



A report on the flora and fauna of selected areas of Kendujhar district, Odisha, India

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Abstract

A survey was conducted to document the diversity of flora and fauna of Kendujhar district of Odisha state of Eastern India, during May 15 to May 21, 2023. A total of 28 species of plants recorded. Among flora diversity, Fabaceae shows domination with 6 Genus which includes total of 6 species and followed by Lamiaceae with 4 genera consisting of 4 species. Among fauna diversity, 36 species of birds and 58 species of insects including 18 species of butterfly were documented. Order Passeriformes is most dominant among the diversity of birds, which consists of 18 genera of total 20 orders. In the case of insects, there are 8 species of aquatic insects and 11 orders of terrestrial insects were recorded. Insects of Diptera, Orthoptera and Collembola order were found more by light trap, sweeping net and pitfall trap technique respectively. Nymphalidae of order Lepidoptera was the richest family among the diversity of butterfly.

Keywords: Biodiversity, flora and fauna, butterfly, light trap, sweep net, pitfall trap, Kendujhar district, Odisha

Introduction

Kendujhar is a landlocked district in the northern part of Odisha, which is very rich in mineral resources and has large deposits of iron, manganese and chromium. The district is covered by dense forests of north tropical deciduous types of trees including Sal, Asan, Jamu, Arjuna, Kusum, Kangada, Mahua, Mango, Kendu^[8, 9]. It has one of the oldest rock formations in the world, covering an area of 100 km². Also, the place is surrounded by breathtaking waterfalls besides thick forests with different species of trees, which showcase the beauty of mother nature.

India is a mega diversity centre with more than 46,000 species of plants [from about 70 per cent geographical area surveyed by the Botanical Survey of India (BSI), Kolkata so far], 518 species of reptiles [according to Zoological Survey of India (ZSI)], approximately 472 species of amphibians are known from India, of which 50% are endemic^[6], approximately 1371 species of birds, of which 81 are endemic to the country^[12], 63,760 species insects grouped in 658 families of 27 order, of which the order Coleoptera is the most diverse having 17,455 species under 114 families^[5] and is the home to about 7.6% of mammal. India added 664 animal species to its fauna database in 2022, including 467 new species and 197 new records (species found in India for the first time). In 2022, the country added 339 new plant taxa, including 186 taxa that are new to science and 153 taxa that are new distribution records from the country (The details of new discoveries and new records were released by Union Minister for Environment, Forest and Climate Change Bhupender Yadav in Kolkata on July 1).

Biodiversity is very important as species and ecosystems provide the basis for human civilization. The value of biodiversity cannot be determined by how far it can be used in terms of money or material by humans. Like humans, all other organisms have the right to live and play a major role in providing stability to the entire biosphere.

Some research has been done on flora and fauna (*viz.* diversity of plant, bird and insect species) in the different parts of Odisha by Ramakrishna *et al.*^[17], Reddy *et al.*^[18], Lahkar *et al.*^[11], Arjun *et al.*^[2].

An extensive survey was conducted over a period of one month to document the flora and fauna within the five study areas of Kendujhar district (also known as Iron City) of the state of Odisha was carried out. Similarly, the diversity of flora and fauna has not been recorded from these areas of these five selected areas of the district before. So, this paper has highlighted the diversity of plant, birds and insect species of these areas, which have been recorded through this field work.

Materials and Method

Study site

From May 15 to May 21, 2023, a field work including survey and documentation of flora and fauna was carried out in different ecosystems of different parts of Kendujhar district of Odisha state of Eastern India, *viz.* Study site 1-surrounding area of Joda (22.0189402,85.4218557), about 51 KM towards North from district headquarters Kendujhar; Study site 2-surrounding area of Jateswar temple (22.0747687,85.4271712), about 6 Km from Barbil; Study site 3- Raeka (22.097762, 85.409119), about 68 km distance from district headquarter Kendujhar; Study site 4- Jhinkra Waterfall (22.0977925,85.3154861), about 10 Km (approx.) from Barbil; Study site 5- surrounding area of Pundul Shiv Temple (22.0156456,85.2899447), about 17 Km from Barbil (Fig.1). Along with observing and recording birds, terrestrial insects, butterflies and plants, aquatic insects are collected from these study sites for living water bodies. The temperature of the district begins to rise rapidly in spring and however the maximum temperature recorded in May is usually up to 38°C.

