Ela Foundation

# Ela Journal of Forestry and Wildlife

ISSN 2319-4361
(Indexed in Google Scholar)

Volume 10 | Issue 1
January - March 2021

A quarterly scientific refereed e-Journal of Ela Foundation and Forest Department, Maharashtra for Nature Conservation through Education and Research

**Listed in UGC- CARE**

# Status and distribution of Marsh Crocodile *Crocodylus palustris* in Terai Arc Landscape, Uttarakhand, India

**S.M. Belal [1], P.M. Dhakate[2] and Jeet Ram[1]**

[1]Department of Forestry and Environment Sciences, Kumaun University, Nainital, Uttarakhand, India

[2]Chief Conservator of Forest, Uttarakhand Forest Department, Dehradun, Uttarakhand, India

Corresponding author: E.mail: belalleo2@gmail.com, +91 9411256591

**Citation:** **Belal, S.M., Dhakate P.M., Ram Jeet,** Status and distribution of Marsh Crocodile *Crocodylus palustris* in Terai Arc Landscape, Uttarakhand, India
*Ela Journal of Forestry and Wildlife*
*Vol.10 (1): 855-866*

**Date of Publication:**
31 March 2021

ISSN 2319-4361



**Abstract**

The objective of the study was to monitor the status and distribution of Marsh Crocodile in the Terai Arc Landscape (TAL), Uttarakhand within the Kosi to Sharda river. Some studies on Marsh Crocodile are conducted in south India, but no status data existent for north India. The study was conducted employing total count method near basking sites during October to December (post-monsoon) and January to March (pre-monsoon) in between 2014 and 2017. On each sighting of crocodile, GPS (Global Positioning System) locations were recorded. The surveys were conducted near dams and rivers connected to its subsidiaries, streams and nalas of Terai landscape of Uttarakhand. Marsh Crocodile (*Crocodylus palustris*) was found to be distributed in different dams and small streams connected through three rivers. The study revealed that the maximum number of individual Marsh Crocodiles was 341 (encounter rate= 5.78 crocodiles/Km) in pre-monsoon and 281 (encounter rate = 4.76 crocodiles/Km) in post-monsoon during 2014 and 2017 and where ever suitable Marsh Crocodile habitat was present. However, the major threats to Marsh Crocodiles was habitat destruction, unintentional trapping in fishing nets, water pollution due to effluent of industries and other anthropogenic activities such as road traffic accident.

Keywords: Marsh Crocodile, Crocodylus palustris, Terai landscape, Population

## Introduction

In India, three crocodilian species are reported namely Gharial (*Gavialis gangeticus*), Marsh Crocodile (*Crocodylus palustris*) and Saltwater Crocodile

(*Crocodylus porosus*), and twenty-three species are known worldwide (King and Burke, 1989). All three species occurring in India are listed as Vulnerable in the IUCN Red Data List (IUCN, 2018). These species are legally protected under Schedule I of Indian Wildlife (Protection) Act, 1972. Out of these three species, the Marsh Crocodile is one of the most common and widespread crocodilian species in India (Vyas, 2002). Several hunters and travellers from India during the late 1800s and early 1900s had reported that the Marsh Crocodile was very common (Whitaker, 1987). Crocodiles all over the world are primarily found in wetland habitats including freshwater rivers, lakes, streams and marshes. Marsh Crocodile may also occur in coastal saltwater lagoons and estuaries (Whitaker and Andrews 2003) and has adjusted well to reservoirs, irrigation canals and human-made ponds, and marshes (Whitaker and Whitaker 1984). The wetland complex is characterized by a mosaic of diverse habitats including forest, fresh and brackish water lakes, agricultural lands, rangelands, sand dunes scrub, reed beds, fish farms and swamps (Chang et al. 2013a). Marsh Crocodile is reported from over ten states of India including Uttarakhand (Whitaker and Daniel, 1978). In Uttarakhand, it is best seen in Corbett Tiger Reserve, Rajaji National Park and two specimens were recorded in Haridwar and Lansdown forest area (Joshi R. et al. 2011 and Joshi R. 2013). I observed three individuals of adult Marsh Crocodile basking on the banks of Ram Ganga River in Marchula (Lat. N 29˚36'19.9'' Long. E 79˚ 05'28.8'' and Elevation-544m), Chilkiya forest range of Almora, Uttarakhand and this sight is also known as 'Crocodile point' for attracting tourists.

The study was carried out in different rivers, dams and connected lakes and ponds, streams and Nalas. The habitats of Marsh Crocodiles are also outside protected areas such as in the present study and are surrounded by dense human habitation as well as State Industrial Development Corporation of Uttarakhand Limited (SIDCUL). These habitation and factories produced chemicals and other form of pollution and toxic pollutants which threaten the Marsh Crocodile's population (Chang *et al.,* 2013). The species often comes into conflict with humans and few records of the crocodile entering human habitation during the monsoon are known. Preliminary study was conducted

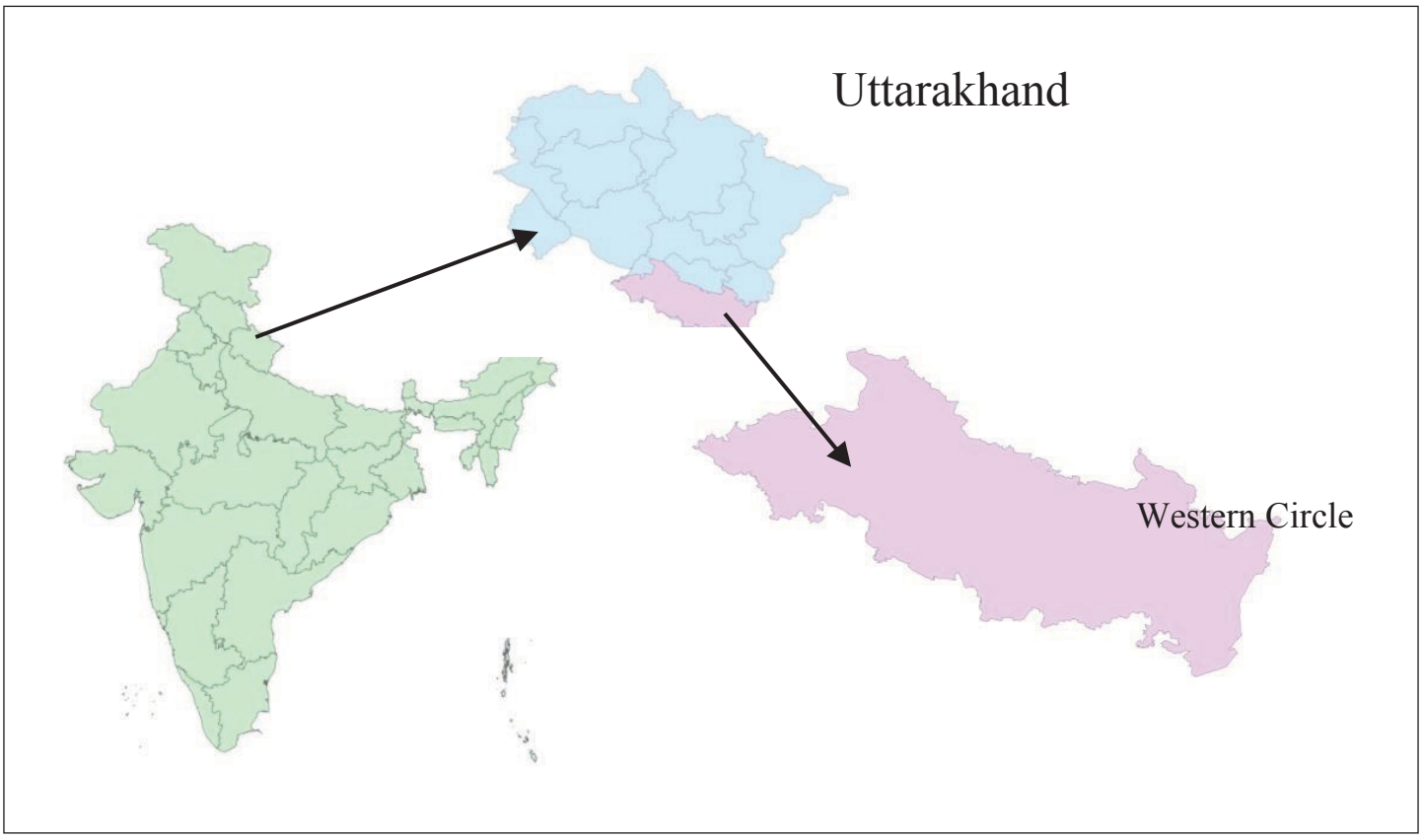



**Figure 1.** Location of the study area

in TAL of India. The present study revealed the status, distribution and population of Marsh Crocodile in various river systems of TAL of Uttarakhand for the first time. The outcome may be useful to prepare management practices to conserve the species.

**Materials and Methods**

The study was undertaken between the Kosi River in the west and Sharda River in the east in the Uttarakhand state. The study area falls under Terai Arc Landscape (TAL), (28˚53'24'' to 31˚27'50''N latitude and 77˚34'27'' to 81˚02'22'' E longitude) in the foothills of Himalayas. This landscape has a rich wetland biodiversity. TAL is a mosaic of various habitats such as mixed forests, riverine forest, grassland, swamps, plantations, scrubland and wetlands that sustains birds representing Himalayan and Gangetic plain affinities (Rahmani et al. 1989; Naoroji 1999; Dhakate et al. 2008). The study area extended in three districts, Nainital, Udham Singh Nagar and Champawat (Figure 1, 2, Table 1). Owing to its location, the study area receives lot of water from its perennial and seasonal rivers namely Kosi, Dabka, Baur, Nihal, Bhakhda, Gola, Nandhaur, Sharda and provides sufficient amount of water to nine reservoirs situated nearby i.e. Kosi, Haripura, Baur, Gola, Goolerbhoj, Dhora, Baigul, Nanak Sagar and Sharda which is the major source of cultivation and drinking water for a large portion of human population residing nearby and also supports a large number of Marsh Crocodiles, resident and migratory water birds and fishes. The landscape has been categorized into two distinct terrain types, Bhabhar tract and plains. The study area supports a mosaic of habitat types such as sal forest, sal mixed forest, mixed forest, teak plantations, agricultural fields and habitations. The vegetation of the forest area in Terai East forest division covers mixed forest of Sal (*Shorea robusta*), Teak (*Tectona grandis*), Rohini (*Mallotus phillipinensis*), Khair (*Acacia catechu*), Semal (*Bombax ceiba*), Haldu (*Haldina cordifolia*), Bahera (*Terminalia bellirica*), Bar (*Ficus benghalensis*), Kusum (*Schleichera oleosa*), Shisam (*Dalbergia sissoo*) and Ipomia (*Ipomoea carnea*), Bamboo (*Bambusa bambos*) and Common water Hyacinth (*Eichhornia crassipes*). The fauna represent by mainly Tiger (*Panthera tigris*), Leopard (*Panthera pardus*), Elephant (*Elephas maximus*), Sloth Bear

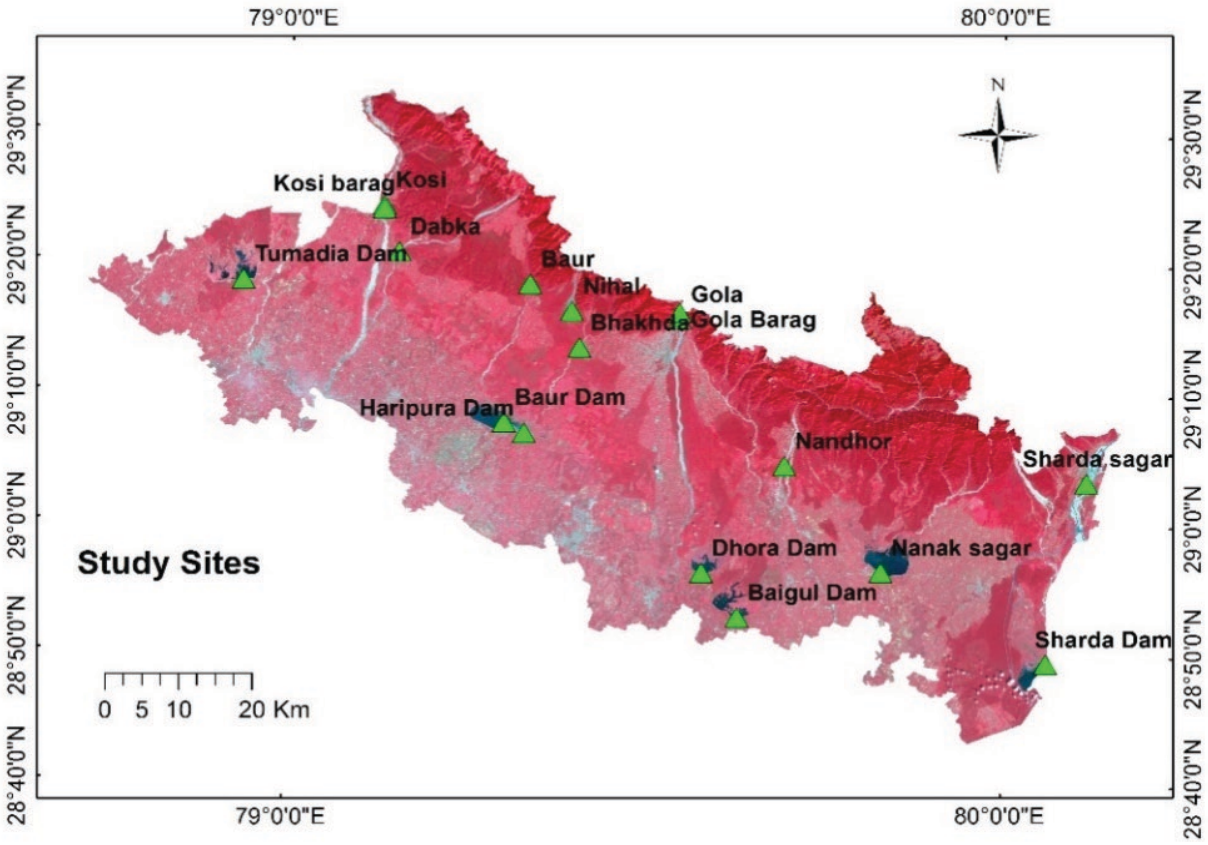



**Figure 2. Location of study sites in the Terai landscape of Western circle, Uttarakhand**

**Table 1.** Location details of study sites in the landscape, Uttarakhand

| S. No. | Sites | District | Tehsil | Presence | Latitude | Longitude |
|---|---|---|---|---|---|---|
| 1 | Kosi | Nainital,U.S. Nagar | Ramnagar | No | 29 24 19.71 | 79 07 54.36 |
| 2 | Dabka | Nainital,U.S. Nagar | Bajpur | No | 29 20 45.1 | 79 09 12.9 |
| 3 | Baur | Nainital | Kaldhungi | No | 29 18 23.70 | 79 20 13.83 |
| 4 | Nihal | Nainital | Kaldhungi | No | 29 16 20.63 | 79 23 46.09 |
| 5 | Bhakhda | Nainital | Kaldhungi | No | 29 13 32.84 | 79 24 25.50 |
| 6 | Gola | Nainital | Haldwani | No | 29 15 49.1 | 79 32 49.7 |
| 7 | Nandhor | Nainital,U.S. Nagar | Haldwani | No | 29 04 37.01 | 79 41 44.40 |
| 8 | Shardasagar | Champawat | Champawat | No | 29 03 27.48 | 80 07 03.71 |
| 9 | Tumadia Dam | U.S.Nagar | Jaspur | No | 29 18 27.6 | 78 56 09.6 |
| 10 | Kosibarag | Nainital,U.S. Nagar | Ramnagar | No | 29 24 03.3 | 79 07 54.3 |
| 11 | Haripura Dam | U.S.Nagar | Bajpur | No | 29 06 55.1 | 79 19 52.8 |
| 12 | BaurDam | U.S.Nagar | Bajpur | No | 29 07 45.5 | 79 18 10.6 |
| 13 | GolaBarag | Nainital | Haldwani | No | 29 16 17.9 | 79 32 49.6 |
| 14 | Nanak Sagar | U.S.Nagar | Sitarganj | Yes | 28 56 29.2 | 79 49 53.7 |
| 15 | Dhora Dam | U.S.Nagar | Sitarganj | Yes | 28 56 20.6 | 79 34 51.9 |
| 16 | Baigul Dam | U.S.Nagar | Sitarganj | Yes | 28 52 57.2 | 79 37 53.8 |
| 17 | Sharda Dam | U.S.Nagar | Khatima | Yes | 28 49 31.4 | 80 03 43.5 |

(*Melursus ursinus*), Sambar (*Rusa unicolor*), Barking deer (*Muntiacus muntjak*), Spotted Deer (*Axis axis*), Wild Boar (*Sus scrofa*), Python (*Python molurus*) and Indian Flapshell Turtle (*Lissemys punctata*), Golden Mahseer (*Tor putitora*), etc. (Shashi K.M., and Girdhari S., 2006-07 to 2015-16). Striped Hyaena *Hyaena hyaena* is also recorded (Shah and Naseem, 2017) in Nandhaur Valley of TAL. The wetlands of TAL has been a regular winter habitat of large number of resident and migratory water birds (Dhakate et al., 2008; Tanveer et al., 2019). The plains are marked by a high water table and abundant surface water in the form of streams and swamps. Much of the bhabhar plains and almost all of the plains are under agriculture and a significant proportion of the bhabhar tract at the fringes of the Shivalik hill range has come under the plough in the past five decades. The altitude of the porous bhabhar lies between 220 m to 750 m, and the moist planes between 200 m to 220 m, and it is relatively flat. There are three distinct seasons winter (November to March), summer (April to June) and the monsoon (July to October). The soil is mainly alluvial, clayey, loamy, sandy, but also mixed with gravel and sand in this area. The vegetation comprises a mosaic of dry and moist deciduous and riverine forests. Marsh Crocodiles are found in and around the Nanak Sagar, Dhora dam and Baigul dam of landscape, Uttarakhand. Recently, Marsh Crocodile had been recorded in other territorial forest divisions of the Western circle of Kumaun, Uttarakhand around one to two decades ago (Shashi K.M., and Girdhari S., 2006-07 to 2015-16).

