity index (H) of Aves in the study area

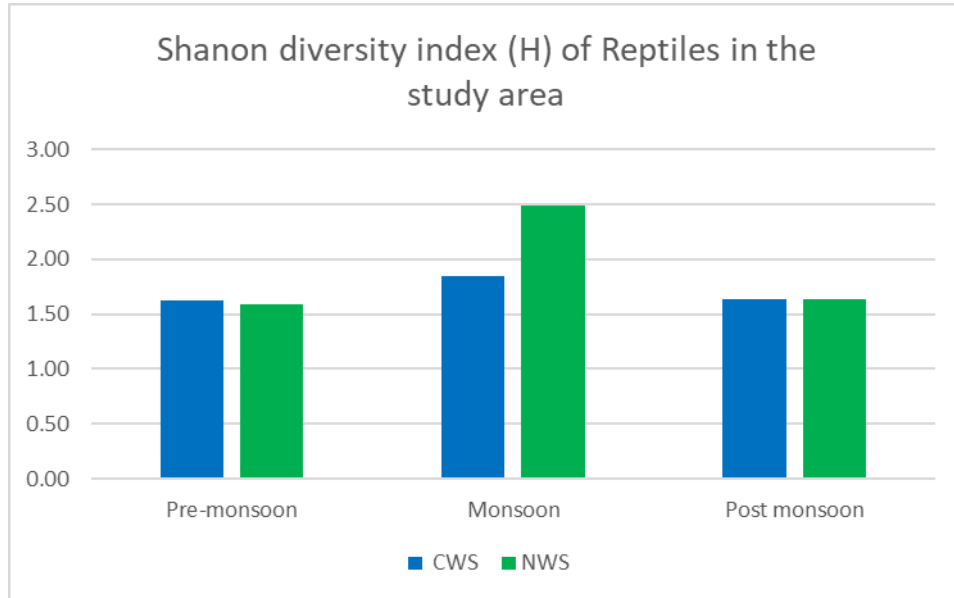


Figure 53: Graph showing Shanon diversity index (H) of Reptiles in the study area

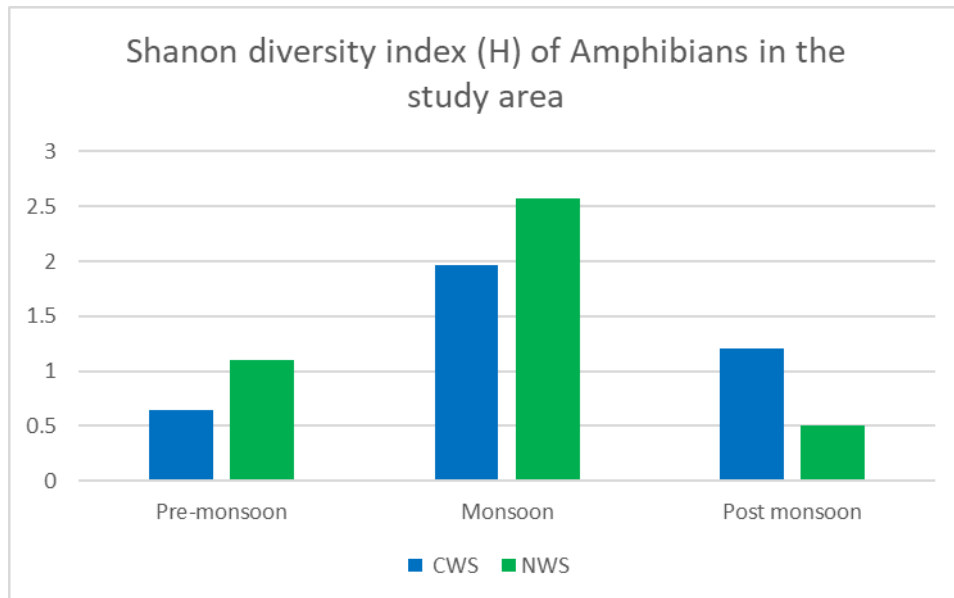


Figure 54: Graph showing Shanon diversity index (H) of Amphibians in the study area