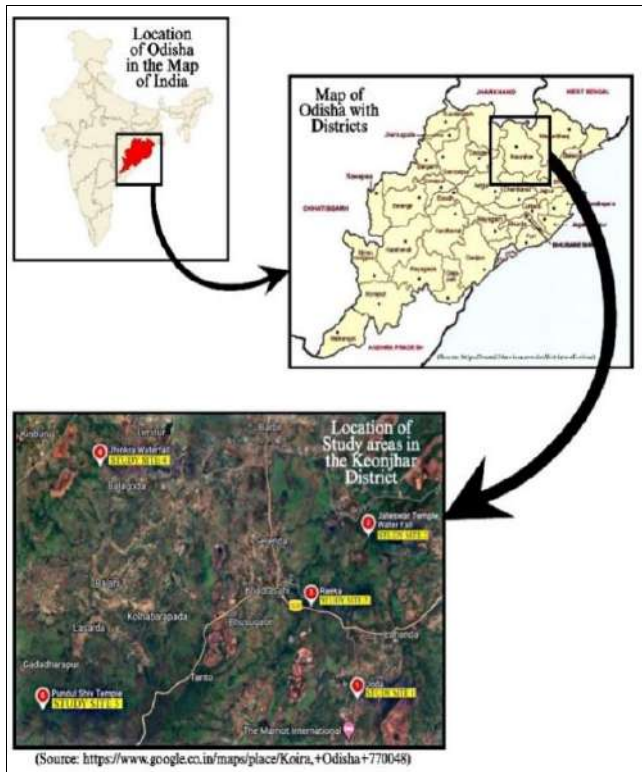


Fig 1: Location of study areas in Kendujhar district of Odisha

Methodology

For studying plants' diversity

Floral diversity is examined and documented to study plant diversity at study sites. Five areas were selected in each study site based on the abundance of trees, shrubs and bushes. Quadrat method was used in the present study for vegetation analysis and for that 10m×10m quadrates were established in each area [16]. Analytical characters have been obtained by square type quadratic method. Photographs of trees, shrubs, and bushes were taken from each quadrat so that they could be identified later by looking at these pictures by Mr. Dipankar Hazra (Plant taxonomist).

For studying birds' diversity

For the aim of studying the diversity of birds, selection of routes is done, but are usually overly controlled by accessibility. To avoid counting the same birds twice, routes were to be reasonably spaced. In this study, during walking through the selected study sites, from 6.30 AM to 8.30 AM and from 3.30 PM to 5.30 PM, birds were accessed. Total length of the route is 15-point Counts and 2.5km Trail each observation.

In open habitats, a speed of about 2 km/hr is taken to be reasonable. In the present study the same was maintained. The birds on both side of the transect were observed using a binocular. Camera lens were used to capture the images of the birds for identification later. The birds were identified following the book written by Grimmett, Inskipp, and Inskipp [7].

For studying the diversity of terrestrial insects

Sweep net

Sweep nets are strongly build nets, often with a canvas bag used to sweep through vegetation to collect random insects, viz. flies, bugs, and small beetles.

Light trap

Light trap is an active trap method as it uses light as an additional attractant in front of a white background. This method was utilized to catch the nocturnal insects.

Pitfall traps

Pitfall traps are used for active, surface-living invertebrates in low vegetation and bare ground, particularly larger beetles, ants, springtail, etc.

Each sample of terrestrial insects collected by sweeping nets, light traps and pitfall traps is put into the Petri dish and identified under stereo binocular microscope.

For studying the diversity of aquatic insects

First, aquatic insects are collected by hand sweep/aquatic net and random field sampling method was used to cover 3 study site (Study site 2, 4 and 5). Then, initially, identified in the field directly, but in the field those aquatic insects are difficult to identify, collected and preserved in 70% alcohol or acetone. After that, carried them to the laboratory for further identification.

For studying the diversity of butterflies

In the present study, during walking through the selected study sites, from 09 AM to 12 PM (when activities of butterflies found in top most to control their body temperature in sunlight), butterflies were accessed by random observations. In the field, with the help of camera, photographs of the butterflies were taken for further identification. Identification of butterfly species were identified on the basis of wing colour patterns, shapes, and sizes was done by following standard literatures [21, 10, 40].

Result

The results of the study revealed that field observation data indicated that a total of 28 species of plants belonging to 16 different families of 11 different orders were found. Among which 11 species of trees, 7 species of shrubs, 10 species of herbs recorded. The study also records 36 species of birds and 58 species of insects including butterflies.

Flora diversity

The plant diversity shows the following families namely Lamiaceae and Acanthaceae which are belongs to Lamiales order; Meliaceae, Anacardiaceae and Rutaceae which are belongs to Sapindales; Lythraceae, Myrtaceae, Combretaceae which are belongs to Myrtales order; Phyllanthaceae, Dioscoreaceae, Fabaceae, Asteraceae, Moraceae, Amaranthaceae, Leiothrichidae and Dipterocarpaceae which are belongs to Malpighiales, Dioscoreales, Fabales, Asterales, Rosales, Caryophyllales, Passeriformes and Malvales order respectively. In these, Fabaceae family topped the list with 6 genus which includes total of 6 species followed by Lamiaceae with 4 genera consisting of 4 species; Asteraceae with 3 genera consisting of 3 species; Lythraceae and Rutaceae both the families 2 species, but in case of Lythraceae both the species belongs to 1 genus and in case of Rutaceae both the species belongs to 2 genus (Table 1 and Fig.2).

Fauna diversity

Also, the distribution of bird and insect species in the study areas were identified. A total of 36 species of birds belonging to 23 different families of 9 different orders were found. Out of these 9 orders, order Passeriformes is most dominant, which consists of 18 genera of total 20 species. On the other side, the 2 orders Bucerotiformes and Phalacrocoracidae are less dominant with 1 species each (Table 2 and Fig.3).