The study was conducted for the period of four years during 2014 to 2017. We decided to carry out this study post-monsoon (October-December) and pre-monsoon (January-March). The data collection was undertaken after thorough examination of the available records of the species presence from the records of forest division offices and discussion with frontline forest department staff and study sites were selected. Field sampling was done to collect data from Kosi, Dabka, Baur, Nihal, Bhakhda, Gola, Nandhaur, Sharda rivers and nine reservoirs, i.e. Kosi, Haripura, Baur, Gola, Dhora,

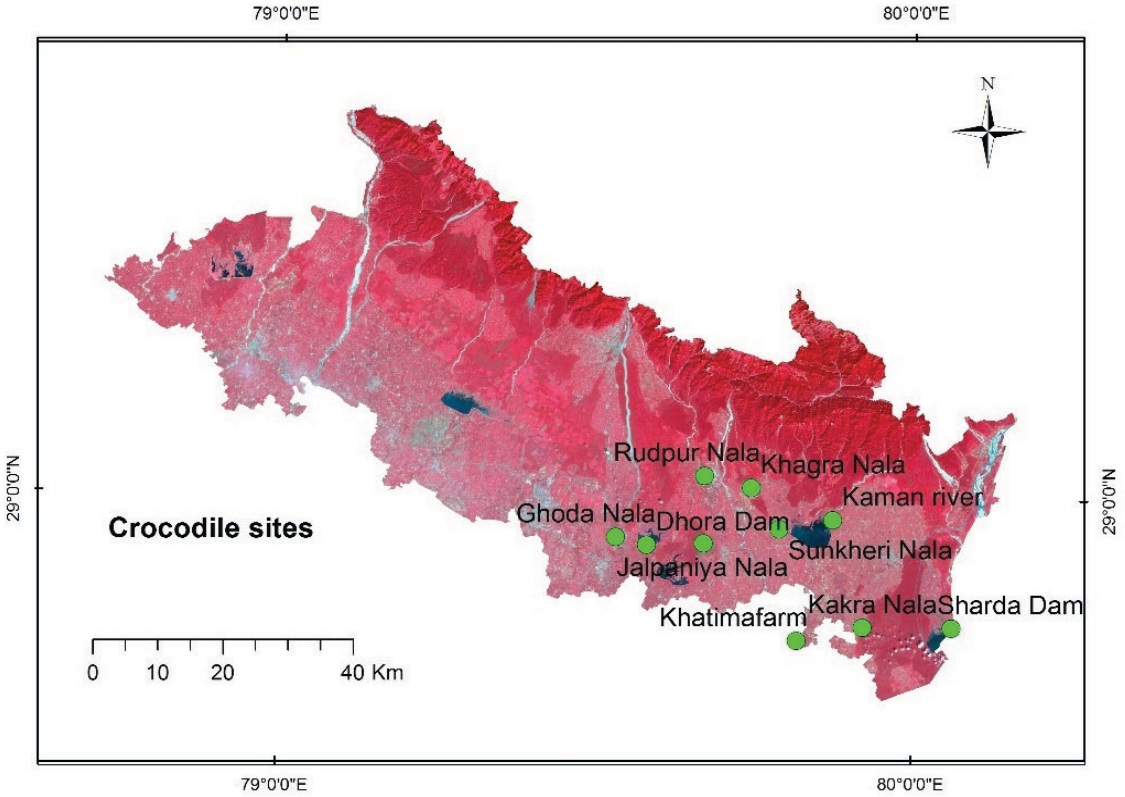



**Figure 3.** Location of Crocodile sighted sites in the Terai landscape of Western circle, Uttarakhand

Baigul, Nanak Sagar, Sharda and their tributaries. We made three visits in three months each (three visits in a month on each site) to count the Marsh Crocodile. Direct and indirect evidence monitoring was conducted on diurnal sunny days based on convenience of vehicle, walk, country boat and vigorously searches during the mid-day between 0900 to 1700 hrs in six months of a year (Chaudhary, 2011; Jayson, et al 2006). We used GPS (GARMIN, etrex 20) to fix locations where the crocodile population was found. Binocular was used to locate crocodiles away from the banks or on islands. Digital camera was used to take the pictures of direct sightings, nest sites, eggs and other indirect evidences of Marsh Crocodiles.

Field data was obtained using a systematic sampling scheme in different study sites. A sampling unit was fixed between two points of total walked distances after marking with paint (Shikha et. al 2011). At the time of data collection, four people in two groups moved at the same time and the same distance on both banks of study sites. Some of the key issues that were addressed during the data collection were the movements of crocodile between banks (when double counting was not done) and foggy winter weather. If the weather was hazy, the crocodiles did not come out. Data were collected from January to March in each year of study during 2015 to 2016. January-March is courtship season and breeding groups tend to bask in groups (Choudhary and Rao, 1982; Rodgers, 1991). The best season for crocodile survey is post winter and pre summer month, i.e. January-March (Chang et. al., 2013). Size and count were observed from the different basking sites and coordinates were recorded by using handheld GPS. Only direct sightings were taken into consideration. Crocodiles above 1.6 m in size were categorized as adults and those between 1.2 m and 1.6 m as sub-adults (Whitaker and Whitaker, 1989; Arumugam & Andrews, 1993), as hatchlings (<0.5 m), juveniles (0.5±1.0 m) (Chang et.al. 2014). For basking habitat, location of all basking sites were also recorded. Specific nest searches were also done in collaboration with Forest Department staff. Nest surveys are important because they help identify the

**Table 2.** Total maximum recorded data of *Crocodylus palustris* conducted in different sites in post-monsoon of 2014-2016

| S.No. | Crocodile sites | Range | Transect length in km | Number of Crocodile Encountered | Encounter rate per km walk |
|---|---|---|---|---|---|
| 1 | Kaman River (Nanak Dam) | South Jaulasal | 7 | 35 | 5.0 |
| 2 | DhoraDam | Doly | 6 | 21 | 3.5 |
| 3 | GhodaNala | Doly | 8 | 38 | 4.75 |
| 4 | JalpaniyaNala | Kishanganj | 4 | 8 | 2.0 |
| 5 | KakraNala | Doly | 12 | 113 | 9.42 |
| 6 | Khatimafarm | Khatima | 4 | 10 | 2.5 |
| 7 | RudpurNala | Kishanpur | 4 | 8 | 2.0 |
| 8 | KhagraNala | Ransali | 4 | 11 | 2.75 |
| 9 | Sunkheri Nala | Ransali | 4 | 9 | 2.25 |
| 10 | Sharda dam | Surai | 6 | 28 | 4.66 |
| **Total** | | | **59** | **281** | **4.76** |

**Table 3.** Total data on *Crocodylus palustris* conducted in different sites in pre-monsoon of 2015-2017

| S. No. | Crocodile sites | Range | Transect length in km | Number of Crocodile Encountered | Encounter rate per km walk |
|---|---|---|---|---|---|
| 1 | Kaman River (Nanak Dam) | South Jaulasal | 7 | 41 | 5.86 |
| 2 | Dhora Dam | Doly | 6 | 28 | 4.66 |
| 3 | Ghoda Nala | Doly | 8 | 54 | 4.00 |
| 4 | Jalpaniya Nala | Kishanganj | 4 | 9 | 6.75 |
| 5 | Kakra Nala | Doly | 12 | 126 | 10.5 |
| 6 | Khatima Farm | Khatima | 4 | 11 | 2.75 |
| 7 | Rudpur Nala | Kishanpur | 4 | 14 | 3.5 |
| 8 | Khagra Nala | Ransali | 4 | 12 | 3.0 |
| 9 | Sunkheri Nala | Ransali | 4 | 11 | 2.75 |
| 10 | Sharda Dam | Surai | 6 | 35 | 5.83 |
| | **Total** | | **59** | **341** | **5.78** |

characteristics of the reproducing population, such as estimating its abundance, and particularly that of reproducing females (Hererra et al. 2011). Other than primary research, information's were also collected from secondary sources by interviewing the locals.

**Results**

The Marsh Crocodile (*Crocodylus palustris*) is a common and widespread crocodilian species in India (Vyas, 2012). We observed 17 rivers and dams in between Kosi and Sharda rivers, in Terai landscape, Uttarkhand (Table 1). The distribution of Marsh

**Figure 4 and 5. Marsh Crocodile basking on the bank of water body. (Photo courtesy: Shah M. Belal)**

Crocodile was found in only four sites and other sites are its tributaries and dams. The census was conducted in 10 sites between Kosi and Sharda Rivers including different tributaries (Nalas) and dams during October to December in all three years in between 2014 and 2016 (2.0 to 9.42 Marsh Crocodile encountered per kilometer) and January to March in all three years in between 2015 and 2017 (2.75 to 10.5 Marsh Crocodile encountered per kilometer) shown in Table 2 and Table 3. In the following results, recorded the total population was estimated to be 281 individual of Marsh Crocodiles and classification of the data revealed 187 adults (66.55%), as sub-adult 59 (21%) and 35 (12.45%) as juveniles during post-monsoon (October to December) of 2014-2016 (Table 4). During the pre-monsoon (January to March) of 2015-2017 season, a total of 341 individuals were observed. Of which, adult found 218 (63.93%), as sub-adult 85 (24.93%) and 38 juveniles (11.14%) (Table 5). Direct total sightings were able to assign manually a size class to all individuals in the field. Marsh Crocodiles were frequently observed in study areas with vegetation and flowing water. Crocodiles were more sighted in the subsidiaries streams (nalas) of rivers and dams. Many sightings were found in tributaries, artificial ponds, natural ponds, and fresh water marshes.

Marsh Crocodile were sighted in the total ten subsidiaries streams of Ghoda nala, Rudpur nala, Kakra nala, Khatima Farm and different dams and its attaching small streams like Baigul dam, Jalpaniya nala, Nanak Sagar (Kaman river), Khagra, Sunkhedi and Sharda dam (Table 4). During the study, the total highest number of Marsh Crocodiles were recorded in 2016 (Jan-Mar) in Kakra Nala, Kakra beat, Suarai range of East forest division. Mostly Marsh Crocodiles were observed during the day time in basking stages. A total of 126 individuals were sighted in Kakra nala (Table 4) and among them 79 individuals were sighted basking away and close to water bodies while 47 individuals including generally sub-adult and juveniles were seen different activities.

**Discussion**

This study confirms a relatively abundant and healthy population of Marsh Crocodile along the tributeries of Nandhaur and Gola rivers in Terai East Forest division. The analysis of the data revealed that adult, sub-adult and juveniles primarily inhabit dense and open vegetation along the riverbanks or within river beds or streams. In contrast, large sub-adults and adults prefer open water in rivers or riverbanks. In the above results, the crocodile habitat in the area is mostly aquatic with riverine forest habitat and they bask around the river bank on rocks and soil. Frequent sightings included crocodiles moving on soil and in water, digging and swimming in the deep water and also basking in contact with water with their mouth oriented towards the water line. However, mostly adult and some sub-adults basked on rocks, fallen trees in water bodies, under bushes and away from the water bodies (Meenakshi et al., 2010). Minimum sightings were found to be 2-4 individuals from Rudpur,


**Figure 6 and 7. Marsh Crocodile habitats (A dam and river). (Photo courtesy: Shah M. Belal)**

Sunkhedi, Khagra and Khatima farm tributaries. Food availability and preference can influence habitat of crocodile (Tucker, 1996). Maximum numbers of Marsh Crocodiles were sighted during sunny days when they basked during January to March of 2016 (Rai and Raj, 2015). In the present study, we observed the lowest sighting of crocodile individual when the day was fully clouded and foggy. Conventional basking sites of Marsh Crocodile were on higher slopes in the cooler month as against hot pre and post monsoon season (Shikha et. al 2018; Meenakshi et al., 2010).

There are few records (in the management plans and guest entry register of the circle) of Marsh Crocodiles presence in other parts of the study area where it was not found to be present in our study, and the possible reason could be the species may have moved or strayed through water channels around one or two decades ago. Western part of the study area has suitable habitat but the absence of the crocodiles was due to repeated diversion of the rivers, increased tourism, habitat modification, and fishing as compared to Eastern parts. Food, habitat and time of the year are the three traditional categories of resources dimensions (Pianka, 1975). In this landscape, no previous focused studies were carried out on the status and population of the crocodiles. Whatever information we have is largely in the form of stray sighting records. The total crocodile population recorded by us was 281 in post monsoon and 341 in pre monsoon. The population in pre monsoon is more than the post monsoon because the breeding season starts from January to March (pre monsoon) (Chang et. al., 2013). Marsh Crocodiles recorded in October were lowest and December to January were highest. January to March is the courtship season and breeding groups tend to bask in groups (Choudhary and Rao, 1982; Rodgers, 1991). The movement, basking, digging for nesting begin in pre monsoon period (October to March) and incubation and hatching of eggs (25-28) is seen between March to April (Rai and Raj, 2015). However, we recorded less sighting of Marsh Crocodiles during October and November.

Land use and land covers are changing rapidly leading to a decline of crocodile population. Some dams and rivers are auctioned or given to villages for fishing by the irrigation department leading to disturbance. Industrialization, intensive tourism, mining and increase in hotels and resorts are further causes of disturbance. Waste materials of hotels, resorts and factories run in the river and dams leading to pollution (Gleick, 2003) so also changes in hydrology, pollution (Naiman et al., 2002) and other development activities such as industries (Dudgeon et al., 2006) profoundly change the processes that drive ecosystem structure and functioning (Jansson et al., 2000). Effective effluent treatment and regularly monitoring of water bodies of Terai Arc Landscape, Uttarakhand can minimize habitat damage and protect Marsh Crocodiles.

Primary disturbing agents for crocodiles in their aquatic habitat are tourism, sand mining, illegal fishing, pollution, land-use changes, reduction in water flow due to dams, modification of river morphology, loss of nesting sites, egg-collection for consumption and

**Table 4.** A maximum and minimum total count of Marsh Crocodile (*Crocodylus palustris*) conducted in different sites in post-monsoon of 2014-2016.

| Sites | Range | Max count | Adult | Sub-adult | Juvenile | Min count | Adult | Sub-adult | Juvenile |
|---|---|---|---|---|---|---|---|---|---|
| Kaman River (Nanak Dam) | South Jaulasal | 35 | 21 | 10 | 4 | 7 | 5 | 2 | 0 |
| Dhora dam | Doly | 21 | 18 | 3 | 0 | 8 | 5 | 2 | 1 |
| Ghoda Nala | Doly | 38 | 26 | 9 | 3 | 5 | 5 | 1 | 0 |
| Jalpaniya Nala | Kisanganj | 8 | 7 | 1 | 0 | 2 | 2 | 0 | 0 |
| Kakra Nala | Doly | 113 | 74 | 20 | 19 | 58 | 37 | 12 | 9 |
| Khatima Nala | Khatima | 10 | 7 | 2 | 1 | 3 | 3 | 0 | 0 |
| Rudpur Nala | Kishanpur | 8 | 5 | 3 | 0 | 3 | 2 | 0 | 1 |
| Khagra Nala | Ransali | 11 | 8 | 2 | 1 | 2 | 2 | 0 | 0 |
| Sunkheri Nala | Ransali | 9 | 5 | 2 | 2 | 4 | 4 | 0 | 0 |
| Sharda dam | Surai | 28 | 16 | 7 | 5 | 8 | 8 | 0 | 0 |
| Total | | 281 | 187 | 59 | 35 | 100 | 73 | 17 | 11 |

**Table 5.** A maximum and minimum total count of Marsh Crocodile (*Crocodylus palustris*) conducted in different sites in pre-monsoon of 2015-2017.

| Sites | Range | Max count | Adult | Sub-adult | Juvenile | Min count | Adult | Sub-adult | Juvenile |
|---|---|---|---|---|---|---|---|---|---|
| Kaman River (Nanak Dam) | South Jaulasal | 41 | 26 | 9 | 6 | 9 | 6 | 1 | 2 |
| Dhora dam | Doly | 28 | 17 | 8 | 3 | 12 | 8 | 3 | 1 |
| Ghoda Nala | Doly | 54 | 38 | 11 | 5 | 5 | 3 | 2 | 0 |
| Jalpaniya Nala | Kisanganj | 9 | 8 | 0 | 1 | 4 | 4 | 0 | 0 |
| Kakra Nala | Doly | 126 | 81 | 33 | 12 | 91 | 62 | 22 | 7 |
| Khatima Nala | Khatima | 11 | 6 | 5 | 0 | 5 | 4 | 1 | 0 |
| Rudpur Nala | Kishanpur | 14 | 9 | 4 | 1 | 4 | 4 | 0 | 0 |
| Khagra Nala | Ransali | 12 | 7 | 3 | 2 | 4 | 4 | 0 | 0 |
| Sunkheri Nala | Ransali | 11 | 9 | 1 | 1 | 3 | 3 | 0 | 0 |
| Sharda dam | Surai | 35 | 17 | 11 | 7 | 17 | 9 | 5 | 3 |
| Total | | 341 | 218 | 85 | 38 | 154 | 107 | 34 | 13 |

poaching (Whitaker and Basu 1983, Venugopal and Prasad 2003, Hussain 2009). Marsh Crocodiles were surveyed in the Eastern part of the study area that is in the Terai East forest division of Kumaun, Uttarakhand. The Marsh Crocodile is not present mostly in rivers such as Kosi, Dabka, Nihal, Baur, Bhakhda, Gola, Nandhor and Sharda during study period. However, the distribution of muggers is in its tributaries. All above mentioned fresh water rivers flow seasonally and not throughout the year, have boulders, have less muddy ground, less shade of vegetation and food availability is also low due less presence of fishes negatively affecting

crocodile presence. The diet of Marsh Crocodiles varies depending on their age. Juveniles eat insects, crustaceans and small fishes. Adults primarily eat reptiles, amphibians, fish, birds, and small mammals, such as monkeys (Britton, 1995). During study, Marsh Crocodile were seen preying on feral dogs, goats and python in some study sites of Terai Arc Landscape, Uttarakhand. We observed, different foraging behaviors depending on different sizes of crocodiles and food availability. Size related habitat segregation is common in *Alligator mississippiensis* (Goodwin and Marion 1978), *Caiman crocodilus* and *Melanosuchus niger* (Heron, 1994), *Crocodilus niloticaus* (Hutton, 989; Kafron, 1992)

Many river and streams flow adjacent to villages and agricultural fields and existence of fish species like *Tor putitora, Catla catla*, *Labeo rohita*, *Sperata seenghala*, *and Wallago attu* in the its tributaries, reservoirs, dam is an important food resource for wetland crocodile species, and the adjoining agriculture fields provide foraging grounds. The fish age and biomass, amphibian and reptile abundance, water transparency and emergent vegetation govern the richness of aquatic species such as crocodiles (Kloskokowski et al., 2010). Many water bodies of TAL presently provide suitable habitat for feeding, breeding and foraging for Marsh Crocodiles and should be managed to conserve the Marsh Crocodiles in the future.

**Acknowledgment:**

The present study was conducted with the support of Forest Department, Uttarakhand and Department of Forestry and Environment Science, Kumaun University, Nainital. We are grateful to all forest staff for field work assistance and thank Shariq Safi for valuable help. We also thank Dr. Chandra Shekhar Sanwal, and Mr. Nitish Mani Tripathi, DFOs of Haldwani and Terai East forest divisions, respectively for their kind cooperation and providing and facilitating research on Marsh Crocodile.

**Author Contributions:**

Shah M. Belal: Original idea and design of the study work, survey and data collection, data analysis and manuscript preparation. Dr. Parag M. Dhakate and Prof. Jeet Ram: Drafting and finalizing the manuscript.