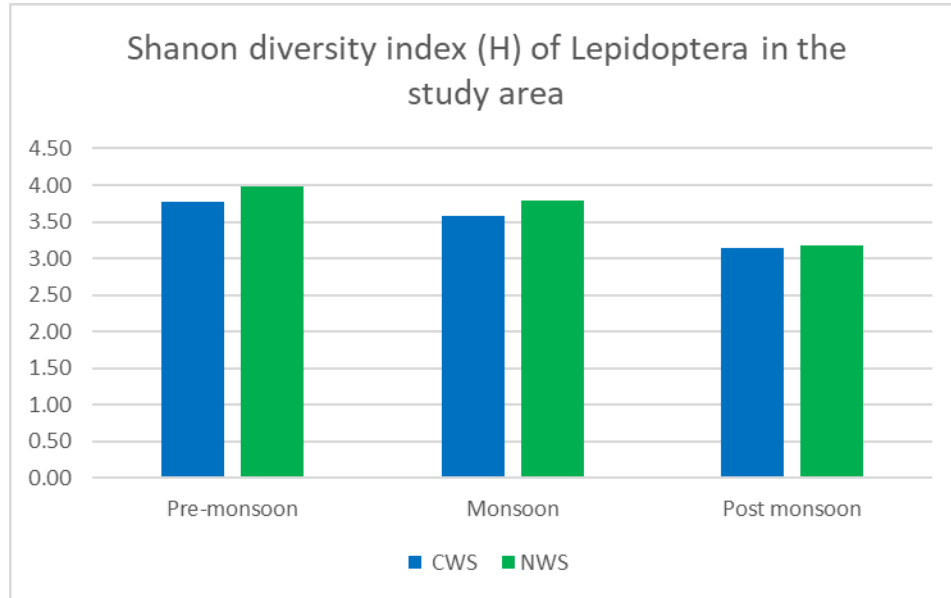


Figure 55: Graph showing Shanon diversity index (H) of Lepidoptera in the study area

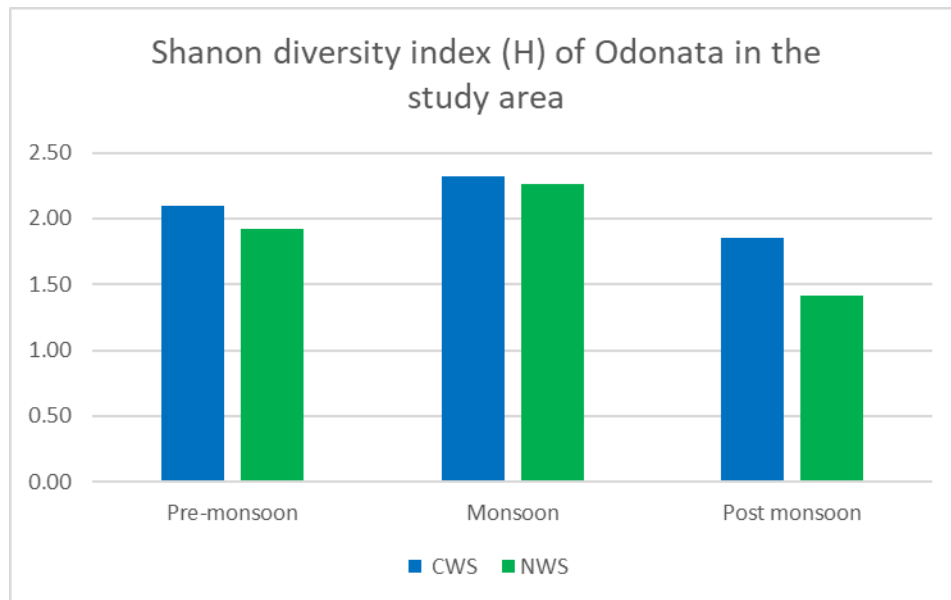


Figure 56: Graph showing Shanon diversity index (H) of Odonata in the study area

Taxa	Season	Shanon diversity index (H)	
		CWS	NWS
Aves	Pre-monsoon	3.74	4.01
	Monsoon	3.61	3.74
	Post monsoon	3.41	3.39