A large variety of insects including some of the spectacular Butterflies were documented during our study. A total of 18 species of butterfly belong to 5 families were recorded in the study area. Nymphalidae was the richest family in the study area that comprised 9 species of butterfly followed by Pieridae with 5 species, Papilionidae with 2 species, Lycaenidae and Hesperidae families were the lowest with 1 species, respectively. Among the 18 butterfly species recorded from the study areas, these 6 species (Gray pansy,

Common sailor, Common four ring, Common crow, Lemon emigrant and Common grass yellow) were found in all the study areas (Table 3 and Fig.4).

In the case of insects, there are 8 species records of aquatic insects, which belong to 5 families of 2 orders and 33 species records of terrestrial insects, which belong to 22 families of 10 orders. Out of these 2 orders of aquatic insects, order Hemiptera is most dominant, which consists of 7 species which belongs to 5 genus (Table 4 and Fig.5). On the other side, out of these 10 orders of terrestrial insects, 2 orders (consist of 4 species of 3 families) of insects were found by light trap technique, 5 orders (consist of 17 species of 11 families) of insects were found by sweeping net technique) and 8 orders (consist of 14 species of 12 families) of insects were found by pitfall trap technique. Insects of Diptera, Orthoptera and Collembola order were found more by light trap, sweeping net and pitfall trap technique respectively (Table 5, Fig.6 and 7).

Table 1: List of Plants recorded in the study area

Sl. No.	Scientific Name	Order	Family
01	<i>Hyptis suaveolens</i> [(L.) Kuntze]	Lamiales	Lamiaceae
02	<i>Bridelia</i> sp.	Malpighiales	Phyllanthaceae
03	<i>Dioscorea</i> sp.	Dioscoreales	Dioscoreaceae
04	<i>Phaseolus</i> sp.	Fabales	Fabaceae
05	<i>Rubicaulis</i> sp.	Fabales	Fabaceae
06	<i>Lagerstroemia parviflora</i> (Roxb.)	Myrtales	Lythraceae
07	<i>Lophomyrtus</i> sp.	Myrtales	Myrtaceae
08	<i>Chromolaena odorata</i> [(L.) R.M.King & H.Rob.]	Asterales	Asteraceae
09	<i>Elephantopus scaber</i> (L.)	Asterales	Asteraceae
10	<i>Clerodendrum fargesii</i>	Lamiales	Lamiaceae
11	<i>Ficus</i> sp.	Rosales	Moraceae
12	<i>Cassia</i> sp.	Fabales	Fabaceae
13	<i>Lagerstroemia</i> sp.	Myrtales	Lythraceae
14	<i>Combretum decandrum</i> (Roxb.)	Myrtales	Combretaceae
15	<i>Tephrosia</i> sp.	Fabales	Fabaceae
16	<i>Albizia lebbek</i> [(L.) Benth.]	Fabales	Fabaceae
17	<i>Alternanthera tenella</i> (Colla)	Caryophyllales	Amaranthaceae
18	<i>Acacia auriculiformis</i> (A.Cunn. ex Benth.)	Fabales	Fabaceae
19	<i>Azadirachta indica</i> (A.Juss.)	Sapindales	Meliaceae
20	<i>Eragrostis gangetica</i> (Roxb.) Steud.	Passeriformes	Leiothrichidae
21	<i>Spilanthes paniculata</i> (Wall. Ex DC.)	Asterales	Asteraceae
22	<i>Pogostemon benghalensis</i> [(Burm.f.) Kuntze]	Lamiales	Lamiaceae
23	<i>Barleria strigosa</i> (Willd.)	Lamiales	Acanthaceae
24	<i>Shorea robusta</i> (Roth)	Malvales	Dipterocarpaceae
25	<i>Mangifera indica</i> (L.)	Sapindales	Anacardiaceae
26	<i>Clerodendrum fargesii</i> (Dode)	Lamiales	Lamiaceae
27	<i>Aegle marmelos</i> [(L.) Corrêa]	Sapindales	Rutaceae
28	<i>Murraya paniculata</i> [(L.) Jack]	Sapindales	Rutaceae

Table 2: List of Bird species recorded in the area

Sl. No.	Common Name	Scientific Name	Order	Family
01	Ashy Prinia (Sykes, 1832)	<i>Prinia socialis</i>	Passeriformes	Cisticolidae
02	Asian Green Bee-eater (Latham, 1801)	<i>Merops orientalis</i>	Coraciiformes	Meropidae
03	Asian Koel (Linnaeus, 1758)	<i>Eudynamis scolopaceus</i>	Cuculiformes	Cuculidae
04	Asian-brown Flycatcher (Pallas, 1811)	<i>Muscicapa dauurica</i>	Passeriformes	Muscicapidae
05	Black Drongo (Vieillot, 1817)	<i>Dicrurus macrocercus</i>	Passeriformes	Dicruridae
06	Brahminy Starling (Gmelin, 1789)	<i>Sturnia pagodarum</i>	Passeriformes	Sturnidae
07	Chestnut-tailed Starling (Gmelin, 1789)	<i>Sturnia malabarica</i>	Passeriformes	Sturnidae
08	Citrine Wagtail (Pallas, 1776)	<i>Motacilla citreola</i>	Passeriformes	Motacillidae
09	Common Hawk-Cuckoo (Vahl, 1797)	<i>Hierococyx varius</i>	Cuculiformes	Cuculidae
10	Common iora (Linnaeus, 1758)	<i>Aegithina tiphia</i>	Passeriformes	Aegithinidae
11	Common Myna (Linnaeus, 1766)	<i>Acridotheres tristis</i>	Passeriformes	Sturnidae
12	Coppersmith Barbet (Stenius Müller, 1776)	<i>Psilopogon haemacephalus</i>	Piciformes	Megalaimidae
13	Homing Pigeon (Gmelin, JF, 1789)	<i>Columba livia</i>	Columbiformes	Columbidae
14	Eurasian Hoopoe (Linnaeus, 1758)	<i>Upupa epops</i>	Bucerotiformes	Upupidae