**References:**


- Britton A., 1999. *Crocodylus palustris*: Lesson 1831 article www.flmnh.ufl.edu/natsci/herpetology/brittoncrcos/cspcpal.htm 1995-98.
- Chang, M.S., Gachal, G.S., Qadri, A.H., Jafri, H.I.S., Khowaja Z., Kalhoro A.M., Memon H.K., Sheikh, M.Y., 2014. Physicochemical assessment and its impacts on Marsh Crocodiles in Deh Akro II wildlife sanctuary. *International Journal of Bioscience*, Vol 4, No. 3, p. 85-96.
- Chang M.S., Gachal G.S., Qadri AH, Sheikh M.Y. 2013. Physico-chemical assessment and its impacts on Marsh Crocodiles of Karachi Zoological Garden. *International Journal of Advanced Research* 1(3), 102-107.
- Chang, M.S., Gachal., G.S., Qadri, A.H., Sheikh, M.Y., Chang, S., 2013a. Ecological impacts on the population of Marsh Crocodiles (*Crocodyluspalustris*) in Chotiari Wetland Complex Sanghar, Sindh: A survey report. *Canadian Journal of Pure and Applied Science*s 7 (2): 2363-2373.
- Da Silva, A. and Lenin, J. (2010). "Mugger Crocodile *Crocodylus palustris*, pp. 94–98 in S.C.
- Manolis and C. Stevenson (eds.) *Crocodiles. Status Survey and Conservation Action Plan*. 3rd edition, Crocodile Specialist Group: Darwin.
- Dhakate, P.M., T.A. Patil & R. Bhartari (2008). Wetland birds of Corbett Tiger Reserve Landscape, pp1974-1982.
- Dudgeon D., Arthington A.H., Gessner M.O., Kawabata Z, Knowler D.J., et al., 2006. Freshwater biodiversity: importance, threats, status and conservation challenges. *Biological Reviews* 81: 163-182.
- Gleick PH., 2003. Global freshwater resources: soft-path solutions for the 21st century. *Science*
- 302: 1524–1528.
- Goodwin, T. M., & Marion, W. R. (1978). Aspects of the nesting ecology of American alligators (*Alligator mississippiensis*) in North□Central Florida. *Herpetologica*, *34*, 43–47.
- Groombridge, B., Wright, L., 1982. The IUCN Amphiba-Reptilia Red Data Book. Part 1, test dines, Crocodylia, Rhynchocephalia. IUCN, 426.
- Herron, J. C. (1994). Body size, spatial distribution, and microhabitat use in the caimans, *Melanosuchus niger* and *Caiman crocodilus*, in a Peruvian lake. *Journal of Herpetology*, *4*, 508–513.

- Hussain, S. A. 2009. Basking site and water depth selection by Gharial *Gavialisgangeticus* Gmelin 1789 (Crocodylia, Reptilia) in National Chambal Sanctuary, India and its implication for river conservation. Aquatic Conserv: Mar. Freshw. *Ecosyst*. 19:127–133.
- Hutton, J. (1989). Movements, home range, dispersal and the separation of size classes in Nile crocodiles. *American Zoologist*, *29*, 1033–1049.
- Jansson R, Nilsson C, Dynesius M, Andersson E., 2000. Effects of river regulation on riparian vegetation: a comparison of eight boreal rivers. *Ecological Applications* 10: 203–224.
- Joshi R., 2013. Range extension of mugger crocodile *Crocodylus palustris* (Lesson, 1 831 ) in upper Ganges and tributaries,lesser Himalayan zone, north India. *J Biol Earth Sci;* 3 (1): B1 00 B1 09.
- Joshi R., Singh R., and Negi M.S., 2011. First record of mugger crocodile *Crocodylus palustris* (Lesson, 1831) from the Rajaji National Park, North India. *International Journal of Biodiversity and Conservation* Vol. 3(9), pp. 444-450
- Jayson E.A., Sivaperuman C. and Padmanabhan P., 2006. Review of the reintroduction programme of the mugger crocodile *crocodylus palustris* in Neyyar reservoir, India. *Herpetological Journal*, vol. 16, pp. 69-76 (2006)
- Kofron, C. P. (1992). Status and habitats of the three African crocodiles in Liberia. *Journal of Tropical Ecology*, *8*, 265–273.
- Kloskowski, J., M. Nieoczym, M. Polak & P. Pitucha (2010). Habitat selection by breeding waterbirds at ponds with size-structured fish populations. *Naturwissenschaften* 97(7): 673–682
- King, F.W. and Burke, R.L., 1989. Crocodilian, Tuatara and Turtles Species of the World. A Taxonomic and Geographic Reference. Assoc. Systematics Collections: Washington, DC.
- Lang, J., 1987. Crocodilian thermal selection. *In*: Wildlife management: crocodiles and alligators. pp: 301-317. G. J. W. Webb, S. C. Manolis& P. J. Whitehead (Eds). Surrey Beatty and Sons Pty Limited/Conservation Commission of the Northern Territory, Chipping Norton.
- Meenakshi M., Chhaya B. and Vijay K.K., 2010. Some Observations on Basking Behavior of a
- Wild Population of Marsh Crocodiles in Baghdarrah Lake, Udaipur, Rajasthan, India Vol. 37: No. 1 Junuary-March 2010
- Naoroji, R. (1999). Status of diurnal raptors of Corbett National Park with notes on their
- ecology and conservation. *J. Bombay Nat. Hist. Soc.* 96: 387–398.
- Naiman RJ, Bunn SE, Nilsson C, Petts GE, Pinay G,Thompson LC., 2002. Legitimizing fluvial
- ecosystems as users of water: an overview. *Environmental Management*.30:455–467.
- Pianka, E. R. (1975). *Ecology and evolution of communities*. Cambridge, MA: Harvard University Press.
- Powell, J., 1973. Crocodilians of Central America, including Mexico and the West Indies: Developments since 1971. In: Crocodiles: Proceedings 2nd Working Meeting of Crocodile Specialist Group. IUCN The World Conservation Union, Morges,n Switzerland. 27-31.
- Revenga C, Kura Y., 2003. Status and trends of biodiversity of inland water ecosystems.
- Secretariat of the Convention on Biological Diversity, Montreal, Technical Series No. 11.
- Rahmani, A.R., G. Narayan, L. Rosalind, R. Sankaran & U. Ganguli (1989). Status of the Bengal Florican (Houbaropsis bengalensis) in India. *J. Bombay Nat. Hist. Soc.* 88:349–375.
- Rai R. K., Raj B. S., 2015. Conservation of Crocodylus palustris in Kotmi Sonar of Janjgir – Chamapa (C.G.) India. *Journal of Environmental Science, Toxicology and Food Technology. Volume. 1 Issue. 3, PP 24-29*
- Sánchez Herrera, O., G. LópezSegurajáuregui, A. GarcíaNaranjo Ortiz de la Huerta, and H. BenítezDíaz. 2011
- Shashi K.M., and Girdhari S., 2006-07 to 2015-16. Management plan of Terai East forest division, Haldwani, western circle, Uttaranchal.
- Stevenson, C., and R. Whitaker, 2010. Gharial *Gavialisgangeticus*Third Edition.Crocodile Specialist Group: Darwin.
- Shah, M.B., and Nasim, A.A. 2017. Striped Hyaena *Hyaena hyaena* (Linnaeus, 1758) (Carnivora: Hyaenidae) new reportsin Nandhaur Valley, Terai Arc Landscape, Uttarakhand, India. *IJAEMS, Vol-3 issue6.*
- Shikha C., Choudhury B.C. and Gopi G.V., 2011. Seasonal habitat use & resource partitioning between two sympatric crocodilian populations (*Gavialis gangeticus* & *Crocodylus palustris*) in Katerniaghat

Wildlife Sanctuary, India. M.Sc. dessrtation, submitted in Wildlife Institute of India (WII), Dehradun.
- Tanveer A. , Harendra S. B. , Deepa B. , Gajendra S. M. & Afifullah K. 2019. Status of water birds in Haripura Baur Reservoir, western Terai-Arc landscape, Uttarakhand, India. Journal of Threatened Taxa, www.threatenedtaxa.org 26 July 2019, 11(9).
- Tucker, A. D., C. J. Limpus, H. I. McCallum, and K. R. McDonald. 1996. Ontogenetic dietary partitioning by *Crocodylus johnstoni* during the dry season. *Copeia* 1996: 978–988.
- Venugopal, P. D., and K. V. D. Prasad. 2003. Basking behaviour and survey of Marsh Crocodiles *Crocodyluspalustris* in Ranganthittu Bird sanctuary, Karnataka, India. Hamadryad 27.
- Vyas, R. and Bhavsar S.R., 2009. Movement of an individual Mugger into urban areas of Vadodara City, Gujarat State, India. *CSG Newsletter* 28(3): 5–7.
- Vyas, R. and Vyas R., 2002. Mugger survey in the Vishwamitri River of Gujarat, India. *CSG Newsletter* 21(3): 9–110.
- Vyas, R., 2010a. Mugger (C*rocodylus palustris*) population in and around Vadodara City, Gujarat State, India. *Russian Journal of Herpetology* 17(1): 43–50.
- Vyas, R., 2011. New threat on the Mugger (C*rocodylus palustris*) population of Vadodara city,
- Gujarat, India. *CSG Newsletter* 30(3): 15–16.
- Whitaker, R. and Andrews H., 2003. Crocodile conservation, Western Asia region: An update.
- *J. Bombay Nat. Hist. Soc.* 100(2&3): 432–445.
- Whitaker, R. 1987. The management of crocodilians in India. In: Wildlife Management: Crocodiles and Alligators. Webb, G.J.W., S.C. Manolis and P.J. Whitehead (eds.).63–72. Surrey Beatty and Sons, Chipping Norton, Australia.
- Whitaker, R., and Basu D., 1983. The gharial (Gavialis gangeticus): a review. *J. Bombay Nat. Hist. Soc.* 79:531–548.
- Whitaker, R., 1977. Note on the status of Gir crocodiles. *J. Bombay Nat. Hist. Soc.* 75:224-227.
- Whitaker, R., and Daniel J. C., 1978. The status of Asiatic crocodiles. Tiger paper (FAO, Asia) 5:12-17.
- Whitaker, R., and Whitaker Z., 1979. Preliminary crocodile survey - Sri Lanka. . *J. Bombay Nat. Hist. Soc.* 76:66-85.
- Whitaker, R., and Whitaker Z., 1984. Reproductive biology of Mugger. *J. Bombay Nat. Hist. Soc.* 81:119-127.
- Whitaker, R., Whitaker, Z., 1989. Ecology of the mugger crocodile. In: crocodiles. Their Ecology, Management and conservation. A Special Publication of the *Crocodile Specialist Group*. ICUN, Gland, Switzerland. 276-297.

**Referees:**

1. Dr. Sanjeev Kumar
Assistant Professor in Zoology Department
S.S.S.K.R. Innani Mahavidyalaya, Karanja Lad, Distt. Washim
Amrawati University, Maharashtra
E.mail: skmprasaddevbhumi@gmail.com
Mob.: +91 9837929293

2. Dr. Ahmad Masood Khan
Assistant Professor, Deptt. Of Wildlife Sciences,
Aligarh Muslim University, Aligarh
E.mail: masoodwls@gmail.com
Mob.: +91 9528593728

3. Dr. Chandra Shekhar Sanwal, IFS
Director, Herbal Research and Development Institute, Mandal, Gopeshwar, Chamoli, Uttarkhand
E.mail: Chandra.sanwal@gmail.com
Mob.: +91 7579009817

# A new, exotic larval host plant record for the Nygmiine Tussock Moth *Orvasca* cf. *subnotata* Walker, 1865, from the Mumbai region (Erebidae: Lymantriinae: Nygmiini)

**Javed Ahmed[1*], Rajashree Khalap[2], Chris Cathrine[2,3], Krishna Mohan[3], Bhushan Jadhav[4].**

[1*]Corresponding Author: Jai Gopi Krishna CHSL, 'A' Wing, Flat No 102,1, Patil Wadi, Govandi East, Mumbai, Maharashtra 400088, India
email - curiocritters@gmail.com
[2]5-A, Sagar Sangeet, 58 Shahid Bhagat Singh Marg, Colaba, Mumbai 400005, India,
email - rajashree.khalap@gmail.com
[2,3]·Office 2 and 3, Craigarnhall, Bridge of Allan, Stirling, FK9 4NG, Scotland
email - chris.cathrine@caledonianconservation.co.uk
[3]Prabhu Hospital, Hospital Cross Road, Moodbidri 574227, India,
email - drkrishi@gmail.com
[4]A-4, Plot no. 82, Aasra Co-operative Housing Society, Near Swami Vivekanand School, Gorai-1, Borivali (West), Mumbai 400091, India.
email - bhushanjadhav7604@gmail.com

**Citation:** **Ahmed Javed, Khalap Rajashree, Chris Cathrine, Mohan Krishna and Jadhav Bhushan.** A new, exotic larval host plant record for the Nygmiine Tussock Moth *Orvasca* cf. *subnotata* Walker, 1865, from the Mumbai region (Erebidae: Lymantriinae: Nygmiini)
*Ela Journal of Forestry and Wildlife*
*Vol.10 (1): 867-873*

**Date of Publication:**
31 March 2021

ISSN 2319-4361



**Keywords**: *Orvasca subnotata*, *Averrhoa bilimbi*, Moths, Mumbai, Naturalised species, Urban Wildlife, Urban Biodiversity, Exotic plants, Natural History, Ecology, Mumbai, Maharashtra, India.

**Abstract:** The Nygmiine tussock moth *Orvasca subnotata* Walker, 1865 is polyphagous and known to utilise a wide variety of larval host plants, belonging to several different families, (Robinson et al., 2010) **(Table 1)**. The present report adds to this list, with the inclusion of *Averrhoa bilimbi* L., a new, exotic (to India)**,** larval host plant for *O. subnotata*.

Caterpillars (instar unknown) were first observed feeding on the flower-heads, and young fruit of the bilimbi tree, *A. bilimbi* **(Figure 1a-1b)**, at the Mumbai Port Trust Botanical Garden, Colaba, in South Mumbai, on 8 September 2020, and collected in order to rear and confirm identification. They were found to be sparsely covered with fine hair, with those on the anterior, and posterior segments projecting forward, and displaying a predominantly yellow and black color scheme, with a thin, dorsal red line running down the length of the body, centered against a broader yellow band, with yet another thin yellow line, flanking the sides of the body laterally, just above the legs, and pro-legs, and extending upwards into, and bordering each segment.

**Figure 1a - Orvasca cf. subnotata larvae feeding on flowers and young fruit of Averrhoa bilimbi**

**Figure 1b - Orvasca cf. subnotata larvae feeding on flowers and young fruit of Averrhoa bilimbi**

Segments 4, 5 and 11 with prominent, black, wart like protrusions, speckled with white spots, and with a double row of similar, but smaller protrusions running along the sides of the body, placed in between the broad yellow dorsal band, and the thin, lateral yellow band, just above the legs **(Figures 2a-2d)**.

Pupation was observed on 11 September 2020 (18:00 hrs. approx.), with the pupae encased in loose, pale greyish-brown, cocoons **(Figure 3)**. Adult moths emerged on 18 September 2020, after a period of 8 days.

An additional caterpillar (instar unknown) was also collected from the same location (and tree), on 1 October 2020, which underwent pupation on 4 October 2020, and emerged on 12 October 2020, after a period of 8 days, as with the preceding specimens.

Adult moths were tentatively identified as *O*. cf. *subnotata* based on the color plate furnished by Gurule & Nikam (2013), and further supported by the following identification marker provided by Wang et al. (2011) namely: forewing pale, crossed by two distinct, whitish median lines **(Figure 4a-4b)**.

*O*. *subnotata* was first described by Walker (1856) as a pale-fawn colored moth (male), with the forewings bearing three large pale yellowish spots on the exterior border of the forewings. This species has a very broad distribution throughout Indomalaya (Wang et al., 2011).

A very similar looking moth to *O*. *subnotata*, which also occurs in India, is the yellow tail tussock moth, *Somena scintillans* (Walker, 1856), which can be differentiated from the former species by reddish brown forewings, irregularly bordered with yellow, in male specimens (as opposed to three distinct yellow spots bordering the forewings of male, and female specimens of *O*. *subnotata*). While female specimens of *S*. *scintillans* also possess three yellow spots at the base of their fore-wings, (similar to what is observed in male and female specimens of *O*. *subnotata*), they can be distinguished by the absence of the two distinct, light colored median lines observed on the forewings of both sexes of *O*. *subnotata* (Wang et al., 2011; Gupta et al., 2013).

*Somena similis* (Moore, [1860]), is yet another species which resembles *O*. *subnotata*, but can be easily separated by two yellow spots (as opposed to three yellow spots, in *O*. *subnotata*) bordering the forewing, in female specimens, with the third (apical) spot either weak, or missing. Male specimens of this species have a distinct irregular border to their forewings, much like *S*. *scintillans*, and can be discerned from both *O*. *subnotata*, as well as *S*. *scintillans*, by two slight protrusions of the reddish brown wing area, into the irregular yellow border of the forewings, centrally and subcostally (*Somena similis* species page on the 'Moths of Borneo' website: https://www.mothsofborneo.com/part-5/nygmiini/nygmiini_2_1.php Copyright © Southdene Sdn. Bhd.).

*A*. *bilimbi* is thought to be native to Indonesia, probably originating in the Maluku Islands (also known as the Moluccas), widely cultivated and naturalised in the continents of Africa, Asia, North America, Oceania,

**Figure 2a - Larva of Orvasca cf. subnotata. Dorsal view**

**Figure 2b - Larva of Orvasca cf. subnotata. Lateral View showcasing protuberances on segments 4, 5 & 11**

**Figure 2c - Close up of protuberances on segments 4 & 5**

**Figure 2d - Close up of protuberance on segment 11**

and South America. In India, it is locally known as 'bilimbi', and frequently sighted in gardens, growing feral in the warmest parts of the country (CABI Datasheet on *Averrhoa bilimbi*: https://www.cabi.org/isc/datasheet/8081; Morton, 1987) **(Figures 5a-5e)**.

While it's not uncommon for native Lepidoptera to utilise exotic species of flora (invasive, and/or naturalised) as larval host plants (see Nitin et al. (2018) for several examples of this), these usually belong to the same family as the natural host plants. We report here, an instance of a new larval host plant for *O*. cf. *subnotata*, which belongs to a family (Oxalidaceae R.Br.), the members of which had never before been recorded as being utilised by this species of moth.

It should be noted that *O. subnotata* also occurs in Indonesia, where *A. bilimbi* is thought to originate from, so this insect-plant association may be a naturally occurring evolutionary adaptation in that country. *A. bilimbi* is also widely cultivated elsewhere within the moth's distribution range (Wang et al., 2011; Morton, 1987), and this interaction may be widespread - further observations throughout the distribution range of *O. subnotata*, are necessary to confirm if this is indeed the case.

Moreover, while *O. subnotata* is known to occur across India (Hampson, 1892), and has been recorded from several states since it was first described, namely: Maharashtra (Northern Maharashtra, which includes Nashik, Dhule, Jalgaon and Nandurbar districts), in Western India, Madhya Pradesh (Bhopal and Umaria) & Chhattisgarh (Bastar), in Central India, Uttar Pradesh (Aligarh city) in Northern India, Kerala (Kavvayi river basin), in South India, Karnataka (Kodagu district, central Western Ghats), in South West India (Gurule & Nikam, 2013; Pathre et al. 2019; Chandra, 2007; Farooqui et. al, 2020; Alex et al., 2021; Mishra et. al, 2016) **(Figure 6 - Map 1)**, the only confirmed, published record from Mumbai (listed simply as 'Bombay', without any locality specified), was by Colonel Charles Swinhoe, from 1892 (Swinhoe, 1892). This, in spite of two separate, recent surveys on the moth fauna of the northern Western Ghats, which also included the Mumbai region, or at least a part of it (Sanjay Gandhi National Park, a protected area) (Shubhalaxmi et al., 2011; Kalawate, 2018). The present record of *O*. cf. *subnotata* from the Mumbai Port Trust Garden, in South Mumbai, is therefore the only recent record of the species from Mumbai city, after a period of 129 years.