Amphibians	Pre-monsoon	0.64	1.10
	Monsoon	1.97	2.57
	Post monsoon	1.21	0.51
Reptiles	Pre-monsoon	1.62	1.59
	Monsoon	1.84	2.49
	Post monsoon	1.64	1.64
Odonata	Pre-monsoon	2.09	1.92
	Monsoon	2.32	2.26
	Post monsoon	1.86	1.41
Lepidoptera	Pre-monsoon	3.77	3.98
	Monsoon	3.58	3.79
	Post monsoon	3.14	3.17

Table 19: Table showing Shanon diversity (H) Index of each taxon in the study area

Simpsons Diversity Index (D)

Aves: On calculating Simpsons Diversity Index of Aves, CWS showed high D index during Pre-monsoon followed by monsoon and post-monsoon, similar trend was followed by NWS. Comparing the D diversity of CWS and NWS, NWS showed higher D index during pre-monsoon and monsoon, but was dominated by CWS in the post monsoon. Both NWS and CWS showed similar trend (Figure 57, Table 20).

Reptiles: The D index of Reptiles in CWS was almost similar in all three seasons, while in NWS it was higher during monsoon and lower during pre-monsoon. Comparing both there was no much difference observed in terms of D index distribution in all three seasons (Figure 58, Table 20).

Amphibians: After calculating Simpson diversity index (D) of Amphibians, CWS showed higher D index during monsoon followed by post-monsoon and pre-monsoon, while NWS showed higher D index during monsoon followed by pre-monsoon and post-monsoon. Comparing both CWS and NWS, NWS showed higher D index during monsoon and pre-monsoon while CWS showed higher diversity during post-monsoon (Figure 59, Table 20).

Lepidoptera: After calculating Simpson diversity index (D) of Lepidoptera, CWS showed higher D index during pre-monsoon followed by monsoon and post-monsoon, while NWS too showed similar trend. Comparing both CWS and NWS, NWS showed higher D index during in all three seasons (Figure 60, Table 20).

Odonata: After calculating Simpson diversity index (D) of Odonata no much difference was observed in D index during all three seasons in both CWS and NWS. Comparing both CWS and NWS, CWS showed higher D index during in all three seasons (Figure 61, Table 20).