15	Greater Coucal (Stephens, 1815)	<i>Centropus sinensis</i>	Cuculiformes	Cuculidae
16	House Sparrow (Linnaeus, 1758)	<i>Passer domesticus</i>	Passeriformes	Passeridae
17	Indian Pied Myna (Linnaeus, 1758)	<i>Gracupica contra</i>	Passeriformes	Sturnidae
18	Indian Pond Heron (Sykes, 1832)	<i>Ardeola grayii</i>	Pelecaniformes	Ardeidae
19	Indian Robin (Linnaeus, 1766)	<i>Copsychus fulicatus</i>	Passeriformes	Muscicapidae
20	Intermediate Egret (Wagler, 1827)	<i>Ardea intermedia</i>	Pelecaniformes	Ardeidae
21	Jungle Babbler (Dumont, 1823)	<i>Argya striata</i>	Passeriformes	Leiothrichidae
22	Lineated Barbet (Vieillot, 1816)	<i>Psilopogon lineatus</i>	Piciformes	Megalaimidae
23	Little Cormorant (Vieillot, 1817)	<i>Microcarbo niger</i>	Suliformes	Phalacrocoracidae
24	Little Egret (Linnaeus, 1766)	<i>Egretta garzetta</i>	Pelecaniformes	Ardeidae
25	Orange-headed Thrush (Latham, 1790)	<i>Geokichla citrina</i>	Passeriformes	Turdidae
26	Oriental Magpie-Robin (Linnaeus, 1758)	<i>Copsychus saularis</i>	Passeriformes	Muscicapidae
27	Oriental White-eye (Temminck, 1824)	<i>Zosterops palpebrosus</i>	Passeriformes	Zosteropidae
28	Plum-headed Parakeet (Linnaeus, 1766)	<i>Psittacula cyanocephala</i>	Psittaciformes	Psittaculidae
29	Purple Sunbird (Latham, 1790)	<i>Cinnyris asiaticus</i>	Passeriformes	Nectariniidae
30	Red-vented Bulbul (Linnaeus, 1766)	<i>Pycnonotus cafer</i>	Passeriformes	Pycnonotidae
31	Red-whiskered Bulbul (Linnaeus, 1758)	<i>Pycnonotus jocosus</i>	Passeriformes	Pycnonotidae
32	Rose-ringed Parakeet (Scopoli, 1769)	<i>Psittacula krameri</i>	Psittaciformes	Psittaculidae
33	Rufous Treepie (Latham, 1790)	<i>Dendrocitta vagabunda</i>	Passeriformes	Corvidae
34	Spotted Dove (Scopoli, 1768)	<i>Spilopelia chinensis</i>	Columbiformes	Columbidae
35	White-breasted Kingfisher (Linnaeus, 1758)	<i>Halcyon smyrnensis</i>	Coraciiformes	Alcedinidae
36	White-throated Fantail (Vieillot, 1818)	<i>Rhipidura albicollis</i>	Passeriformes	Rhipiduridae

Table 3: List of Butterfly species (Order: Lepidoptera) recorded in the study area

Sl. No.	Common Name	Scientific Name	Family
01	Larger banded swift (Moore, 1878)	<i>Pelopidas subochracea</i>	Hesperiidae
02	Common grass blue (Godart, 1824)	<i>Zizina labradus</i>	Lycaenidae
03	Gray pansy (Linnaeus, 1763)	<i>Junonia atlites</i>	Nymphalidae
04	Lemon pansy (Linnaeus, 1758)	<i>Junonia lemonias</i>	
05	Common crow (Cramer, 1780)	<i>Euploea core</i>	
06	Plain tiger (Linnaeus, 1758)	<i>Danaus chrysippus</i>	
07	Blue tiger (Cramer, 1775)	<i>Tirumala limniace</i>	
08	Common four ring (Kirby, 1871)	<i>Ypthima huebneri</i>	
09	Common Evening Brown (Linnaeus, 1758)	<i>Melanitis leda</i>	
10	Common sailor (Linnaeus, 1758)	<i>Neptis hylas</i>	
11	Common castor (Cramer, 1777)	<i>Ariadne merione</i>	
12	Common rose (Fabricius, 1775)	<i>Pachliopta aristolochiae</i>	
13	Lime (Linnaeus, 1758)	<i>Papilio demoleus</i>	Pieridae
14	Lemon emigrant (Fabricius, 1775)	<i>Catopsilia pomona</i>	
15	Mottled emigrant (Linnaeus, 1758)	<i>Catopsilia pyranthe</i>	
16	Common grass yellow (Linnaeus, 1758)	<i>Eurema hecabe</i>	
17	Psyche (Fabricius, 1793)	<i>Leptosia nina</i>	
18	Common Albatross (Boisduval, 1836)	<i>Appias albino</i>	