**Additional remarks**

The larval description for *O. subnotata* provided by Moore (1882-1883) appears to have been confused with that of *Somena* species (*Orvasca subnotata* species page on the 'Moths of Borneo' website: https://www.mothsofborneo.com/part-5/nygmiini/nygmiini_3_1.php Copyright © Southdene Sdn. Bhd.). This is particularly exemplified by the fact that both the larval description, and its corresponding illustration (but not that of the cocoon, and pupa) for *S. scintillans*, as

**Figure 3 - Close up of Cocoon of Orvasca cf. subnotata**

**Figure 4a - Orvasca cf. subnotata. Imago at rest.**

**Figure 4b - Orvasca cf. subnotata. Imago with wings slightly relaxed, showcasing the three spots bordering the forewing**

provided by Moore, closely match (but differ significantly enough from) the caterpillars collected, and reared by the authors of this publication, the resultant imagines of which were subsequently identified as *O*. cf. *subnotata* (based on the information, and images presented in this publication). One key difference includes the placement of the tubercles (segments 5, 6, and 12, on *S. scintillans*, versus 4, 5, and 11 on *O*. *subnotata)* which aligns with the larval description of *O*. *subnotata* from China, provided by Zhou et al., (2015). Additionally, photographs resembling the species identified in this publication as *Orvasca* cf. *subnotata* have been found listed as *Somena scintillans,* on the 'Moths of India' website ('Moths of India' species page for *Somena scintillans* - https://www.mothsofindia.org/sp/356624/Somena-scintillans - Copyright (c) National Centre for Biological Sciences). This identification, which is based on user submitted data, is likely erroneous (for no fault of the chief editors of the 'Moths of India' website), especially in light of the information gathered, cited and presented in this publication. Furthermore, the moth presented as '*O*. *subnotata*' in Kalaisekar et al., (2017) (Figure 2.10, page 44), is also likely misidentified, since its appearance aligns closely with the female specimen of *S. scintillans,* based on the identification characteristics provided by Wang et al., (2011), and a color photograph of the imago provided by Gupta et al., (2013).

**Acknowledgements**

The authors express their grateful thanks to Caledonian Conservation Ltd (Scotland), for their generous financial support. Sunjoy Monga, naturalist, and ornithologist par excellence, is thanked for his constant encouragement, and support. Javed Ahmed would like to acknowledge, and thank Rajashree Khalap, for her help with rearing larvae, keeping meticulous records, and for photographing the various life stages presented in this paper. All images copyright Rajashree Khalap/Javed Ahmed/Krishna Mohan/The Urban Bestiary Project/Wild Megapolis Project.

**Figure 5a - Averrhoa bilimbi tree.**

**Figure 5b - Averrhoa bilimbi leaves. Close-up.**

**Figure 5c - Averrhoa bilimbi flowers.**

**Figure 5d - Averrhoa bilimbi fruits. Close-up.**

**Figure 5e - Averrhoa bilimbi canopy with fruits.**

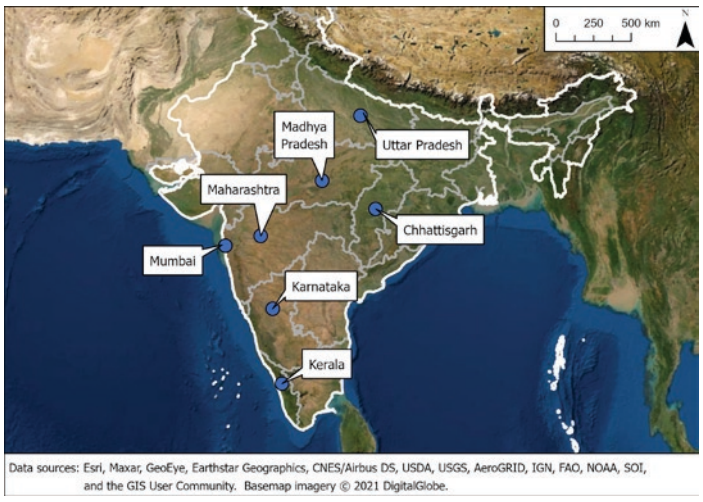



**Figure 6, Map 1 showing distribution of Orvasca subnotata in India.**

**Table 1. Known foodplants of *Orvasca subnotata*.**

| Family | Taxon |
|---|---|
| ***Anacardiaceae*** | *Anacardium* sp.<br>*Mangifera indica*<br>*Anacardium occidentale*<br>*Buchanania latifolia* |
| **Fabaceae** | *Acacia nilotica*<br>*Cajanus cajan*<br>*Medicago sativa*<br>*Sesbania sesban*<br>*Dalbergia odorifera* |
| **Palmae** | *Areca catechu* |
| ***Cucurbitaceae*** | *Benincasa hispida* |
| **Cycadaceae** | *Cycas circinalis* |
| **Myrtaceae** | *Eugenia aquea*<br>*Psidium guajava* |
| **Euphorbiaceae** | *Hevea brasiliensis*<br>*Hevea* sp. |
| **Rhizophoraceae** | *Kandelia candel* |
| **Sapindaceae** | *Litchi* sp.<br>*Nephelium lappaceum* |
| **Sterculiaceae** | *Theobroma cacao* |
| **Euphorbiaceae** | *Hevea* sp.<br>*Hevea brasiliensis* |
| **Rutaceae** | *Citrus maxima* |
| **Solanaceae** | *Solanum melongena* |
| **Lythraceae** | *Sonneratia* |
| **Apocynaceae** | *Tabernaemontana* |
| **Poaceae** | *Pennisetum americanum* |

**References**


- Alex, C. J., Soumya, K. C. & Sajeev, T. V. (2021). A report on the moth (Lepidoptera: Heterocera) diversity of Kavvai River basin in Kerala, India. *Journal of Threatened Taxa,* 13(2), 17753–17779.
- Anonymous. 2021. Somena scintillans Walker, 1856 – *Yellow-tail Tussock Moth*. In Sondhi, S., Y. Sondhi, P. Roy and K. Kunte (Chief Editors). Moths of India, v. 2.40. Indian Foundation for Butterflies. http://www.mothsofindia.org/sp/356624/Somena-scintillans
- Chandra, K. (2007). *Moth diversity of Madhya Pradesh and Chhattisgarh, India, and its conservation measures*. Kendrick, R.C. (Ed.) Proceedings of the First South East Asian Lepidoptera Conservation Symposium, Hong Kong 2006, 49–61.
- Chung, A. Y. C. (2008*). Insects Associated with Some Ornamental Plants in Sabah, Malaysia.* 7th International Conference on Plant Protection. Kuala Lumpur, 27-29 August, 2008.
- Cotes, E. (1887). *A catalogue of the moths of India*. Part II, Bombyces. Calcutta (Trustees of the Indian Museum).
- Farooqui, S. A., Parwez, H., & Joshi, R. (2020). A preliminary study and new distributional records of family Erebidae (Leach, [1815]) (Lepidoptera: Noctuoidea) from Aligarh, Uttar Pradesh, India. *Notulae Scientia Biologicae*, 12(4), 794–806. https://doi.org/10.15835/nsb12410830
- Gupta, R., Tara, J. & Pathania, P. (2013). First Report of Yellow Tail Tussock Moth, Somena Scintillans Walker (Lepidoptera: Lymantriidae) On Apple Plantations In Jammu. *Journal of Insect Science*, 25(1), 130–133.
- Gurule, S.A. (2013). *Taxonomic study of moths Lepidoptera Heterocera from North Maharashtra India [Pune]*. PHD Thesis In Savitribai Phule Pune University. http://hdl.handle.net/10603/98571
- Gurule, S. A. & Nikam, S. (2011). Inventory of Lepidopterous Insects in North Maharashtra And Survey for Moth Diversity. *Flora and Fauna, Jhansi,* 17(1), 165–176.
- Gurule, S.A. & Nikam, S. (2013). The moths (Lepidoptera: Heterocera) of northern Maharashtra: a preliminary checklist. *Journal of Threatened Taxa,* 5, 4693–4713. http://www.threatenedtaxa.org/index.php/JoTT/article/view/1045
- Gurule, S.A., Nikam, S.M., Kharat, A. & Gangurde, J. (2010). Check-list of owlet and underwing moth (Lepidoptera: Noctuidae) from Nashik district, (MS) India. *Flora and Fauna, Jhansi,* 16, 295–304.
- Hampson, G. F. (1892). *The Fauna of British India, including Ceylon and Burma. Moths,* Vol. 1. London, Taylor and Francis.
- Irungbam, J., Gurule, S.A. & Fric, Z. (2020). Lappet moths (Lepidoptera: Lasiocampidae) of Manipur, north east India: an updated checklist. *Journal of Insect Biodiversity*, 19(2), 24-43. https://doi.org/10.12976/jib/2020.19.2.1
- Kalawate, A. S. (2018). On a collection of Moths (Lepidoptera: Heterocera) from the northern Western Ghats of Maharashtra, India. *Zoology and Ecology*, 28(3), 231–251. https://doi.org/10.1080/21658005.2018.1506378
- Kalawate, A. S., Upadhyay, N. & Mukhopadhyay, B. (2019). Rediscovery of an endemic Indian moth *Gurna indica* (Moore, 1879) (Lepidoptera: Erebidae: Arctiinae) after 125 years. *Journal of Threatened Taxa*, 11(6), 13808–13810. https://doi.org/10.11609/jott.4649.11.6.13808-13810
- Kalaisekar, A., Padmaja, P., Bhagwat, V. & Patil, J. (2017*). Insect pests of millets: systematics, bionomics, and management*. Academic Press.
- Mishra, S.B., Kencharaddi, R.N, Devagiri, G.M. & Khaple, A.K. (2016). Moths Diversity of Kodagu District in Central Western Ghats of Karnataka, India. Indian *Journal of Ecology*, 43 (Special Issue-2), 713–718.
- Moore, F., 1882–1883. *The Lepidoptera of Ceylon.* Volume 2. London (L. Reeve). 162 pp.
- Morton, J. (1987). Fruits of warm climates. Julia F. Morton, Miami, Forida, USA. 128–129 pp.
- New, T. R. (1997). Are Lepidoptera an effective 'umbrella group' for biodiversity conservation? *Journal of Insect Conservation*, 1, 5–12. https://doi.org/10.1023/A:1018433406701
- Nayak, A. & Ghosh, S. (2020). Moth diversity (Lepidoptera: Heterocera) of Banaras Hindu University, Varanasi, India: a preliminary checklist. *Notulaebiologicae.Ro,* 12(3), 592–607. https://doi.org/10.15835/nsb12310749
- Nitin, R., Balakrishnan, V. C., Churi, P. V., Kalesh, S., Prakash, S. & Kunte, K. (2018). Larval host plants of the butterflies of the Western Ghats, India. *Journal of Threatened Taxa,* 10(4), 11495–11550.

https://doi.org/10.11609/jot.3104.10.4.11495-11550

- Robinson, G. S., P. R. Ackery, I. J. Kitching, G. W. Beccaloni & L. M. Hernández, 2010. HOSTS - A Database of the World's Lepidopteran Hostplants. Natural History Museum, London. http://www.nhm.ac.uk/hosts. (Accessed: 18 Aug.2010).
- Shubhalaxmi, V., Kendrick, R. C., Vaidya, A., Kalagi, N. & Bhagwat, A. (2011). Inventory of Moth Fauna (Lepidoptera:Heterocera) of the Northern Western Ghats, Maharashtra, India. *Journal of the Bombay Natural History Society*, 108(3), 183–205. http://www.bnhsjournal.org/index.php/bnhs/article/view/156346
- Swinhoe, C. (1890). V. The moths of Burma. Part I. *Transactions of the Royal Entomological Society of London,* 38(1), 161–200.
- Swinhoe, C. (1892). *Catalogue of eastern and Australian Lepidoptera Heterocera in the collection of the Oxford University Museum.* Part 1. Sphinges and Bombyces, with eight plates. Oxford, Clarendon Press.
- Swinhoe, C. (1923). VI.— A revision of the genera of the family Liparidæ. *Annals and Magazine of Natural History,* 11(61), 47–97. https://doi.org/10.1080/00222932308632827
- The Moths of Borneo. (Accessed: 2 April 2021) Copyright © Southdene Sdn. Bhd. All rights reserved.
- Walker, F. (1865). *List of the Specimens of Lepidopterous Insects in the Collection of the British Museum*. Part XXXII.– Supplement Part 2 - Lepidoptera Heterocera. British Museum, London. 323–706pp.
- Wang, H., Wang, M. & Fan, X. (2011). Notes on the tribe Nygmiini (Lepidoptera: Erebidae: Lymantriinae) from Nanling National Nature Reserve, with description of a new species. *Zootaxa*, 2887(2887), 57–68. https://doi.org/10.11646/zootaxa.2887.1.3
- Zhou, B., Zhou, G., Yang, Q., Dong, W., Li, X., Zhou, S. & He, Y. (2015). Biological characteristics and larval instar determination of Orvasca subnotata (Lepidoptera: Lymantriidae), a defoliator of Dalbergia odorifera (Leguminosae). *Acta Entomologica Sinica* 58(11), 1253-1261.

**Select Bibliography for additional information (but not cited in MS):**

Nimbalkar, R.K, & Shinde, S. (2015). Studies on ecology of Lepidopteran fauna of Agro-ecosystem in Marathwada region of Maharashtra State (India). *Science Research Reporter,* 5(1), 80–91.

Pathre, R., Jadhav, S. & Shedolkar, T. (2019). Moth Fauna (Lepidoptera: Heterocera) from the Marathwada Region of Maharashtra. *International Journal of Base and Applied Research,* 9(3), 627–637.

Singh, A. P., Bahuguna, K. & Ramola, G. C. (2019). New host records of polyphagous Lepidoptera on Ban Oak Quercus leucotrichophora A. Camus (Fabaceae) in the Garhwal Himalaya, India. *Journal of Threatened Taxa*, 11(5), 13579–13591.

Vun Khen, C. (2010). Moth diversity in Tropical Rain Forest of Maliau Basin, Sabah, Malaysia, with special reference to Ginseng Camp. *Journal of Tropical Biology & Conservation,* 6(1), 61–77.

# Effect of seasons on ground flora under plantation and in natural forest in South West Bengal

**Tridib Kumar Sahoo**
(Assistant Professor, Department of Botany, Tamralipta Mahavidyalaya, Tamluk, Purba-Midnapore. W.B., India.
Corresponding Address – C-21, Saratpally, P.O – Midnapore, Dist- Paschim-Midnapore, Pin- 721101, West Bengal, India. E-mail: tksahoo.botany@gmail.com)

**Citation:** **Sahoo Tridib Kumar.** Effect of seasons on ground flora under plantation and in natural forest in South West Bengal
*Ela Journal of Forestry and Wildlife*
*Vol.10 (1): 874-885*

**Date of Publication:**
31 March 2021

ISSN 2319-4361

**Abstract**

The present study reveals that more herbaceous species were found in natural coppice Sal (*Shorea robusta*) forest i.e. 29 and 35 species respectively in Jogardanga forest and in Pathrisole forest than Akashmoni (*Acacia auriculiformis*) plantation stand, where the number of herbaceous species was 21 in Jogardanga forest and 23 in Pathrisole forest during rainy season. Species diversity index was higher in rainy season (i.e. 1.50 in Pathrisole Sal forest) than winter (0.952 in Akashmoni plantation stand of Jogardnga forest) and summer season (0.752 in Akashmoni plantation stand of Pathrisole forest) in the forest communities. Similar trend was found in species richness index i.e. during rainy season highest species richness index was in Pathrisole Sal forest (5.965) and lower in Akashmoni plantation stand of Jogardnga forest (1.929) during winter and in Akashmoni plantation stand of Pathrisole forest (0.877) during summer season and opposite trend was found in dominance index. Highest dominance index was found in Akashmoni plantation stand of Pathrisole forest (0.184) during summer season and lower in Pathrisole Sal forest (0.031) during rainy season. The species distribution pattern was contiguous type during rainy season and it became contiguous and random type during winter and summer season respectively. Higher similarity index was found between the two natural coppice Sal forests (57.14%) and lower between the two plantation stands (54.55%). The effect of season on the composition and vegetation changes of ground flora in a forest community is seen in this study.

**Key words** " IVI, lateritic region, natural forest, plantation stand, species diversity".

## Introduction

Forest community is a dynamic biological system consisting of a number of plant and animal species (Sahoo, 2002). Vegetation at a particular site is the result of interaction of various climatic and bioedaphic factors and during the course of natural succession, many tree species compete with each other to establish their hold on the vacant niches (Sinha, *et.al.* 2015). Herbaceous species are important occupants of the ground layer of woodlands and are mostly influenced by prevalent tree communities on these landscapes, and although ground vegetation comprises only a small proportion of total biomass in the forest ecosystem, it plays a very important role in ecological characteristics (Small, 2001; Jhariya and Oraon, 2012a, b; Pawar *et. al.* 2012; Kittur *et. al.* 2014a, b; Oraon *et. al.* 2014 and 2015). Ground vegetation constitutes only 22% of total above ground production but provides 41% of annual litterfall in mixed deciduous woodland (Maurya and Mishra, 1996). Proper undergrowth in a forest is essential for maintenance of nutrient status and ecological balance of any forest ecosystem. The quality and quantity of undergrowth depends on the tree canopy and the edaphic and microclimatic conditions existing under the particular type of forest (Rajvanshi *et.al.*1987). The nature of ground flora, its diversity and density vary with the type of forest and it is more sensitive to changes in environment than trees (Pandey *et. al.*1988).

The vegetation and distribution pattern were studied seasonally in two study sites i.e. Jogardanga forest and Pathrisole forest. In each site, two different forest communities under different management regimes were studied. One is natural coppice Sal (*Shorea robusta* Gaertn. F) forest, which is managed by the concerned FPC (Forest Protection Committee) along with State Forest Department through JFM (Joint Forest Management) and the other was Akashmoni (*Acacia auriculiformis* A. Cunn. ex Benth.) plantation stand which is solely managed by the State Forest Department.

## Study area

Two forest sites were selected for this study, these are Jogardanga forest (22.8141°N and 87.2693°E) of Hoomgarh Forest Range and Pathrisole Forest (22.8186°N and 87.3412°E) of Amlagora Forest Range. Both the study sites are under Rupnarayan Forest Division, Paschim Midnapore, West Bengal, India. The mean annual precipitation of these sites ranges between 1580 mm to 1650 mm of which 75% is received from July to September. The mean maximum and minimum temperature ranges from 37.8° C to 15.6° C. According to Champion and Seth (1968), the coppice Sal (*Shorea robusta*) forest of this region fall under the Major Group – II, Dry Tropical Forest.

## Methodology

The phyto-sociological observation of herbaceous vegetation under both natural coppice Sal forest and Akashmoni plantation stand were recorded every month during March 2019 to February, 2020 by using (1m x 1m) quadrats. The data were represented in three main seasons, summer (March to June), monsoon (July to October) and winter (November to February).To minimise sampling errors, permanent quadrats were laid down for regular observations on the same site to find out the impact of seasons on ground flora. The quadrats were demarcated by small concrete pegs.

### 1) Layout of sample plots

The minimum size and minimum number of the quadrats were determined by "species area curve" method, Oosting (1958). Ten quadrats of (20m x 20m) were fixed randomly at different places. The vegetational data were sub-sampled and recorded in five sites of 1mx1m quadrat from all the 10 quadrats (Sharma *et. al.* 1983; Rajvanshi *et. al.* 1987). Plant species encountered in each quadrat were listed and identified on the basis of floristic studies of regional vegetation by Prain (1903) and then the names were cross checked with the help of Bennet (1987).

### 2) Importance Value Index (IVI)

This is calculated by the formula

- $IVI = R_A + R_D + R_F$ (Curtis, 1959).