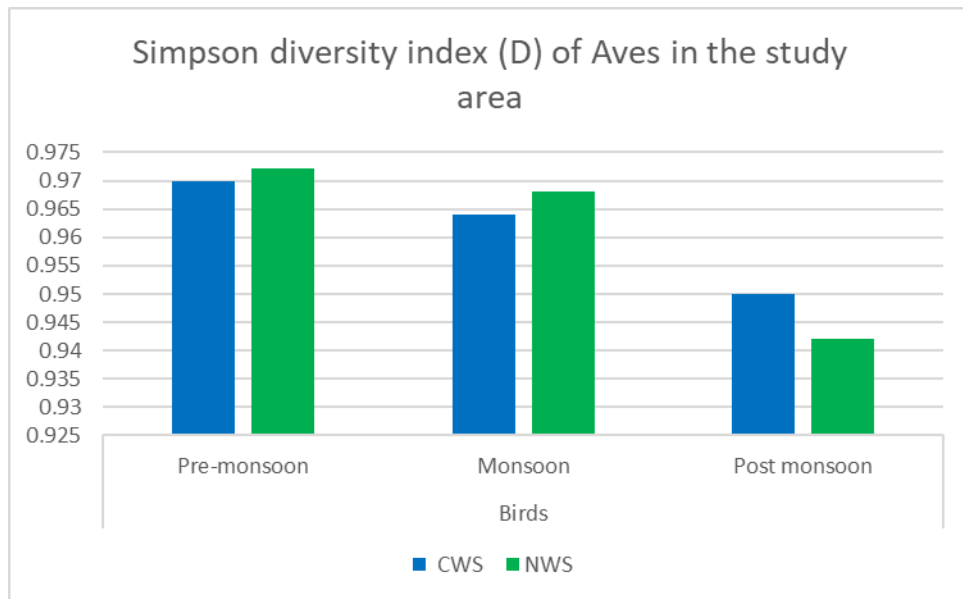


Figure 57: Graph showing Simpson diversity (D) index of Aves in the study area

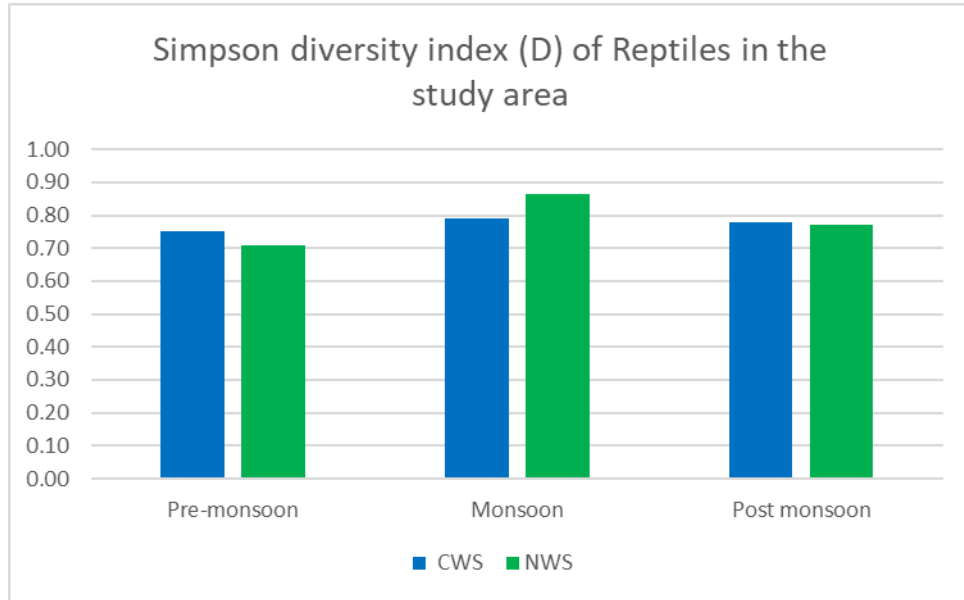


Figure 58: Graph showing Simpson diversity (D) index of Reptiles in the study area