Table 4: List of aquatic insects recorded in the study area

SI No.	Scientific Name	Order	Family
01	<i>Metrocoris communis</i> (Chen and Nieser, 1993)	Hemiptera	Gerridae
02	<i>Limnogonus fossarum</i> (Stal, 1859)		Mesoveliidae
03	<i>Mesovelia vittigera</i> (Horváth, 1895)		Hydrometridae
04	<i>Hydrometra butleri</i> (Hungerford and Evans, 1934)		
05	<i>Hydrometra</i> sp.		Nepidae
06	<i>Ranatra elongata</i> (Fabricius, 1790)		
07	<i>Ranatra filiformis</i> (Fabricius, 1790)		
08	<i>Cybister</i> sp.	Coleoptera	Dytiscidae

Table 5: List of terrestrial insects recorded in the study area through light trap, sweep net and pitfall trap technique

SI No.	Scientific Name	Order	Family
During light trap technique			
01	<i>Musca domestica</i> (Linnaeus, 1758)	Diptera	Muscidae
02	<i>Culex</i> sp.		Culicidae
03	<i>Aedes</i> sp.		
04	<i>Oxya fuscovittata</i> (Marschall, 1836)	Orthoptera	Acrididae
During sweep net technique			
05	<i>Polistes</i> sp.	Hymenoptera	Vespidae
06	<i>Polistes olivaceus</i> (DeGeer, 1773)		
07	<i>Vespa tropica</i> (Linnaeus, 1758)		

08	<i>Vespa</i> sp.		
09	<i>Phyllotreta</i> sp.		Chrysomelidae
10	<i>Batocera rufomaculata</i> (De Geer, 1775)	Coleoptera	Cerambycidae
11	<i>Oryctes</i> sp.		Scarabaeidae
12	<i>Holochlora japonica</i> (Brunner von Wattenwyl, 1878)		Tettigoniidae
13	<i>Oxya fuscovittata</i> (Marschall, 1836)		Acrididae
14	<i>Gryllotalpa</i> sp.	Orthoptera	Gryllotalpidae
15	<i>Gryllus bimaculatus</i> (De Geer, 1773)		Gryllidae
16	<i>Modicogryllus confirmatus</i> (Walker, 1859)		
17	<i>Rhyothemis variegata</i> (Linnaeus, 1763)		Libellulidae
18	<i>Trithemis aurora</i> (Burmeister, 1839)	Odonata	
19	<i>Brachythemis contaminata</i> (Fabricius, 1793)		Coenagrionidae
20	<i>Ischnura aurora</i> (Brauer, 1865)		
21	<i>Periplaneta americana</i> (Linnaeus, 1758)	Dictyoptera	Blattidae
During pitfall trap technique			
22	<i>Thrips</i> sp.	Thysanoptera	Thripidae
23	<i>Isotoma</i> sp.		Isotomidae
24	<i>Entomobrya</i> sp.	Collembola	Entomobryidae
25	<i>Camponotus compressus</i> (Fabricius, 1787)	Hymenoptera	Formicidae
26	<i>Solenopsis geminata</i> (Fabricius, 1804)		
27	<i>Acheta domesticus</i> (Linnaeus, 1758)	Orthoptera	Gryllidae
28	<i>Reticulitermes</i> sp.	Isoptera	Rhinotermitidae
29	<i>Culex</i> sp.		Culicidae
30	<i>Chironomus</i> sp.		Chironomidae
31	<i>Musca</i> sp.	Diptera	Muscidae
32	<i>Drosophila</i> sp.		Drosophilidae
33	<i>Scaptomyza</i> sp.		
34	<i>Gonocephalum</i> sp.	Coleoptera	Tenebrionidae
35	<i>Nezara</i> sp.	Hemiptera	Pentatomidae





Fig 2: Some Pictures of plants observed during the present study; **A.** *Hyptis suaveolens*, **B.** *Bridelia* sp., **C.** *Dioscorea* sp., **D.** *Phaseolus* sp., **E.** *Albizia lebbek*, **F.** *Cassia* sp., **G.** *Lagerstroemia parviflora*, **H.** *Chromolaena odorata*, **I.** *Tephrosia* sp., **J.** *Alternanthera tenella*, **K.** *Azadirachta indica*, **L.** *Eragrostis gangetica*, **M.** *Pogostemon benghalensis*, **N.** *Acacia auriculiformis*, **O.** *Elephantopus scaber*, **P.** *Clerodendrum fargesii*, **Q.** *Ficus* sp., **R.** *Lagerstroemia* sp., **S.** *Combretum decandrum*