Where, $R_A$ = Relative Abundance, $R_D$ = Relative Density, and $R_F$ = Relative Frequency

$R_A$ =× 100

$R_D$ =× 100

$R_F$ = × 100

**3) Diversity Index (H')** = - {()

Log ()}, (Shanon & Wiener, 1963)

where, ni = IVI of individual species and N= IVI of all the species.

**4) Concentration of Dominance (Cd)-** It was measured by Simpson's Index (Simpson- 1949).

$Cd = (ni/N)^2$, where, ni = IVI of individual species and N= IVI of all the species.

**5) Species richness index (d) –** It was calculated according to Margalef (1958). Species richness index (d) = S -1 / log N,
S= Total no. of species, N= IVI of all the species

**6) Species Distribution Pattern -**
Curtis and Cottam (1956) described species distribution pattern into three types, i.e.
(i)Regular distribution (R) if A/F is < 0.025,
(ii) Random distribution (r) if A/F is 0.025 – 0.050 and
(iii) Contiguous distribution (C) if A/F is > 0.050,

Where, A = Abundance and F = Frequency of the species.

The ratio of abundance to frequency (A/F) was used to interpret the distribution pattern of the species (Whiteford, 1949) in terms of regular, random and/or contiguous distribution. (Curtis, 1959).

**7) Index of Similarity (IS) or Quotient of Similarity (QS) -** Index of Similarity (IS) or Quotient of Similarity (QS) between two sample sites or communities was derived by the formula of Sorensen (1948) as described by Muller-Dombois and Ellenberg (1974). IS or QS = 2c / a + b

Where, a = Total no. of plant species in one strand / community, b = Total no. of plant species in another strand/community, c = Total no. of plant species in both the strand /community.

## Results

During the study period the number of herbaceous species under these two forests ranged from 8 to 29 in Jogardanga forest and 6 to 35 in Pathrisole forest. Highest number of herbaceous species were recorded during rainy season in both the forest stands of Jogardanga ~~forest~~ natural coppice Sal forest and Akashmoni plantation stand (29 and 21 respectively). Similarly in Pathrisole forest these were 35 and 23 species respectively in natural coppice Sal forest and Akashmoni plantation stand (Table 1). In summer the number of herbaceous species reduced to a remarkable extent (Table 1). Different phytosociological parameters were estimated during summer, rainy and winter seasons. In monsoon season in Jogardanga natural coppice Sal forest highest IVI was for *Cynodon dactylon* (19.59), followed by *Vernonia cinerae* (14.61), and *Mimosa pudica* (14.52). In Jogardanga Akashmoni plantation stand during rainy season highest IVI was for *Aristida adscensionis* (22.52), followed by *Cynodon dactylon* (19.65), and *Mimosa pudica* (18.44). The dominant herbs of this forest were *Aristida adscensionis*, *Cynodon dactylon*, *Mimosa pudica* and *Vernonia cinerae* (Table–2). During monsoon season in Pathrisole natural coppice Sal forest highest IVI was for *Chrysopogon aciculatus* (16.94), followed by *Heteropogon contortus* (14.63), and *Aristida adscensionis* (13.95); similarly in Pathrisole Akashmoni plantation stand highest IVI was for *Chrysopogon aciculatus* (27.45), followed by *Cynodon dactylon* (17.52) and *Heteropogon contortus* (16.53). Hence, the dominant herbs of Pathrisole forest were *Chrysopogon aciculatus*, *Heteropogon contortus*, *Aristida adscensionis* and *Cynodon dactylon* (Table – 3).

The range of species diversity index of ground flora under Sal forest was higher in rainy season than winter and summer season (Table 4). The comparative study indicates that in rainy season the diversity index was highest in Pathrisole natural coppice Sal forest (1.50) than the other forest such as, Jogardanga natural coppice Sal forest (1.42), Pathrisole Akashmoni plantation stand (1.33) and 1.30 in Jogardanga Akashmoni plantation stand (Table – 4). In both the study sites in any season lower species diversity was in Akashmoni plantation stand than the natural coppice Sal forest. During summer lower species diversity was 0.862 in Jogardanga forest and 0.752 in Pathrisole forest. In natural coppice Sal forest in spite of repeated coppicing and human interventions for collection of NTFPs (non-timber forest products), higher species diversity structure was maintained.

In this study it was seen that higher Cd was in summer season and lower in rainy season in both the forest sites. During summer higher Cd was in Akashmoni plantation stand, such as 0.184 in Pathrisole forest and 0.147 in Jogardanga forest. During rainy season lower Cd was in natural coppice Sal forest, such as 0.035 in Jogardanga forest and 0.031 in Pathrisole forest (Table-4). The study also reveals that the Cd was more in Akashmoni plantation stand than the natural coppice Sal forest in both the study sites, particularly during rainy season in Jogardanga Akashmoni plantation stand Cd was 0.051 and in Jogardanga natural coppice Sal forest Cd was 0.035. Similar result of Cd was found in Pathrisole forest, these were 0.048 and 0.031 respectively in Akashmoni plantation stand and natural coppice Sal forest (Table – 4).

The species richness index (d) was closely related to the season, generally it was seen that this value became highest in rainy season, moderate in winter and lowest

in summer in any forest of the study sites. During rainy season highest species richness index (d) was in natural coppice Sal forest, such as 5.965 in Pathrisole forest and 4.912 in Jogardanga forest (Table–4). During winter moderate species richness index was in Akashmoni plantation stand, such as 2.982 in Pathrisole forest and 1.929 in Jogardanga forest(Table-4). During summer lowest species richness index was in Akashmoni plantation stand, such as 1.228 in Jogardanga forest and 0.877 in Pathrisole forest (Table-4). In between the natural coppice Sal forest and Akashmoni plantation stand more species richness was available in natural coppice Sal forest than the Akashmoni plantation stand in any season and in any forest sites. It was more prominent in rainy season, such as 5.965 in Pathrisole Sal forest and 4.912 in Jogardanga Sal forest (Table-4). Among the four forest sites highest species richness was in Pathrisole natural coppice Sal forest during rainy season (5.965) and lowest in Pathrisole Akashmoni plantation stand in summer season (0.877).

During rainy season the distribution pattern of ground flora in the two study sites was more contiguous in natural coppice Sal forest than for Akashmoni plantation stand. During winter in both the natural coppice Sal forests the distribution of 50% ground flora was categorised as contiguous and remaining 50% as random with some species of regular pattern, these were *Desmodium triflorum*, *Emilia sonchifolia*, *Evolvulus nummularius*, *Mollugo pentaphylla* and *Rungia pectinata* (Table 5). In summer the distribution was mostly random with some contiguous pattern of distribution.

In Jogardanga forest highest similarity index was between the natural coppice Sal forest and Akashmoni plantation stand (80.00%), whereas in Pathrisole forest the similarity index between the natural coppice Sal forest and Akashmoni plantation stand was 72.41% (Table 6). The lowest similarity index was in between the two Akashmoni plantation stands (54.55%), where as medium similarity index was between the two natural coppice Sal forests (57.14%).

**Discussion**

The study revealed that the density of species was maximum during rainy season, declined during winter and was minimum in summer. Similar observations were reported by Mishra *et.al.* (2008).They reported that in any forest community the number of plant species becomes maximum during monsoon and minimum in premonsoon period. Propagules of *Amaranthus viridis*, *Andrographis paniculata*, *Crotalaria* prostata, *Hedyotis corymbosa*, *Mollugo pentaphylla*, *Rungia pectinata*, *Solanum nigram* and *Tridax procumbens* are deposited earlier in soil and respond to better soil moisture conditions immediately during the monsoon showers resulting in their sprouting. The process of sprouting depends on optimum soil moisture conditions and dormancy of seeds. According to Bahuguna *et. al.* (1990) and Durani *et.al.*(1985), a large number of plant species specially shrubs and herbs are newly regenerated in this period because during this period nutrient addition to soil becomes higher and the microclimate is conducive for the invasion of new species as a result the optimal vegetational structure is encountered during this period.

The species density thus becomes highest during rainy season. Major ground flora is seasonal. Some ground flora sprouts late because of breaking of the dormancy of seeds or on reaching optimum moisture conditions like *Barleria cristata*, *Mollugo pentaphyll a*nd *Elephantopus scaber*. During summer season only those species remain in the field which are tolerant to dry conditions and the rest die, such as *Alysicarpus vaginalis*, *Cyperus compresus*, *Desmodium triflorum*, *Eragrostis tenella*, *Fimbristyles dichotoma*, *F. ovata Kyllinga monocephala*, *Lindernia ciliata*, *L. crustacea*, *Phyllanthus fraternus* and *Setaria glauca* reducing the species density to minimum. During summer in ground flora *Aristida adscensionis, Chrysopogon aciculatus,* C*ynodon dactylon* and *Heteropogon contortus* were dominant under Sal forest of both the study sites. This is supported by Sahoo *et. al.* (2004).

During rainy season IVI was the lowest, which increased to maximum in summer under plantation forests than natural Sal forest in both the study sites. During summer, number of species decreased, thus relative dominance of species in IVI was shared among a few species, such as *Aristida adscensionis, Chrysopogon aciculatus,* C*ynodon dactylon*, *Euphorbia hirta*, *Heteropogon contortus*, *Mimosa pudica* and *Sida cordata,* resulting into higher IVI. Similar findings were also reported by Shadangi and Nath (2005) in natural Sal forest and plantation forest of Pine and *Eucalyptus* in Amarkantak.

Diversity of ground flora was closely related to seasons. Species diversity increased during rainy season since during rainy season new species sprouted depending upon the root or seed stock in the soil. This is also reported by Shadangi and Nath (2005).

**TABLE- 1 Number of Herbaceous species in different seasons in the study area**

| | Jogardanga Forest | | Pathrisole Forest | |
|---|---|---|---|---|
| Season | Natural Coppice Sal Forest | Akashmoni Plantation stand | Natural Coppice Sal Forest | Akashmoni Plantation stand |
| SUMMER | 11 | 08 | 09 | 06 |
| RAINY | 29 | 21 | 35 | 23 |
| WINTER | 20 | 12 | 20 | 18 |

**TABLE- 2 List of Herbaceous Species with their IVI values at Jogardanga Forest**

| SL NO. | NAME | Natural Coppice Sal Forest ( IVI values) | | | Akashmoni Plantation Stand ( IVI values ) | | |
|---|---|---|---|---|---|---|---|
| | | SUMMER | RAINY | WINTER | SUMMER | RAINY | WINTER |
| 01 | *Ageratum conyzoides* Linn. | | 9.77 | | | 8.69 | |
| 02 | *Alysicarpus vaginalis* (L) Dc. | | 7.90 | | | | |
| 03 | *Andrographis paniculata* Nees. | | 11.39 | 14.28 | | 14.74 | 14.81 |
| 04 | *Aristida adscensionis* L. | 31.44 | 11.03 | 19.69 | 50.65 | **22.52** | 35.66 |
| 05 | *Atylosia conyzoides* Linn. | | 11.36 | | | 14.82 | |
| 06 | *Barleria cristata* Linn. | 21.46 | 9.60 | 16.31 | | | |
| 07 | *Blumea lacera* Dc. | | 12.36 | 18.17 | | 10.24 | |
| 08 | *Chrysopogon aciculatus* Retz. | 28.76 | 9.81 | 21.97 | 30.43 | 11.26 | 15.07 |
| 09 | *Cynodon dactylon* Pers. | 41.33 | **19.59** | 28.96 | 51.56 | **19.65** | 30.02 |
| 10 | *Cyperus compresus* Linn. | | | | | 8.95 | |
| 11 | *C. rotundus* Linn. | 20.53 | 9.72 | 10.14 | | 17.28 | |
| 12 | *Desmodium triflorum* Dc. | | 10.38 | 12.02 | | 14.53 | |
| 13 | *Eragrostis tenella* Roem & Schtt. | | 12.17 | | | 14.65 | |
| 14 | *Euphorbia hirta* Linn. | 33.52 | 11.67 | 12.21 | 64.29 | 17.04 | 38.42 |
| 15 | *Evolvulus nummularius* Linn. | | 6.63 | 10.99 | | | |
| 16 | *Fimbristyles dichotoma* (L.) Vahl. | | 6.91 | | | | |
| 17 | *Hedyotis corymbosa* (L) Lamk. | | 8.01 | 9.46 | | 12.14 | |
| 18 | *Heteropogon contortus* (L)Beavu.ex. Roem & Schtt. | 25.81 | 9.36 | 19.05 | 38.16 | 14.60 | 23.25 |
| 19 | *Lindernia. crustacea* (L) F. Muell. | | 6.14 | | | 6.99 | |
| 20 | *Mimosa pudica* Linn. | 21.04 | **14.52** | 19.08 | 22.38 | **18.44** | 28.89 |
| 21 | *Mollugo pentaphylla* L. | | 10.58 | | | | |
| 22 | *Pergularia daemia* (Forssk.) Chiov. | 10.02 | 11.45 | 11.76 | | 17.01 | 26.79 |
| 23 | *Phyllanthus fraternus* Webstern. | | 5.40 | | | | |
| 24 | *Rungia pectinata* (L) Nees. | | 12.94 | 10.68 | | | |
| 25 | *Sida cordata* (Burm. f.) Borssum. | 36.87 | 13.27 | 17.33 | 29.34 | 17.12 | 35.49 |
| 26 | *S. rhomboidea* Linn. | 29.22 | 9.75 | 11.79 | 13.19 | 12.84 | 11.58 |
| 27 | *Solanum nigram* Linn. | | 6.69 | 10.38 | | | |
| 28 | *Tridax procumbens* Linn. | | 11.65 | 14.06 | | 14.40 | 22.42 |
| 29 | *Vernonia cinerae* (L) Less. | | **14.61** | 11.66 | | 12.08 | 17.60 |
| 30 | *Zornia gibbosa* Spen. | | 5.35 | | | | |
| | **Total** | 300.00 | 300.01 | 299.99 | 300.00 | 299.99 | 300.00 |

**TABLE- 3 List of Herbaceous Species with their IVI values at Pathrisole Forest**

| SL NO. | NAME | Natural Coppice Sal Forest ( IVI values) | | | Akashmoni Plantation Stand ( IVI values ) | | |
|---|---|---|---|---|---|---|---|
| | | SUMMER | RAINY | WINTER | SUMMER | RAINY | WINTER |
| 01 | *Amaranthus viridis* L. | | 7.76 | 9.89 | | 8.76 | 11.67 |
| 02 | *Andrographis paniculata* Nees. | | 9.89 | 15.72 | | 13.29 | 19.85 |
| 03 | *Aristida adscensionis* L. | 24.43 | **13.95** | 21.41 | 55.82 | 17.5 | 21.82 |
| 04 | *Blumea lacera* Dc. | 43.14 | 11.15 | | | 14.71 | 16.35 |
| 05 | *Chrysopogon aciculatus* Retz. | 45.66 | **16.94** | 17.52 | 61.43 | **27.45** | 14.32 |
| 06 | *Commelina benghalensis* Linn. | | 11.12 | | | | |
| 07 | *Crotalaria prostata* Roxb. | | 8.84 | | | 14.29 | |
| 08 | *Cynodon dactylon* Pers. | 57.95 | 11.49 | 20.21 | 62.25 | **17.52** | 21.84 |
| 09 | *Cyperus compresus* Linn. | | 9.86 | 15.41 | | 11.29 | 14.82 |
| 10 | *C. cyperoides* (L) Kuntze. | | 8.86 | | | 14.17 | 16.85 |
| 11 | *C. rotundus* Linn. | | 11.93 | 21.59 | | 10.98 | 26.07 |
| 12 | *Desmodium triflorum* Dc. | | 6.75 | | | | |
| 13 | *Elephantopus scaber* Linn. | | 8.35 | | | | |
| 14 | *Emilia sonchifolia* Dc. | | 11.95 | 19.07 | | 14.10 | 15.70 |
| 15 | *Eragrostis elongata* Jacq. | | 8.89 | | | | |
| 16 | *E. tenella* Roem & Schtt. | | 9.64 | | | 15.53 | |
| 17 | *Euphorbia hirta* Linn. | 27.11 | 8.82 | 15.21 | 32.29 | 17.54 | 19.93 |
| 18 | *Evolvulus nummularius* Linn. | | 5.29 | 5.62 | | | |
| 19 | *Fimbristyles dichotoma* (L.) Vahl. | | 5.86 | | | | |
| 20 | *F. ovata* (Burm.f.) Kern. | | | | | 4.75 | |
| 21 | *Hedyotis corymbosa* (L) Lamk. | | 8.85 | 15.7 | | 12.72 | 17.32 |
| 22 | *Heteropogon contortus* (L)Beavu.ex. Roem & Schtt. | 47.92 | **14.63** | 18.05 | 65.06 | **16.53** | 21.87 |
| 23 | *Kyllinga monocephala* Rottb. | | 2.34 | | | | |
| 24 | *Lindernia ciliata* (Colsm.) Pennell. | | 7.66 | | | | |
| 25 | *Mimosa pudica* Linn. | 20.19 | 10.68 | 17.72 | 23.15 | 14.28 | 16.97 |
| 26 | *Mollugo pentaphylla* L. | | 9.35 | 14.78 | | 9.03 | |
| 27 | *Pentanema indicum* (L) Ling. | | 2.69 | | | | |
| 28 | *Perotis latifolia* Ait. | | 4.82 | | | | |
| 29 | *Phyllanthus fraternus* Webstern. | | 4.49 | 4.91 | | | |
| 30 | *Rungia pectinata* (L) Nees. | | | | | 6.19 | 8.16 |
| 31 | *Saccharum aurundinaceum* Retz. | | 11.79 | 16.73 | | 14.63 | 18.32 |
| 32 | *Setaria glauca* Beauv. | | 3.11 | | | | |
| 33 | *Sida acuta* Burm. f. | 13.12 | 8.87 | 11.16 | | 7.64 | 9.92 |
| 34 | *S. rhomboidea* Linn. | 20.48 | 7.13 | 10.95 | | | |
| 35 | *Solanum nigram* Linn. | | 6.03 | 10.82 | | 8.02 | 8.31 |
| 36 | *Tridax procumbens* Linn. | | 5.39 | 8.58 | | | |
| 37 | *Vernonia cinerae* (L) Less. | | 4.82 | 8.98 | | 9.07 | |
| | Total | 300.00 | 299.99 | 300.03 | 300.00 | 299.99 | 300.09 |

**TABLE- 4 Different Phytosociological Parameters of the Study Forests**

| | Jogardanga Forest | | | | | | Pathrisole Forest | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameters | Natural Coppice Sal Forest | | | Akashmoni Plantation Stand | | | Natural Coppice Sal Forest | | | Akashmoni Plantation Stand | | |
| | S | R | W | S | R | W | S | R | W | S | R | W |
| **No. of Herbs** | 11 | 29 | 20 | 08 | 21 | 12 | 09 | 35 | 20 | 06 | 23 | 18 |
| **Diversity Index** | 1.018 | 1.42 | 1.276 | 0.862 | 1.30 | 0.952 | 0.911 | 1.50 | 1.26 | 0.752 | 1.33 | 1.23 |
| **Dominance Index** | 0.099 | 0.035 | 0.054 | 0.147 | 0.051 | 0.092 | 0.132 | 0.031 | 0.052 | 0.184 | 0.048 | 0.059 |
| **Richness Index** | 1.754 | 4.912 | 3.333 | 1.228 | 3.508 | 1.929 | 1.403 | 5.965 | 3.333 | 0.877 | 3.859 | 2.982 |

S = Summer, R =Rainy and W = Winter

**TABLE- 5 Distribution Pattern (%) of Ground Flora**

| Study sites | Forest types | Season | Contiguous | Random | Regular |
|---|---|---|---|---|---|
| **Jogardanga Forest** | Natural Coppice Sal Forest | Summer | 23 | 66 | 11 |
| | | Rainy | 94 | 05 | 01 |
| | | Winter | 43 | 54 | 03 |
| | Akashmoni Plantation Stand | Summer | 31 | 57 | 12 |
| | | Rainy | 87 | 08 | 05 |
| | | Winter | 46 | 52 | 02 |
| **Pathrisole Forest** | Natural Coppice Sal Forest | Summer | 26 | 61 | 13 |
| | | Rainy | 97 | 02 | 01 |
| | | Winter | 50 | 46 | 04 |
| | Akashmoni Plantation Stand | Summer | 21 | 73 | 06 |
| | | Rainy | 84 | 12 | 04 |
| | | Winter | 48 | 49 | 03 |

**TABLE- 6 Similarity Index (%) of the Study Forests**

| | | Jogardanga Forest | | Pathrisole Forest | |
|---|---|---|---|---|---|
| | | Natural Coppice Sal Forest | Akashmoni Plantation Stand | Natural Coppice Sal Forest | Akashmoni Plantation Stand |
| **Jogardanga Forest** | Natural Coppice Sal Forest | 100 .00 | 80.00 | 62.50 | 57.69 |
| | Akashmoni Plantation Stand | | 100.00 | 57.14 | 54.55 |
| **Pathrisole Forest** | Natural Coppice Sal Forest | | | 100.00 | 72.41 |
| | Akashmoni Plantation Stand | | | | 100.00 |

During winter and summer the rate of sprouting or germination of propagules was less and species diversity became reduced as compared to rainy season. The increase of diversity correlated with the rainfall and increased during rainy season. Mishra *et.al*. (1993) observed similar trend of species diversity in South West Bengal in monsoon.