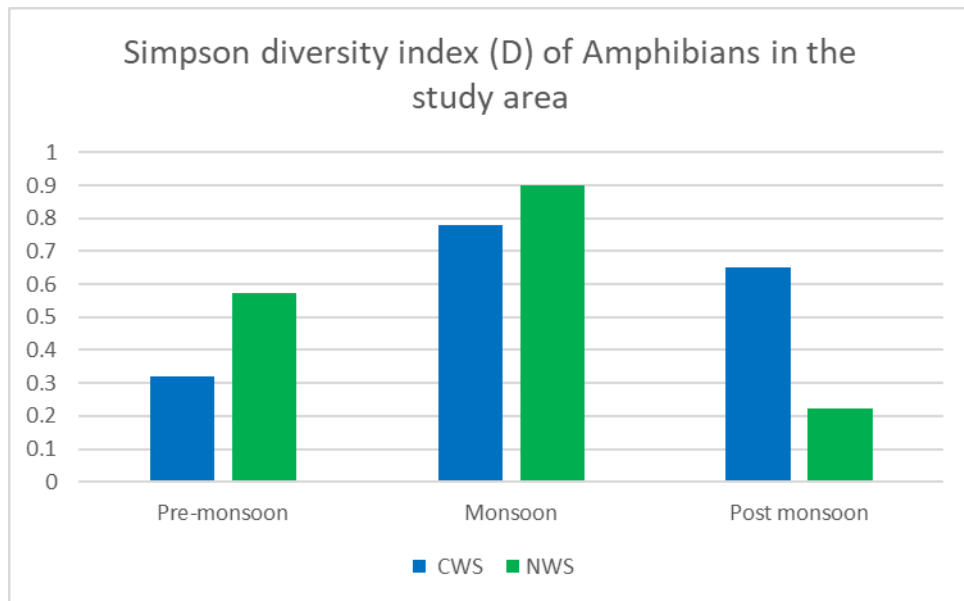


Figure 59: Graph showing Simpson diversity (D) index of Amphibians in the study area

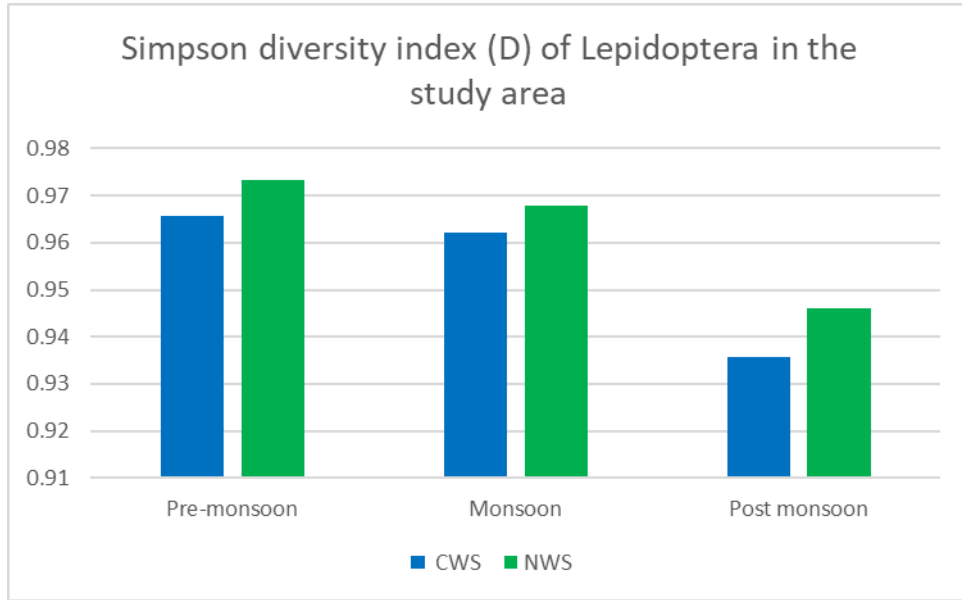


Figure 60: Graph showing Simpson diversity (D) index of Lepidoptera in the study area