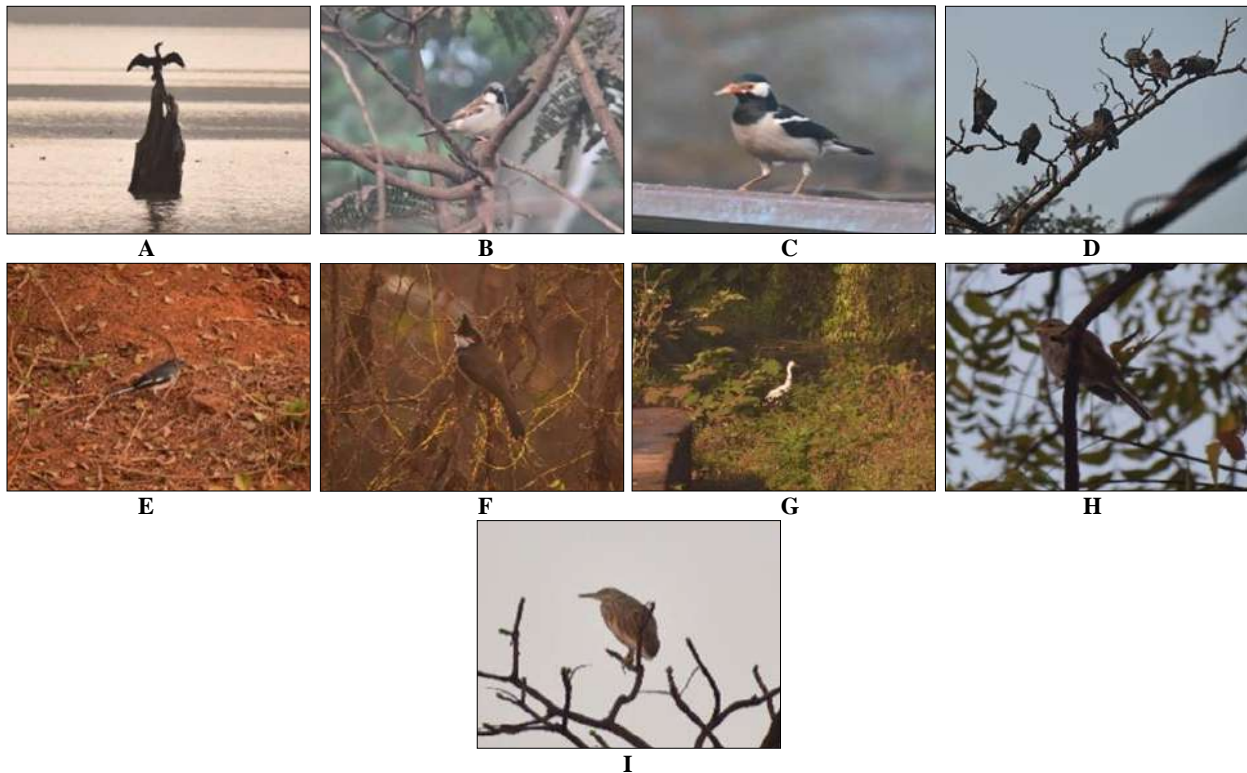


Fig 3: Some pictures of birds observed during the present study; **A.** *Microcarbo niger*, **B.** *Passer domesticus*, **C.** *Gracupica contra*, **D.** *Colomba livia*, **E.** *Copsychus saularis*, **F.** *Pycnonotus jocosus*, **G.** *Ardea intermedia*, **H.** *Muscicapa dauurica*, **I.** *Ardeola grayii*

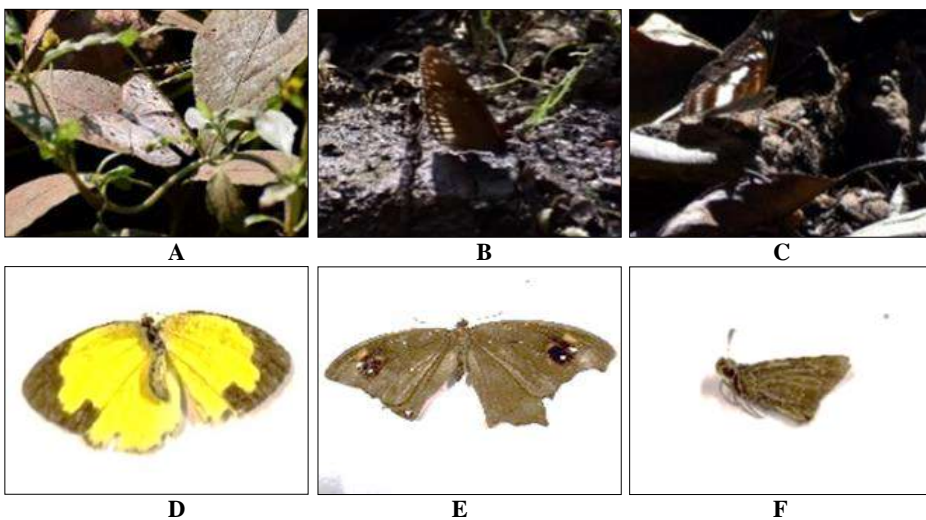


Fig.4: Some Pictures of butterflies observed during the present study; **A.** *Junonia atlites*, **B.** *Euploea core*, **C.** *Neptis hylas*, **D.** *Eurema hecabe*, **E.** *Melanitis leda*, **F.** *Pelopidas subochracea*