According to Hairston *et. al.* (1964) the concept of diversity is commonly considered as an important attribute of an organized community. So, in a forest community the species richness index (d) strongly correlated with the species diversity, which reflected the species richness value. In ~~my~~ this study, the distribution of ground flora was contiguous type during rainy season and it became contiguous and random type during winter and summer. Verma and Totey (1996) observed similar distribution pattern of tree species in the permanent preservation plots in Malyagiri, Orissa. In rainy season, the distribution of niche space or availability of resources was equally distributed among all the species, so the distribution pattern of the species was contiguous. In summer, some species have occupied more niche space than the other species, because these species are drought resistant and shows normal growth even in crisis of water and in high temperature i.e. in summer period, besides this some species became die during summer, so the distribution pattern was mostly random. According to Odum (1971), contiguous distribution is common in nature, random distribution is found only in uniform environment such as in plantations and regular distribution occurs where severe competition exists between individuals.

The similarity index between the natural coppice Sal forest and Akashmoni plantation stand was higher, because these two forest stands are situated adjacent to one another. Among two natural coppice Sal forests and two Akashmoni plantation stands, the similarity index was higher for two natural coppice Sal forests because the climatic condition, edaphic factors were more or less similar. These two forest sites can be fitted in Champion and Seth's classification (1968) of Forest Type – Major Group – II, i.e. "Dry Tropical Forest", on the basis of climatic factors and vegetation of this region. Lower similarity was seen in two Akashmoni plantation stands because these were manmade.

**Conclusion**

Ground flora is more sensitive to changes in environment. The number of species recorded was highest in rainy season and lowest in summer in forest study sites. The range of IVI was highest in summer than winter and rainy season. The population distribution was generally contiguous and random but in winter and summer regular distribution was not seen probably due to lower water and nutrients in soil as a result of adverse climatic conditions during summer. The diversity of ground flora was maximum in rainy season and lowest in summer for both the forest sites. The species richness index was also higher during rainy season and lowest in summer. Dominance index showed the opposite trend i.e. highest during summer and lowest in rainy season. The dominance – diversity relationship forms a continuous progression from dominants to intermediate to rare species. The dominance – diversity relationship also reflect that during rainy season the resource is optimum resulting in highest vegetation structure of ground flora under Sal forest, where as in winter and summer seasons, resources are deficient and the climatic conditions are not congenial for plant growth. My study showed seasonal variation in the structure and composition of vegetation.

**References**


*) Bahuguna, V. K. Negi. J. D. S. Joshi, S. R. and Naithani, K. C. (1990) Leaf litter decomposition and nutrient release in *Shorea robusta* and *Eucalyptus camaldulensis* plantation. *Indian For.*, 116 : 103 – 114.

*) Bennet S.S.R. (1987) *Name Changes of Flowering Plants of India and Adjacent Region,* Pub. by S. Selvaraja, Triseas Publishers, Dehradun, India.

*) Champion H. G and Seth S. K. (1968) *Forest Types of India,* Manager Publications. Delhi.

*) Curtis J. T. and Cottam G. (1956) *Plant Ecology Work Book Laboratory Field Reference Manual.* Burgess Publ. Minnesota Co. ; 193 pp.

*) Curtis J. T. (1959) *The Vegetation of Wiscosin*, University Wisconsin Press, Madison. *Ecology*, 44 : 678 – 697.

*) Durani, P. K. Rout, D. K. and Begum Asma. (1985) Estimates of litter accumulation in the forest system of the Kandagiri hill. *Indian For.*, 111 : 554 – 561.

*) Hairston, N. G. Smith, F. E. and Slobodkin, L. D. (1964) Community structure, population control and competition. *American Naturalist,* 94.

*) Jhariya, M. K. and Oraon, P. R. (2012a) Regeneration Status and Species Diversity along the Fire Gradients in Tropical Deciduous Forest of Chhattisgarh. *Journal of plant Development Sciences,*

4(1) : 49- 54.

*) Jhariya, M. K. and Oraon, P. R. (2012b) Analysis of Herbaceous Diversity in fire affected areas of Bhoramdeo Wildlife Sanctuary, Chhattisgarh. *The Bioscan*, 7(2) : 325- 330.

*) Kittur, B. Swamy, S. L. Bargali, S. S. and Jhariya, M. K. (2014a) Wildland Fires and Moist Deciduous Forests of Chhattisgarh, India : Divergent Component Assessment . *Journal of Forestry Research,* 25(4) : 857 – 866. (DOI) 10.1007/s11676-014-0471-0.

*) Kittur, B. Jhariya, M. K. and Lal, C. (2014b) Is the forest fire can affect the regeneration and species diversity. *Eco, Env. and Cons.* 20(3) : 989 – 994.

*) Margalef R. (1958) *Perspective in Ecological Theory,* University of Chicago Press, Chicago.

*) Maurya R. B and Mishra K. N. (1996) Biomass and net production of herbaceous layer in manmade Sissoo forest at Jaunpur. *J. Trop. For.* 12(4) : 230 – 236.

*) Mishra, T. K. Namhata, D. Behari B. and Banerjee S. K. (1993) Species Diversity under Sal and Teak Plantations in Lateritic Region. *Indian Journal of Trop. Biodiver.* 1: 188 – 201.

*) Mishra, T. K. Sahoo, T. K. Mishra, P. N. and Banerjee S. K. (2008) Species Diversity under different management systems – a case study in Amlachati Range of Midnapore West Forest Division. *Eco. Env. & Cons.*, 14(1) : 101 – 110.

*) Muller-Dombois D. and Ellenberg H. (1974) *Aims and Methods of Vegetation Ecology,* John Willey and Sons Inc., New York.

*) Odum E. P. (1971) *Fundamentals of Ecology*, 3rd edn., W. B. Saunders and Co. Philadelphia, 557 pp.

*) Oosting H. J. (1958) The study of Plant Communities, W. H. Freeman and Co., USA: 43- 46.

*) Oraon, P. R. Singh, L. and Jhariya, M. K. (2014) Variations in Herbaceous Composition of Dry Tropics Following Anthropogenic Disturbed Environment. *Curr. World Environ.* 9(3) : 967 – 979.

*) Oraon, P. R. Singh, L. and Jhariya, M. K. (2015) Shrub Species Diversity in Relation to Anthropogenic Disturbance of Bhoramdeo Wildlife Sanctuary, Chhattisgarh. *Environment and Ecology*, 33(2A) : 996 – 1002.

*) Pandey P. K, Bisht A. P. S and Sharma S. C. (1988) Comparative vegetation analysis of some plantation ecosystems. *Indian Forester*, 114 (7) : 379 – 389.

*) Pawar, G. V. Singh, L. Jhariya, M. K. and Sahu K. P. (2012) Regeneration Status in Relation to Anthropogenic Disturbance in Tropical Deciduous Forest of Chhattisgarh. *The Ecoscan,* 8(3&4) : 225 – 233.

*) Prain D. (1903) *Bengal Plants, Vol.-I and Vol.-II*. Bishen Singh and Mahendra Pal Singh. Dehradun, India.

*) Rajvanshi, R. Kumar, V. Bachpai, W. Rajgopal K. and Raj, S.F.H. (1987) Herbaceous undergrowth in some forest habitats in Nilgiris. *Indian Forester*, 113 (9) : 599 – 608.

*) Sahoo, T. K. (2002) Ecolological Impacts of Joint Forest Management (JFM) in Midnapur Region of South West Bengal, Ph.D Thesis, FRI, Dehradun. pp – 53.

*) Sahoo, T. K. Mishra, T. K. Jain, A. and Banerjee S. K. (2004) Impact of Different Managemaent Systems on Biodiversity Conservation – A Case Study. *Indian For.*, 130 (9) : 991 – 1007.

*) Shadangi D. K. and Nath V. (2005) Imapct of seasons on ground flora under plantation and natural forest in Amarkantak, *Indian For*., 131(2): 240- 250.

*) Shannon C. E. and Wiener W. (1963) *The Mathematical Theory of Communication* Univ. Illinois Press, Urbana.

*) Sharma, S. K. George, M. and Prasad K. G. (1983) Forest vegetation survey and classification with special reference to South India. I. Vegetation survey and quadrat analysis. *Indian Forester*, 109 (6): 384 – 394.

*) Simpson E. H. (1949) Measurement of Diversity. *Nature*, 163 : 688 – 699.

*)Sinha, R. Jhariya, M. K. and Yadav D. K.(2015) Assessment of Sal Seedlings and Herbaceous Flora in the Khairbar Plantation of Sarguja Forest Division, Chhattisgarh. *Curr. World Environ.* Vol. 10(1) : 330 – 337.

*) Small, C. J. (2001) Environmental and plant Biology Herb Layer Dynamics and Disturbance Response in the Mixed Mesophytic Forest Region of Southeastern Ohio. Ph.D. Thesis (176pp).

*) Soreson, T. (1948) *Kongelige Danske Videnskabernes Selskab.* A Method of Establishing Groups of Equal Amplitudes in Plant Sociology Based on Similarity of Species Content and its Application to Analyses of the Vegetation on Danish Commons. Biologiske Skrifter, 5 : 1 – 34.

*) Verma R. K. and Totey N. G. (1996) Vegetation Diversity in the Permanent Preservation Plot in Malyagiri, Orissa. *MYFOREST*, 32 (1) : 49 – 56.

*) Whiteford, P. B. (1949) Distribution of woodland plants in relation to succession and clonal growth. *Ecology.* 30 : 199 – 208.

## VEGETATION OF NATURAL COPPIES SAL FOREST

### JOGARDANGA FOREST

SUMMER SEASON

RAINY SEASON

WINTER SEASON

### PATHRISOLE FOREST

SUMMER SEASON

RAINY SEASON

WINTER SEASON

**VEGETATION OF AKASHMONI PLANTATION STAND**

JOGARDANGA FOREST

SUMMER SEASON

RAINY SEASON

WINTER SEASON

PATHRISOLE FOREST

SUMMER SEASON

RAINY SEASON

WINTER SEASON

**DOMINENT TREE SPECIES**

**SAL *(Shorea robusta Gaertn. F.)***

**AKASHMONI (*Acacia auriculiformis* A. Cunn. ex Benth)**

# Environmental enrichment in *ex- situ* condition and its influences on White-crested Kalij Pheasant *Lophura leucomelanos hemiltoni*

**Rekha Palariya[1], H.C.S. Bisht[2], Tejaswini A. Patil[3]**

[*1]Ph.D. Scholar, Department of Zoology, D.S.B. Campus, Kumaun University, Nainital, Uttarakhand, 263002, India rekhapalariya15@gmail.com, 07454882678

[2]Professor, Department of Zoology, D.S.B. Campus, Kumaun University, Nainital, Uttarakhand, 263002, India 09411376398

[3]Chief Conservator of Forest, Forest Department, Uttarakhand, 263002, India, 09761193278

**Citation:** **Palariya Rekha, H.C.S. Bisht and Tejaswini A. Patil.** Environmental enrichment in *ex- situ* condition and its influences on White-crested Kalij Pheasant *Lophura leucomelanos hemiltoni*
*Ela Journal of Forestry and Wildlife*
*Vol.10 (1): 886-892*

**Date of Publication:**
31 March 2021

ISSN 2319-4361



**Female Kalij Pheasant**

**Male Kalij Pheasant**

**Male Kalij Pheasant in habitat**

**Abstract**

An experiment for environmental enrichment was conducted at G.B. Pant High Altitude Zoo, Nainital on 04 individuals (2:2:0; Male:Female:Juvenile) of White-crested Kalij Pheasant. We carried out this study for 60 days from February to March in the yaer 2020 with an aim to know the response and interactions and reactions towards the introduced environmental change in ex-situ conditions. During this experiment, we took observations on foraging, space utilization, display, locomotion, open area exhibit, under shade exhibit, roosting and stereotypic behavior in pre- enrichment and post enrichment conditions. We used various types of natural enrichment materials such as drinking water, sand bath, rotten logs, various types of perches, swings, climbing ladders, nest houses with bamboo shoots and leaves, plantation with herbs, native grasses (Ringal) and ornamental plant species, feed supplements like sprouted greens. Environmental enrichment positively affected pheasants with respect to the above parameters.

***Keywords:*** *Enrichment, habitation, stereotypic*

## Introduction

White-crested Kalij Pheasant is a medium sized heavy bodied, glossy blue- black colored, ground feeding and non migratory bird from family Phasianidae and order Galliformes (Ramesh *et al.*,1999). It is native to India in high altitudinal region but also adaptable to various environments in captive conditions. This pheasant species also known as the Himalayan game bird, is also introduced in Hawaii Island of United States in 1962 which was introduced from Southern Asia (Lewin,1971). According to IUCN Red List data, this pheasant is least concern but *In- Situ*, its population is under heavy depletion due to habitat loss, forest degradation, excessive hunting and poaching for flesh

and body feathers (Kumar *et al*., 2014). It falls under the Schedule I (Part III), as per the Indian Wildlife (Protection) Act, 1972.

All living beings are influenced by internal as well as external environmental conditions and adapt themselves to surrounding habitat. In *Ex- Situ* conservation or captivity, due to confined space area and lack of natural environment such as barren land, hiding places, etc. animal shows monotypic or stereotypic behavior and compromise their health and longevity of life. Whereas in wild or feral condition, they interact with various types of habitats in the surrounding environment including abiotic and biotic factors. In free range, species- typical behavior patterns are shown by pheasants *vis-a-vis* their natural environment. Pheasant can migrate from adverse condition or environment to favorable habitation in *In –Situ* situations whereas in captive condition, it is impossible to move anywhere and have to adapt to the compromised surrounding and restricted space (Enrichment manual, CZA).

**Materials and Methods**

**a. Study Area:** This observational study was done with 04 (2:2:0) captive individuals of White-crested Kalij Pheasant at G.B. Pant, High Altitude Zoo, Nainital, Uttarakhand. This high altitude zoo covers about 4.952 ha. area with an elevation of 2200 meters. It was established in the year 1984 for the conservation and breeding of high altitudinal fauna (Nainital Zoo working plan). The maximum temperature reaches up to 35$^{o}$ C in summer and minimum temperature in winter remains as low as 02$^{o}$ C. The monsoon season occurs between June and October. The pheasant individuals were kept in pairs in separate enclosures with retiring rooms which could be identified with the cage numbers. KP1 and KP2 (KP denotes Kalij Pheasant). Detailed behavioral observation study was done by using ethogram for 6 days in a week for a period of 25 days in the month of February, 2020 without any enhancement in enclosures (pre- enrichment). Subsequently, a period of one week was required for the preparation of enrichment activities with the help of Zoo officials and pheasant keepers and then we moved to the next observation with post-enrichment environment for next 25 days in March, 2020. This observational study was done in the early hours of the day (08:00am- 09:00 am) and in the evening (04:00pm- 05:00pm). The time duration for activities recording was 30 minutes for each hour as per suggested by guidelines of Zoo Authority and Wild animal health advisory committee.

**b. Enclosure and Habitat Enrichments:** Initially both the selected pheasant enclosures measured 3x3x3 meters with poor natural habitat and less enrichment equipment for displaying, feeding and foraging, roosting, etc. (few number of logs, less vegetation and nest sites). Two cages were selected. After the first phase of observations, environmental enrichment was incorporated with various objects such as drinking water, sand bath, rotten logs, various types of perches, swings, climbing ladders, nest houses with bamboo shoots and leaves, plantation with herbs, native grasses (Ringal) and ornamental plant species, feed supplements like sprouted greens. According to the Zoo management and Central Zoo Authority guidelines, White-crested Kalij Pheasant's enclosures should not be placed close to aggressive animals and at least 50 meters away from large carnivores.

**c. Observations and Analysis:** Management of environmental enrichment and health care of this high altitudinal pheasant is a dynamic process. In previous studies which were done with Tragopan and Red Panda at Padmaja Naidu Himalyan Zoological Park, Darjeeling (W.B.). we studied the physiology such as weight, height, body length including tail, morphology (body color, wattle color, leg shank etc.) and ethology (animal behavior) of this gregarious pheasant. Ethological observations included feeding and foraging, locomotion and daily social activities like display, digging, roosting and interaction with each other (In relation to male and female). We also compared the time utilization between pre- enrichment and post- enrichment of the environment.

**Results and Discussion**

At G. B. Pant High Altitude Zoo, Nainital, both White-crested Kalij Pheasant enclosures had a chain-link mesh and ground cover with soil. Only the wooden logs were used as perches and resting places with less hiding places for pheasants at the time of pre- enrichment period. Absence of enrichment inside the pheasant enclosure induced repeated movement (Stereotypic behavior) of walking within the enclosure or pecking

**Table No. 01**

| Sr. No. | Behavioral Activity Pattern | Pre- enrichment Stage | Post- enrichment Stage |
|---|---|---|---|
| 1. | Roosting | Very less no. of logs and perches | Enhancement in logs, perches with leaves |
| 2. | Foraging | Served feed items in same place in bulk and drinking water in a bowl | Feed items served in different places in scattered manner and drinking water in more than one bowl |
| 3. | Displaying | Display moves were very less due to lack of hiding spaces | More of hiding places increased display manners. |
| 4. | Locomotion | Due to confined area in enclosure pheasant used to rest | Cage space increased with chain link to avoid the lethargic habit |
| 5. | Open Area Exhibit | Without sand and mud bath area | Enhanced with sand and mud bath to play and rest |
| 6. | Under shade Exhibit | No hedges or ornamental plants to rest under it or hide | Preferred local grass swings, plantation of falls capsicum hedges |
| 7. | Stereotypic Behavior | Confined area to move | After chain link sufficient space to move and other activities |

**Table No. 2** denotes provided enrichment items at the period of Pre and Post enrichment

| Sr. No. | Objects used for Enrichment | Prior to Enrichment (In Numbers) | After Enrichment (In Numbers) |
|---|---|---|---|
| 1 | Wooden logs | **02** (about 2 feet) | **03** (about 2 feet with large hole) |
| 2 | Perches | **01** | **02** |
| 3 | Feed items | **01** (whole amount at same place) | **04** (divided into four parts at different places) |
| 4 | Drinking water | **01** (with one bowl) | **02** |
| 5 | Hiding space i.e. nest | **01** (with local grasses) | **05** (with local grasses and wooden boxes) |
| 6 | Sand and mud bath | -- | **01** (For parasite eradication) |
| 7 | Plant hedges or shrubs | **02** | **06** |
| 8 | Enclosure extension | -- | **02** (3 feet extension towards outside) |
| 9 | Rotten wooden logs | -- | **01** (To enhance instinct) |
| 10 | Swings | -- | **01** (For roosting) |

over the chain- link mesh without any reason. After the first set of observations, the enclosures were enriched and modified. Subsequent observations showed increased time for foraging and social activities and reduced the stereotypic behavior which was exhibited by the pheasants earlier before enrichment.