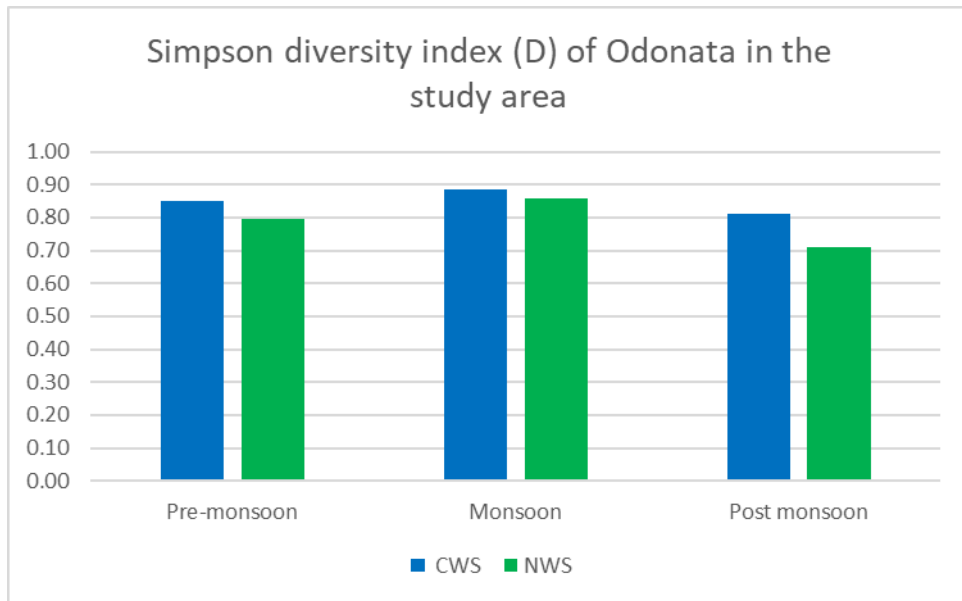


Figure 61: Graph showing Simpson diversity (D) index of Odonata in the study area

Taxa	Season	Simpson diversity index (H)	Taxa
		CWS	NWS
Aves	Pre-monsoon	0.97	0.97
	Monsoon	0.96	0.97
	Post monsoon	0.95	0.94
Amphibians	Pre-monsoon	0.32	0.57
	Monsoon	0.78	0.90
	Post monsoon	0.65	0.22
Reptiles	Pre-monsoon	0.75	0.71
	Monsoon	0.79	0.86
	Post monsoon	0.78	0.77
Odonata	Pre-monsoon	0.85	0.80
	Monsoon	0.88	0.86
	Post monsoon	0.81	0.71
Lepidoptera	Pre-monsoon	0.97	0.97
	Monsoon	0.96	0.97
	Post monsoon	0.94	0.95

Table 20: Table showing Simpson diversity (D) Index of each taxon in the study area

Plate 1: Mammals



Malabar Giant Squirrel



Grey Slender Loris



Three-striped Palm Squirrel



Gaur



Dhole



Indian Giant Flying Squirrel

Plate 2: Mammals



Bonnet Macaque



Spotted Deer



Sloth Bear



Malabar Gray Langur

Plate 3: Aves



Black-naped Monarch



Brown-breasted flycatcher



Crimson-backed Sunbird



Forest Wagtail



Green Warbler



Grey Wagtail

Plate 4: Aves



Nilgiri Flowerpecker



Square-tailed Bulbul



Oriental-dwarf Kingfisher



Orange Minivet



Flame-throated Bulbul



Malabar Trogon

Plate 5: Aves



Brown Fish Owl



Great Hornbill



Malabar Grey Hornbill



Malabar Pied Hornbill



White-bellied Blue Flycatcher



White-rumped Shama

Plate 6: Reptiles



Deccan Banded Gecko



Goan Day Gecko



Roux's Forest Lizard



Malabar Pit Viper



Bengal Monitor



Southern Flying Lizard

Plate 7: Reptiles



Checkered Keelback



Buff Striped Keelback



Whitaker's Boa



Forsten's Cat Snake



Green Vine Snake



Hump Nosed Pit Viper

Plate 8: Amphibians



Malabar Gliding Frog



Amboli Bush Frog



Reddish Burrowing Frog



Common Indian Toad



Night Frog



Indian Burrowing Frog

Plate 9: Lepidoptera



Glad-eye Bushbrown



Tamil Lacewing



Fluffy Tit



Plane



Malabar Flash



Blue Oakleaf

Plate 10: Lepidoptera



Tawny Coaster



Monkey Puzzle



Red-spot Duke



Danaid Egg-fly



Water-snow Flat



Blue Tiger

Plate 11: Odonata



Clear-winged Forest Glory



Malabar Torrent Dart



Coral-tailed Cloudwing



Fulvous Forest Skimmer



Orange-tailed Marsh Dart



Asiatic Bloodtail

Chapter IV: References

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