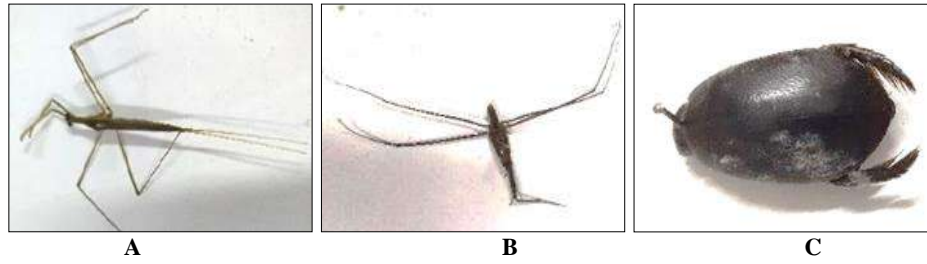


Fig 5: Some Pictures of aquatic insects observed during the present study; A and B. *Rantara spp.*, C. *Cybister sp.*

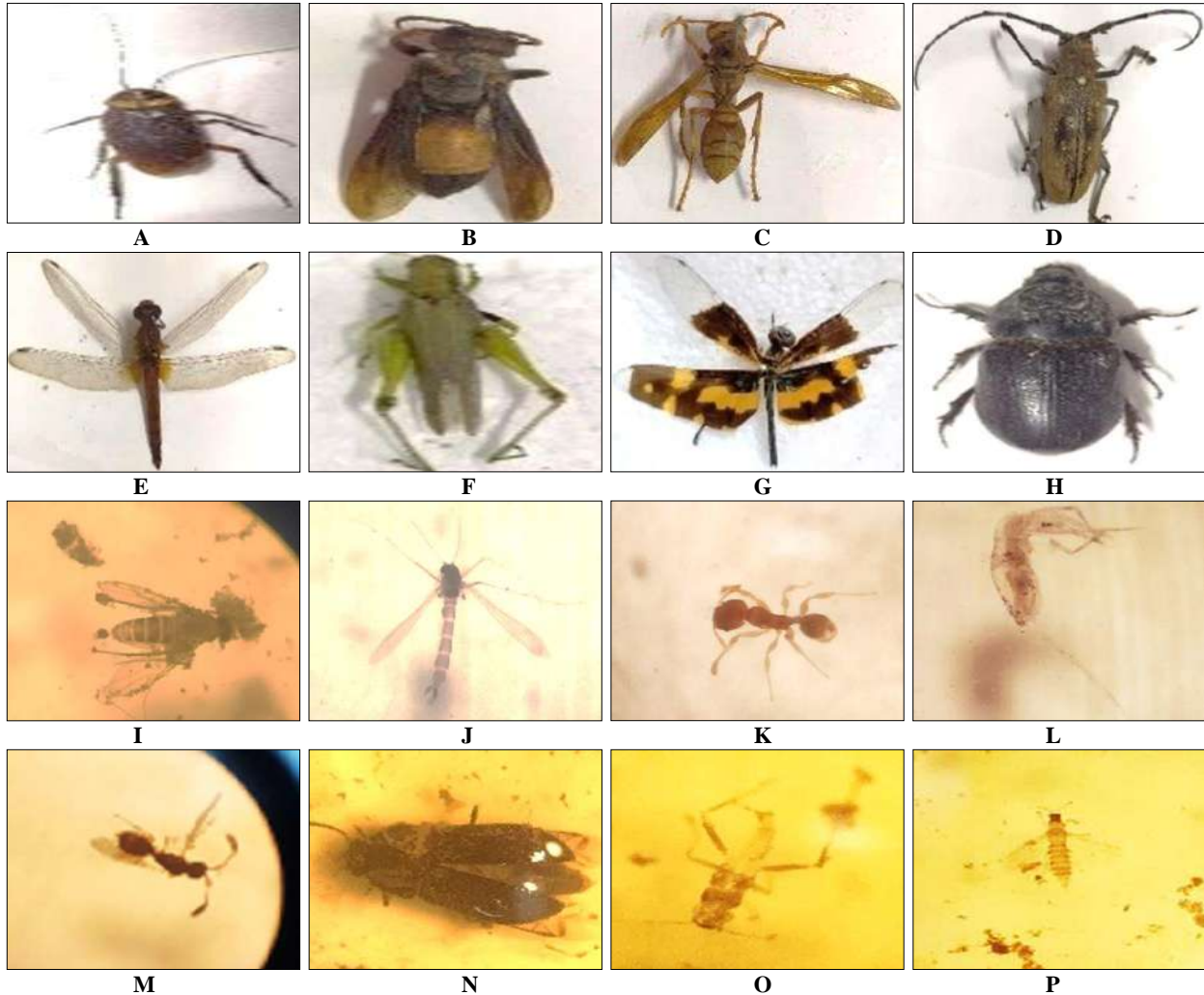


Fig 6: Some Pictures of terrestrial insects observed during the present study [during light trap, sweeping net technique and study (A-G) and pitfall trap technique (I-P)]; A. *Periplaneta americana*, B. *Vespa tropica*, C. *Polistes olivaceus*, D. *Batocera rufomaculata*, E. *Trithemis aurora*, F. *Oxya fuscovittata*, G. *Rhyothemis variegata*, H. *Oryctes sp.*, I. *Drosophila sp.*, J. *Chironomus sp.*, K. *Solenopsis geminate*, L. *Isotoma sp.*, M. *Camponotus compressus*, N. *Gonocephalum sp.*, O. *Acheta domesticus*, P. *Thrips sp.*

Discussion

Previously, as work has been done on the flora and fauna of different places outside India, similarly work has been done on it in different places of India and through that on one hand such as diversity of plant, birds, reptiles, amphibia, insects including butterflies etc. has been recorded, on the other hand, every year new species has been recorded. Through this, one can learn about the biodiversity of different areas and try to protect and conserve it according to its conditions. During the present study in 5 different study areas of Kendujhar district, Odisha different species of plants, birds, insects including butterflies were recorded.