Table No. 01 shows the variation in enrichment items at the period of Pre and Post enrichment

Prior to enrichment of both enclosures of the White-crested Kalij Pheasant, they came in open area for foraging and drinking of water which was kept at the same place. They spent most of the time in roosting and in showing stereotypic movements. After providing environmental enrichment such as rotten logs, bamboo ladders and swings, sand bath, wooden perches, grass huts, stones and dispersing sprouted seeds inside the enclosures, we observed enhanced locomotion, foraging, displays and reduction in the number of stereotypic movements in all four specimens of the pheasant.

**Enclosures prior to Enrichment**

**Enclosures at post Enrichment**

**Fig. 1. Graphical representation of Pre and Post Enrichment activities**

## Conclusion

In *Ex- Situ* condition or captivity, pheasant has a very compact and confined space that restricts natural behavioral activities. Hence, to improve their behavioral activities and subsequent breeding in captive conditions, environmental enrichment needs to be provided. To avoid intra-species conflict and aggression (picking of feathers from body of other pheasant), environmental enrichment is useful in captive conditions. Fig.1 shows the positive effect of environmental enrichment in the behavior of pheasants prior to after *in-situ* environmental enrichment. Implementation of environmental enrichment is therefore recommended and the subsequent influence on longevity and breeding success needs to be evaluated in the future.


## Acknowledgements

I am thankful to Dr. H.C.S. Bisht, Professor, Department of Zoology, D.S.B. Campus, Kumaun University, Chief Wildlife warden, Uttarakhand Forest Department, Dehradun, Uttarakhand, Dr. Tejaswini A. Patil (IFS), Chief Conservator of Forest, Forest Department, Uttarakhand, Director, G.B. Pant High Altitude Zoo, Nainital, Dr. Yogesh C. Bhardwaj, Senior Veterinary Officer, Nainital Zoo, Uttarakhand for their guidance, encouragement and valuable suggestion during the research work period. I am humbly thankful to the entire staff especially Mr. P.S. Mehra (Pheasant Keeper) of G. B. Pant High Altitude Zoo, Nainital for their kind help and support for the completion of the research work. I am thankful to Mr. Sundeep Kumar, Wildlife Photographer, Nainital for kind help and cooperation by providing me wonderful photographs.

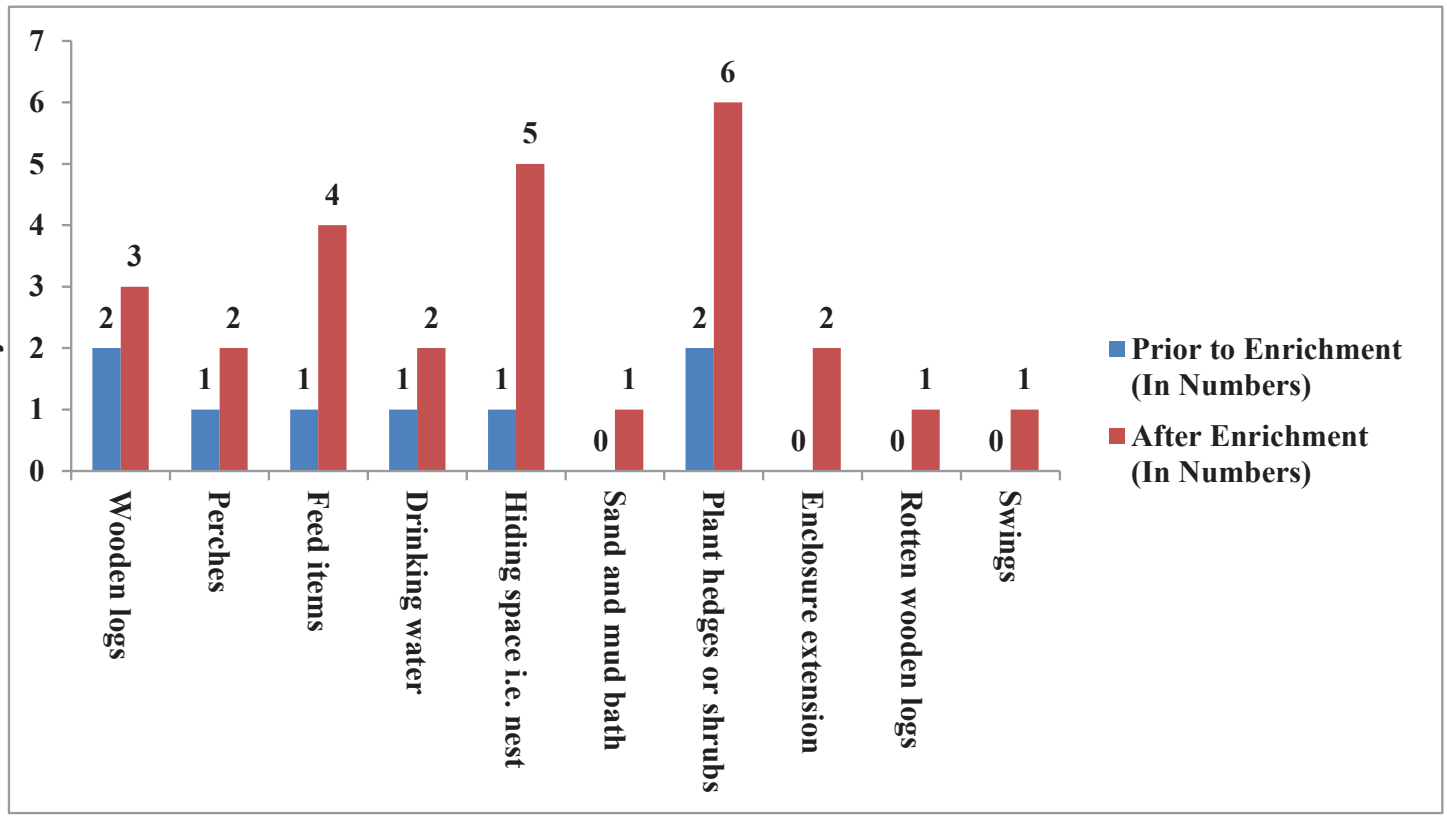

## References


**1.** Adeola, O., Ragland, D. and King, D. 1997. Feeding and excreta techniques in metabolizable energy assays for ducks. *Poult. Sci*. 76: 728-732.

**2.** Adhikari, B.S., Joshi, M., Rikhari, H.C. and Rawat, Y.S., 1992, Cluster Analysis (Dendrogram) of high altitude (2150- 2500m) forest vegetation around glacier in Kumaun Himalaya. *Journal of Environmental Biology*, 13(2),101-105.

**3.** Ahmad, A., 1995, Studies on the population

**Fig. 1. Graphical representation of Pre and Post Enrichment activities**





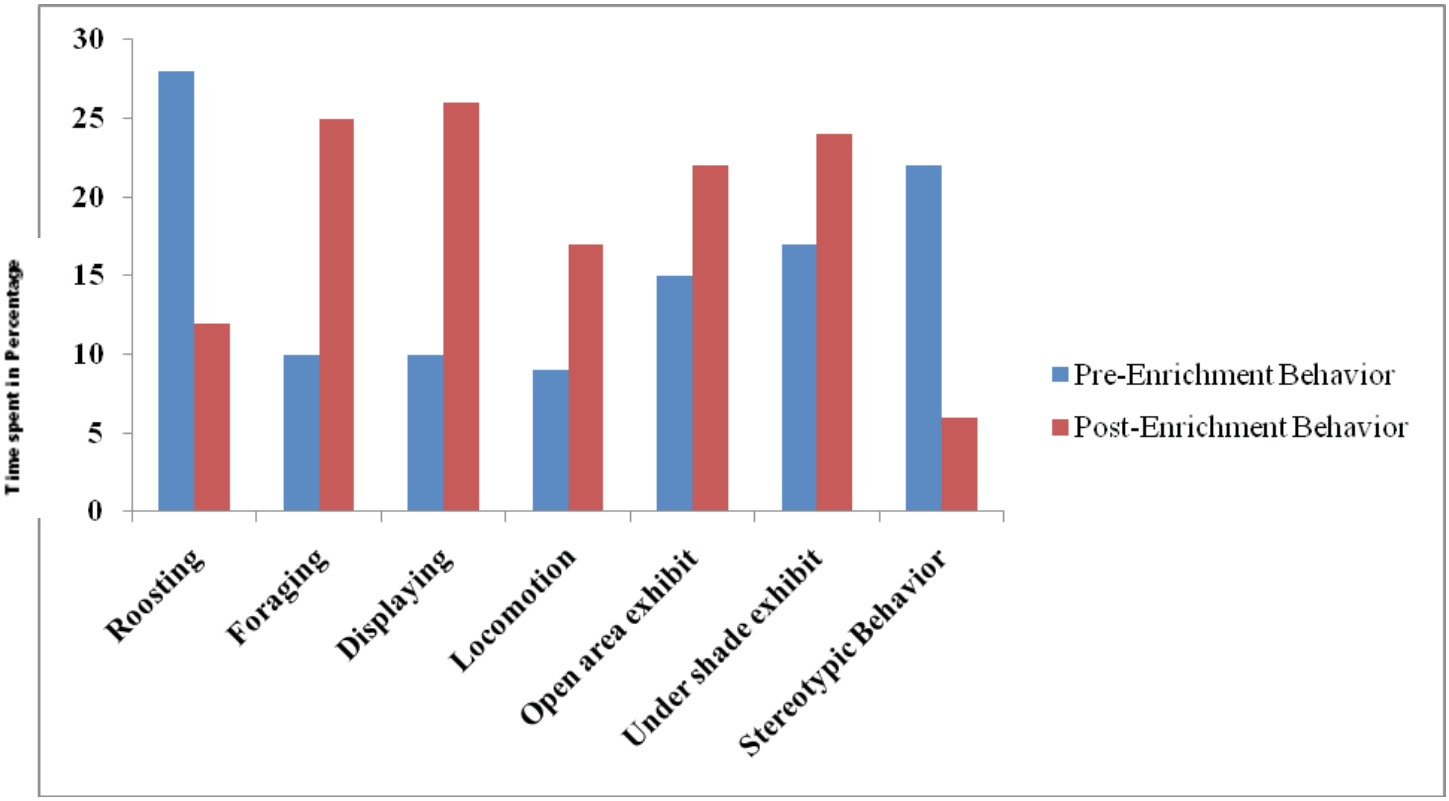
status, distribution and some aspects of behavior of White crested Kalij (*Lophura leucomelana*) in the cantonment forest of the Ranikhet region, Almora, Ph.D. thesis, AMU, Aligarh, India.

**4.** Ahmed, A. and Musavi, H.M. 1997. Sex- ratio: A problem in the management of Kalij pheasant. Abstract; The International Symposium on Galliforms 1997, Melaka, Penninsular Malaysia. Pp 82.

**5.** Ali, S. and S. D. Ripley. 1969. *Handbook of the birds of India and Pakistan together with those of Nepal, Sikkim, Bhutan and Ceylon,* Vol. 2. Oxford Univ. Press, New York, New York.

- Animalcorner.2012.http://www.animalcorner.co.uk/wildlife/goldpheasant.html. Downloaded on 04 November, 2013.
- Arnett, E.J. 2010. *Effects of forage leveling in feedlot finishing diets on Carcass characteristics, sensory attributes, and palatability of jersy beef.* M.Sc. Thesis, Graduate School of the OHIO State University.
- Balan, S.V. and Holmes, B.A. 1993. *Status and conservation of pheasants in the Greater and Lesser Sundas, Indonesia.* (IN) Jenkins, D. (Ed.) 1993. Pheasants in Asia 1992. World Pheasant Association Reading, U.K. Pp 40-49.
- Beebe, W., 1931, *Pheasants: their lives and homes*, Henry Doubleday &Co, New York.
- Bohl, W.H. 1971. *The Kalij Pheasants*. U.S. Fish and Wildlife Service, Foreign Game Investigations Rept. 18.
- Breitenbach, R.P., Nagra, C.L. & Meyer, R.K. (1963) Effect of limited food intake on cyclic annual changes in ring- necked pheasant hens. *Journal of Wildlife Management*, 27. 24-36.
- Bump, G. and W. H. Bohl. 1961. *Red Junglefowl and Kalij Pheasants*. U.S. Fish and Wildlife Service, Spec. Sci. Rept.- Wildlife 62.
- Chandola- Saklani, A., Bisht, M., Kar, A., Shekhar, C. and Lakhera, P., 1987, *Wildlife in Garhwal Himalaya: Breeding and Behavioural Biology*, in Pangtey, Y.P. and Joshi (Eds.), The Western Himalaya- Environment, People &Development.
- Chaudhry, A.A. 1993. *Distribution and status of Pheasant of Pakistan.* (IN) Jenkins, D. (Ed.) 1993. Pheasants in Asia 1992. World Pheasant Association

**Fig. 2. Comparative observational study on the behavior of White-crested Kalij Pheasants for Pre-enrichment and Post- enrichment of cage environment**





Reading, U.K. Pp 7-14.

- Cu, N and Eames, J. C. 1993. *Distribution and status of Pheasant in Vietnam*. (IN) Jenkins, D. (Ed.) 1993. Pheasants in Asia 1992. World Pheasant Association Reading, U.K. Pp 20-27.
- Dale, F.H., 1952, Sex ration in pheasant research and management, *Journal of Wildlife management*, 16(2), 156- 163.
- Draycott, R.A.H., Hoodless, A.N., Ludiman, M.N. &Robertson, P.A. (1998) Effects of spring feeding on body condition of captive- reared ring- necked pheasant in Great Britain. *Journal of Wildlife Management*, 62, 557-563.
- Duke, G.1990. *Using call counts to compare Western Tragopan populations in Pakistan's Himalaya.* In. Hill, D.A., Garson, P.J. and Jenkins, D. (Eds.) 1990. Pheasants in Asia 1989. World Pheasant Association, Readings, U.K. Pp 116-122.
- Fowler, J. and Cohe, L. 1986, *Statistics for Ornithologist*. BTO Guide No. 22.
- Garson, P.J. 1983. The Cheer Pheasant (Catreus wallichii) in Himachal Pradesh, Western Himalaya: An update. *Journal of World Pheasant Association*, 8:29-39.
- Gaston,A.J., Garson, P.J. and Hunter, M.L.Jr. 1983a. The status and conservation of forest wildlife in Himachal Pradesh, Western Himalayas. *Biological Conservation* 27: 291-314.
- Gaston,A.J., Garson, P.J. and Pandey, S.1993. Birds recorded in the Great Himalayan National Park, Himachal Pradesh, India. *Forktail* 9:45-57.
- Hill, D.A. (1985) The feeding ecolgy and survival of pheasant chicks on arable farmland. *Journal of Applied Ecology*, 22, 645-654.
- Hill, D. and Robertson, P.1988.*The Pheasants: ecology, management and conservation*. BSP. Professional Books, Oxford, U.K. Pp 281.
- Hoodlass AN, Draycott RAH, Ludiman MN, Robertson PA. Effects of supplementary feeding on territoriality, breeding success and survival of pheasants. *J Appl Ecol.* 1999; 36:147-156.
- Hussain, M.S., 2012, *Conservation of pheasants of Kumaon Himalaya, India.* Lambert Academic Publishing, Germany.

- Kaul, R.1989. *Ecology of the Cheer Pheasant (Catreus wallichii) in Kumaon Himalaya.* Unpublished Ph.D. thesis. University of Kashmir, Shrinagar.
- Kaul, R. and Ahmad, A.1993. *Pheasant surveys in Arunachal Pradesh, India, in February – March 1991.* (IN) Jenkins, D. (Ed.) 1993. Pheasants in Asia 1992. World Pheasant Association Reading, U.K. Pp 50-54.
- Kaul, R. and Garson, P.J. 1993. *Present distribution and status of pheasants in India.* Abstract; (IN) Jenkins, D. (Ed.) 1993. Pheasants in Asia 1992. World Pheasant Association Reading, U.K. Pp 157.
- Khaling, S.1997. Satyr tragopan in the Singhalila National Park, Darjeeling, India. Tragopan: *Newsletter of the WPA/SSC/Pheasant Specialist Group*, 6: 13-14.
- Lu X, Zheng GM. Reproductive ecology of Tibetan Eared Pheasant, *Crossoptilon harmony*, in scrub environment, with special reference to the effect of food. *Ibis*. 2003; 145;657-666.
- McGowan, P.J.K. and G.M. Kirwan (2020). *Kalij Pheasant (Lophura leucomelanos),* version 1.0. In Birds of the World (J. del Hoyo, A. Elliott, J. Sargatal, D.A. Christie, and E. de Juana, Editors). Cornell Lab of Ornithology, NY, USA.
- Sathyakumar, S., Prasad, S.N., Rawat, G.S. and Johnsingh A.J.T., 1993, *Ecology of Kalij and Monal in Kedarnath Wildlife Sanctury,* in Jenkins, D. (Ed.) Pheasants in Asia, WPA, Reaing, UK.
- Sathyakumar, S. and Sivkumar, K. (Eds.) 2007. *Galliforms of India*. ENVIS Bulletin: Wildlife and Protected Areas, Wildlife Institute of India, Dehradun, India. 10(1), 252.
- Severinghaus, S.R. 1979.Observations on the ecology and behavior of the Koklass pheasant in Pakistan. *Journal of the World pheasant Association* 4: 52-71.
- Sharma, 1993.*Ecological status of pheasants in Himachal Pradesh.* Abstract; (IN) Jenkins, D. (Ed.) 1993. Pheasants in Asia 1992. World Pheasant Association Reading, U.K. Pp 158.
- Shrestha, T.K. 1993. *Impact of habitat fragmentation and deforestation on rare pheasants of Nepal.* Abstract; (IN) Jenkins, D. (Ed) pheasants in Asia 1992. World Pheasant Association Reading, U.K. Pp 157.
- Taber, R.D., 1949, Observation on the breeding behavior of the ring- necked pheasant, *Condor*, 5, 153-175.
- Watson, A., Moss, R. &Parr, R. (1984) Effects of food enrichment on numbers and spacing behavior of red grouse. *Journal of Animal Ecology*. 53, 663-678.
- Yatim, S.H. 1993. *The status and distribution of Pheasants in Peninsular Malaysia*. (IN) Jenkins, D. (Ed.) 1993. Pheasants in Asia 1992. World Pheasant Association Reading, U.K. Pp 28-39.