A total of 28 species of 16 families (Lamiaceae, Phyllanthaceae, Dioscoreaceae, Fabaceae, Lythraceae, Myrtaceae, Asteraceae, Moraceae, Combretaceae, Amaranthaceae, Meliaceae, Leiothrichidae, Acanthaceae, Dipterocarpaceae, Anacardiaceae and Rutaceae) belonging to 11 orders (Lamiales, Malpighiales, Dioscoreales, Finales, Myrtales, Asterales, Rosales, Caryophyllales, Sapindales, Passeriformes and Malvales) were found during fieldwork in the study areas. Through the faunal study of aquatic insects from water bodies in the study area, 7 species of 5 genera (Metrocoris, Limnogonus, Mesovelgia, Hydrometra and Ranatra) belonging to 4 families (Gerridae, Mesoveliidae, Hydrometridae and Nepidae) under

Hemiptera order and 1 species of *Cybister* genus belongs to Dytiscidae family under Coleoptera order have been documented. In the case of terrestrial insect, from these study areas a total 32 species of 22 families (Muscidae, Culicidae, Acrididae, Vespidae, Chrysomelidae, Cerambycidae, Scarabaeidae, Tettigoniidae, Gryllotalpidae, Gryllidae, Libellulidae, Coenagrionidae, Blattidae, Thripidae, Isotomidae, Entomobryidae, Formicidae, Rhinotermitidae, Chironomidae, Drosophilidae, Tenebrionidae and Pentatomidae) belonging to 10 orders (Diptera, Orthoptera, Odonata, Hymenoptera, Coleoptera, Dictyoptera, Thysanoptera, Collembola, Isoptera and Hemiptera) were recorded during this study. The occurrence of the above insect species with different habitats were also reported by earlier workers from India as well as Abroad viz., Adams^[1]; Nazneen *et al.*^[15], Nayan *et al.*^[14]; Sharma and Agrawal^[19].

Similarly, earlier in different parts of the Odisha state of Eastern India, on the one hand, various works have been done on the overall flora and fauna, and on the other hand, different works have been done on the diversity of plants, diversity of birds, diversity of butterflies etc. Lahkar *et al.*^[11] study earlier in the North Orissa University campus, Baripada, Orissa and documented 11 families of bird. Of butterflies, 8 species of Nymphalidae family, 1 species (*Pachliopta aristolochiae*) of Papilionidae family and 3 species of Pieridae family were recorded by Arjun *et al.*^[2] during the diversity study of butterflies in Sulaipat, Odisha state of India. Dash *et al.*^[3] studied on the aquatic insect fauna from Subhadra Estuary of Ganjam, Odisha and recorded 3 Hemipteran species under the family Nepidae and Gerridae. Dytiscidae family of Aquatic Coleoptera also has been documented from South Coastal of Odisha^[4].

Studies have shown that species diversity as well as numbers are being strongly affected, as suitable habitats are lost due to traffic, industrial activities and other sources of pollution. In addition, vehicle emissions, fuel oil and natural gas for home heating, manufacturing and by-products of power generation, especially coal-fired power plants and smoke from chemical production are primary sources of man-made air pollution that disrupts the area's floral and faunal diversity. According to Global Forest Watch, from 2002 to 2022, Kendujhar lost 423 hectares of humid primary forest, accounting for 8.0% of its total tree cover loss over the same period. The total area of humid primary forest in Kendujhar decreased by 5.2% during this period. From 2001 to 2022, Kendujhar lost 5.37 ha of tree cover, which equates to a 4.8% reduction in tree cover since 2000 and 2.55 megatons of CO₂ emissions. From 2001 to 2022, 740 ha of tree cover was lost due to fires and 4.63kh from all other drivers of loss. The year with the highest tree cover loss due to fires during this period was 2008 and fires caused 91ha of loss - 42% of all tree cover loss in that year. Misha *et al.*^[13] quantified forest cover loss (FCL) in the state of Odisha due to mining activities by analysing the Hansen Global Forest Change (HGFC) time series data for the period 2001–2019 on the Google Earth Engine platform. In Odisha's mining hub Kendujhar district, around 530 villages have been affected by human-elephant clashes resulting in fewer casualties and damage to houses, but an increase in crop attacks. The district has suffered severe deforestation due to iron and manganese ore mining. Unplanned land use has degraded habitat and disrupted traditional elephant corridors, forcing elephants to wander into human

settlements in search of food, leading to deadly human-elephant encounters. Also, lack of adequate food sources has forced elephants to face starvation and death in neighbouring states like Jharkhand and West Bengal. The forest area of Kendujhar district has decreased from 3,378 square kilometres (sq. km) in 2001 to 3,212 sq. km in 2017. At the same time, the elephant population in the district has also come down from 112 to just 40 elephants, mainly due to large size minimums^[22].

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