# Raptor Diversity of Manyarkheda Lake Region, Jalgaon, Maharashtra, India

**Laxminarayan Sonawane[*1], Prasad Sonawane[*2], Aman Gujar[*3]**
*(Vanyajeev Sanrakshan Sanstha, Jalgaon (425001), Maharashtra)
rahulsonawane1727@gmail.com[1], polarisrahul@gmail.com[2], amangujar@gmail.com3

**Citation:** **Sonawane Laxminarayan, Sonawane Prasad and Gujar Aman.** Raptor Diversity of Manyarkheda Lake Region, Jalgaon, Maharashtra, India.
*Ela Journal of Forestry and Wildlife*
*Vol.10 (1): 893-899*

**Date of Publication:**
31 March 2021

ISSN 2319-4361



**Abstract**- We recorded 29 diurnal, nocturnal, resident and migratory raptor species belonging to 4 families in and around Manyarkheda Lake region. A total of 223 species of birds belonging to 59 families and 19 orders were also recorded. Passeriformes was the dominant order with 83 species under 28 families, followed by Accipitriformes. This area shelters 15 species of threatened birds, 3 endangered, 2 vulnerable and 10 near threatened bird species listed by IUCN. Need for conservation of this raptor paradise is stressed in view of tremendous anthropogenic pressure.

**Introduction**- Manyarkheda and Mehrun are the two major lakes in the vicinity of Jalgaon city. Manyarkheda is a village in Jalgaon Taluka in Jalgaon District of Maharashtra State. It is located 5 Km from Jalgaon city. A lake ($20^0$ 98'40.8" N, $75^0$ 61'68.4" E) constructed by the irrigation department around 1848 is situated on southern part of this village. Manyarkheda Lake coveres approximately 0.47 Sq. km area. This lake is fed by a seasonal stream originating near Kusumba village located south of the Manyarkheda. This lake serves as main source of irrigation for the local agricultural fields.

**Materials and methods-**
The study area was centred on Manyarkheda Lake, adjoining scrubland and grassland. Data was gathered through field surveys. As part of regular bird-watching, monitoring surveys conducted voluntarily by Vanyajeev Sanrakshan Sanstha of water bodies in Jalgaon district surveys to study raptor diversity of Manyarkheda lake were conducted mainly on Sunday and whenever possible on other weekdays. Observations were made by direct sighting with binoculars (Nikon 10×50) and photographs & videos were recorded with digital cameras. Various types of habitats studied during survey were Manyarkheda Lake, adjoining marshes, scrub and


**Google map image showing location of Manyarkheda Lake region.**

thorny forest, grassland, fallow land, agricultural and semi-urban areas within 2 Km radius of the lake. Study duration was January 2015 to November 2020. Field observations were taken during summer, monsoon and winter. Field guides (Ali, 2002, Grimmett, 2011, Kazmierazack, 2014, Pande et al, 2013), reference books, published literature and e-Bird app were used to confirm identity of the bird and to confirm known range of its distribution. Nearest GPS co-ordinates were fixed using Google maps and GPS enabled digital cameras. Time and Date of observations were noted by observers and were also extracted from photographic data. The birds were classified as Resident (RS), Winter Migrant (W), Vagrant (V), Common (C), and Occasional (O), Rare (R). Following methodologies were used to ascertain the migration and occurrence status of the birds. 1) By measuring frequency of sighting of the related birds in the study area in respective seasons. 2) By accessing published data on Avi-fauna of Jalgaon district. 3) By accessing citizen science portal like eBird for current and previous sighting status of the birds described. The IUCN conservation status was obtained from the Red Data list of threatened birds of IUCN (https://www.birdsofindia.org/IUCN-Red-List). For nomenclature of the birds Checklist of Birds of India (Praveen, J. et al, 2016) was followed. The Floras of Jalgaon, Dhule and Nandurbar districts was used to confirm the of the plant species.

**Result-**

**1. General vegetation of the lake**-A large number of plant species are recorded in and around this lake. *Hydrilla verticillata, Potamogeton pectinatus* and *Vallisneria spiralis* were submerged aquatics. *Lemna perpusilla, Spirodella polyrhiza, Ipomoea aquatica, Eichhornia crassipes* were floating aquatics. *Ipomoea carnea, Typha domingensis, Coix lacryma-jobi, Ammania baccifera, Rumex dentatus, Bergia ammanoides, Hygrophila schulli, Eclipta prostrata, Phyla nodiflora, Persicaria glabra, Cyperus difformis, Cyperus alulatus, Cyperus*

*rotundus, Eliocharis geniculata., Scirpus litoralis,* and *Fimbristylus dichotoma* were found along the margin of this lake. All these are our own observations. All these plant species are recorded by us during our study visits to the lake and adjoining area. Till date there is no special published data available on floral diversity of Manyarkheda lake. Plants observed were identified by using flora of Jalgaon district and flora of Dhule & Nandurbar district.

**2. General vegetation of the scrubland and grassland around Manyarkheda lake-** The Lake is surrounded by scrub and grassland on northern and western side. The area is covered with open grassland with few scattered shrubs and trees like Hiwar *Vachellia leucophloea*, Palas *Butea monosperma*, Neem *Azadirachta indica,* Maharukh Ailanthus excelsa, *Capparis sepiaria*, Petari *Abitulon pannosum*, Arkathi *Mimosa hamata*, Babool *Acacia nilotica*, Henkal *Balanites aegyptiaca,* Bor *Ziziphus mauritiana, Ziziphus nummularia*, Aawali *Cassia auriculata*, etc. Considerable area around the lake is dominated by grassland, chiefly dwarf grasses and herbaceous elements. The area faces a prolonged hot, dry season which results in drying up of the entire herbaceous vegetation giving a scorched appearance to the ground cover. The principal herbaceous species of this grassland are *Alysicarpus tetragonolobus, A. vaginalis, Cleome simplicifolia, Indigofera cordifloia, I. linifolia, Cassia uniflora, Tribulus terrestris, Evolvulus alsinoides, Lepidagathis trinervis,*

**Table-1 : Diversity and status of raptors recorded at Manyarkheda Lake and adjoining grasslands**

| Sr.No | Common Name | Scientific name | Migration status | Sighting status | IUCN Status |
|---|---|---|---|---|---|
| 1 | Egyptian Vulture | *Neophron percnopterus* | V | R | EN |
| 2 | Steppe Eagle | *Aquila nipalensis* | W | R | EN |
| 3 | Indian Spotted Eagle | *Clanga hastata* | W | R | VU |
| 4 | Greater Spotted Eagle | *Clanga clanga* | W | R | VU |
| 5 | Crested Serpent Eagle | *Spilornis cheela* | RS | O | LC |
| 6 | Bonelli's Eagle | *Aquila fasciata* | RS | O | LC |
| 7 | Booted Eagle | *Hieraaetus pennatus* | W | C | LC |
| 8 | Oriental Honey Buzzard | *Pernis ptilorhynchus* | RS | C | LC |
| 9 | White-eyed Buzzard | *Butastur teesa* | RS | C | LC |
| 10 | Long-legged Buzzard | *Buteo rufinus* | W | R | LC |
| 11 | Black Kite | *Milvus migrans* | RS | C | LC |
| 12 | Brahminy Kite | *Haliastur indus* | W | R | LC |
| 13 | Black-winged Kite | *Elanus caeruleus* | RS | C | LC |
| 14 | Red-necked Falcon | *Falco chicquera* | RS | R | NT |
| 15 | Peregrine Falcon | *Falco peregrinus* | RS | O | LC |
| 16 | Amur Falcon | *Falco amurensis* | V | R | LC |
| 17 | Eurasian Hobby | *Falco Subbuteo* | RS | R | LC |
| 18 | Short-toed Snake Eagle | *Circaetus gallicus* | RS | C | LC |
| 19 | Shikra | *Accipiter badius* | RS | C | LC |
| 20 | Eurasian Sparrowhawk | *Accipiter nisus* | W | O | LC |
| 21 | Western Marsh Harrier | *Circus aeruginosus* | W | C | LC |
| 22 | Montague's Harrier | *Circus pygargus* | W | C | LC |
| 23 | Pallid Harrier | *Circus macrourus* | W | R | NT |
| 24 | Osprey | *Pandion haliaetus* | W | O | LC |
| 25 | Common Kestrel | *Falco tinnunculus* | W | C | LC |
| 26 | Indian Eagle Owl | *Bubo benghalensis* | RS | C | LC |
| 27 | Spotted Owlet | *Athene brama* | RS | C | LC |
| 28 | Indian Scops Owl | *Otus bakkamoena* | RS | C | LC |
| 29 | Barn Owl | *Tyto alba* | RS | C | LC |

**Diversity and status of raptors recorded at Manyarkheda Lake and adjoining grasslands**

**Status code- C** = Common, **R**=Rare, **O**=Occasional, RS- Resident

**W**=Winter Migrant, V- Vagrant,

**EN**=Endangered, **VU**-Vulnerable,

**NT**=Near Threatened **LC**=Least Concern.

*Goniogyna hirta, Hyptis suaveolens, Biophytum sensitivum, Tridax procumbens.* Commonly found grass species are *Andropogon pumilus, Apluda mutica, Themeda quadrivalvis, Iseilema anthephoroides, I. laxum, Hackelochloa granularis, Melanocenchris jacquemontii, Lophopogon tridentatus, Andropogon pumilus, Chloris barbata, Dichanthium annulatum, Aristida redacta, A. funiculata,* and *Tragus roxburghii.* On north-eastern part of the lake *Phoenix sylvestris* was the dominant vegetation. On these trees nests of Baya weaver are seen. In winter harriers are seen to roost amidst groves in the north-eastern part of the lake.

**3. Fish fauna**- Common fishes found in this lake are Rohit *Labeo rohita,* Ger *Labeo boggut,* Katla *Catla catla,* Mrugal *Cirrhinus mrigala,* Common Carp *Cyprinus carpio, Puntias stigmata,* Glass Perch *Chanda nama,* Spotted Snakehead *Channa punctata,* Striped Snakehead *Channa striata,* Silver Carp *Hypophthalmichthys molitrix.* Fish fauna was identified by Vanyajeev Sanrakshan Sanstha members who are presently doing research on fish-fauna of Jalgaon district, acknowledged in the acknowledgement section. Checklist of fish fauna of Jalgaon district and knowledge of local fishermen were also utilised to ascertain identity of the fishes observed (Shelke, 2018).

**4. Other key fauna**- Common mammals found in this area are Nilgai *Boselaphus tragocameleus*, Wild Boar *Sus scrofa*, Indian Rufous Hare *Lepus nigricollis*, Field Mice *Mus booduga*, Common Bandicoot, Indian Gerbil *Tatera indica*, Flying Fox *Pteropus giganteus*. Reptiles such as Russell's Viper *Daboia russelii*, Saw-scaled Viper *Echis carinatus*, Indian Cobra *Naja naja*, Common Krait *Bungarus caeruleus*, Indian Rock Python *Python molurus*, Checkered Keelback *Fowlea piscator*, Indian Rat Snake *Ptyas mucosa,* Fan-throated Lizard Sitana ponticeriana, Oriental Garden Lizard *Calotes versicolor*, Brooks gecko *Hemidactylus brookii*, Common House gecko *Hemidactylus frenatus*, Brahminy Skink *Eutropis carinata*, Little Skink *Eutropis macularia,* Common Snake Skink *Lygosoma punctata* are found here.

All these are our own observations. All these animal species are recorded by us during our study visits to the lake and adjoining area. Observed animal species were identified by using available literature (David Raju et al, 2016 & Menon, 2014).

**5. Avifauna**-Manyarkheda Lake shelters resident and migratory birds. From September to March waterfowl, waders and other migrants visit this lake. Adjoining farms, scrubland, and grasslands inhabit and support grassland birds. Fifteen species of threatened birds are recorded from this area. Out of these five are globally threatened viz. Egyptian vulture *Neophron percnopterus*, Lesser Adjutant *Leptoptilos javanicus*, Steppe Eagle *Aquila nipalensis*, Greater Spotted Eagle *Clanga clanga*, and Indian Spotted Eagle *Clanga hastata*. Near threatened species of birds were Darter *Anhinga melanogaster*, Red-headed Falcon *Falco chicquera*, Woolly-necked Stork *Ciconia episcopus*, Painted Stork *Mycteria leucocephala*, Black-headed Ibis *Threskiornis melanocephalus*, Black-tailed Godwit *Limosa limosa*, Curlew Sandpiper *Calidris ferruginea*, River Tern *Sterna aurantia*, Alexandrine Parakeet *Psittacula eupatria*, Common Pochard *Aythya farina*. (https://www.birdsofindia.org/IUCN-Red-List). Other important bird species found were Chestnut-bellied Sandgrouse *Pterocles exustus*, Indian Courser *Cursorius coromandelicus*, Baillon's Crake *Porzana pusilla*, Yellow Bittern *Ixobrychus sinensis*, Black Bittern *Ixobrychus flavicollis*, and Eurasian Wryneck *Jynx torquilla*. (Checklist of birds of Manyarkheda lake is under preparation). The Lake area harbours 29 species of raptors. Raptors are ecological barometers and their diversity underlines ecological health of the region. Table 1 gives details of birds of prey found at Manyarkheda Lake and surrounding scrubland and grassland.

Total 223 species of birds were recorded from Manyarkheda Lake and surrounding scrub and grasslands. (These are our unpublished observations which we intend to publish as checklist of birds of Manyarkheda lake and adjoining scrub & grasslands very soon.) 29 species of raptors were recorded belonging to 02 orders and 4 families. Out of these 9

species were common residents, 5 occasional, 5 rare and 10 winter migrants. 2 species were endangered, 2 were vulnerable, 02 were near threatened and 23 were least concern (Rahmani, 2012, Rahmani et al, 2013, https://www.birdsofindia.org/IUCN-Red-List). During study period three Egyptian Vultures were seen gliding over the scrub and lake only once. This area has potential for vulture existence due to nearby Kusumba Gau-Shala. More vulture focused study is needed to establish status of these endangered species of birds in this area. Endangered Steppe Eagle was seen perched on Neem *Azadirachta indica* only once. Greater Spotted Eagle, a vulnerable species was also sighted once. Vulnerable Indian Spotted Eagle is a regular winter visitor to this area. It was seen soaring and circling above the scrub and grassland. Once it had gained height, it dived vertically with folded wings on the prey, as was witnessed by the authors. Authors recorded Indian Spotted Eagle attacking Oriental Garden Lizard *Calotes versicolor* and Rock Bush Quails *Perdicula argoondah*. Near threatened Red-headed Falcon was rarely seen resting on electric poles and wires attempting to pounce on the prey. Pallid Harrier was regularly seen returning to its roosting place in north-eastern part of the lake which was dominated by *Phoenix Sylvestris, Dendrocalamus strictus* and *Prosopis* Of the remaining 23 least concern raptor species 14 were resident or local migratory viz. Crested Serpent Eagle, Bonellis eagle, Short-toed Snake Eagle, Oriental Honey Buzzard, White-eyed Buzzard, Black Kite, Black-winged Kite, Peregrine Falcon, Shikra, Eurasian Sparrowhawk, Indian Eagle Owl, Spotted Owlet, Indian Scops Owl and Barn Owl. 9 species of raptors were least concern. Booted Eagle and Long-legged Buzzard were regularly seen wintering here each year. Montague's Harrier was seen gliding and circling over scrub and grassland while Marsh Harrier was seen frequently gliding over water and *Ipomoea carnea* and *Typha*. Brahminy Kite and Eurasian Hobby were seen rarely with only single sighting record for each. 6 individuals of Amur Falcon were seen flying over the scrubland in November 2020. Indian Eagle Owl and Barn Owl were occasionally seen on electric poles or stumps of dead trees. Spotted Owlet was regularly seen perched on electric wires singly, in pairs or in groups at dusk.

**Conclusion-** Raptors are the apex consumers in any ecosystem. Manyarkheda Lake region has good avian diversity, including 29 species of resident and wintering raptors. 6 raptors were listed in the Red Data Book. Rodents, amphibians, birds, fishes, snakes and other reptiles are probably attracting raptors to the study site. However, this region is facing tremendous pressure from rapid urbanisation, industrialisation, pollution, and stone-quarries. Industrial effluents and household sewage from nearby residential colonies is directly released in this lake causing water pollution, threatening aquatic flora and fauna. This raptor hotspot is slowly being transformed in to an industrial and residential area. Habitat degradation, air and water pollution, decrease in quantity and quality of hunting areas, intensive agriculture rapidly eliminating grassland, fallow land, and scrubland and increased use of pesticides and chemicals are the major threats to the raptor and other faunal population of Manyarkheda Lake region. Holistic approach while development of Manyarkheda Lake region is warranted for protection and conservation of this raptor habitat and home to some rare and threatened species.





**Acknowledgement**- The authors are obliged to Dr. Sudhakar Kurhade, Professor of Zoology, Ahmednagar, for his guidance. They thank Ravindra Phalak, Ravindra Sonawane, Bhushan Chaudhari, Balkrishna Devre, Vasudev Vadhe, Satish Kamble, Gaurav Shinde, Chetan Bhavsar, Skylab D'Souza, Azeem Kazi and Yogesh Galfade for encouragement and participation in field visits.

**References**-


- Ali, S. 2002. *The Book of Indian Birds*. 13th ed. Bombay Natural History Society & Oxford University Press pp. 11-178.
- David, R., Surya Ramachandran, 2017, *Photographic field guide, Wildlife of central India*, Notion press Chennai pp. 22-259.https://www.birdsofindia.org/IUCN-Red-List
- Grimmett, R, Inskipp, C, Inskipp, T., 2011. *Birds of the Indian Subcontinent* 2nd ed. London: Oxford University Press & Christopher Helm Pp. 96-223
- Kazmierczak, K. 2014. *A field Guide to the Birds of the Indian Subcontinent*. Om Books International, New Delhi. Pp. 62-160.
- Kshirsagar, S., Patil, D., 2008. *Flora of Jalgaon District, Maharashtra*. Dehra Dun: Bishen Singh Mahendra Pal Singh. Menon, V., 2014. *Indian mammals, a field guide* , Hachette Book Publishing India Pvt. Ltd. pp. 1-728.
- Normon A, 2015. Birds of India Pakistan, Nepal, Bhutan, Bangladesh and Sri Lanka, William Collins, an imprint of Harper Collins Publishers.
- Pande, S, Deshpande, P, Sant, N., 2013. *Birds of Maharashtra,* 2nd ed. Pune: Ela Foundation Pp. 40-152.
- Patil, D. A. (2003)." *Flora of Dhule and Nadurbar District (Maharashtra)"* Bishan Singh Mahendra Pal Singh, Deharadun.
- Praveen, J., Jaypal, R. & Pittie, A., 2016. A checklist of the birds of India. *Indian BIRDS* 11(5&6): 113-172.
- Rahmani, A., Islam, Z., Kasambe, R. and Wadatkar, J., 2013. *Important bird areas Of Maharashtra*, Bombay Natural History Society & Oxford University Press, Pp.1-174
- Rahmani, A., 2012. *Threatened Birds of India--Their conservation requirements*, Indian Bird Conservation Network: Bombay Natural History Society: Birdlife International. Oxford University Press. Pp. 263-737.
- Shelke, A., 2018. Freshwater fish fauna of Girna River, Dist. Jalgaon, Maharashtra, India, *International Journal of Zoology Studies*. Vol. 3(1): 68-75.

# Charadriiformes avifauna in Ratlam, Madhya Pradesh

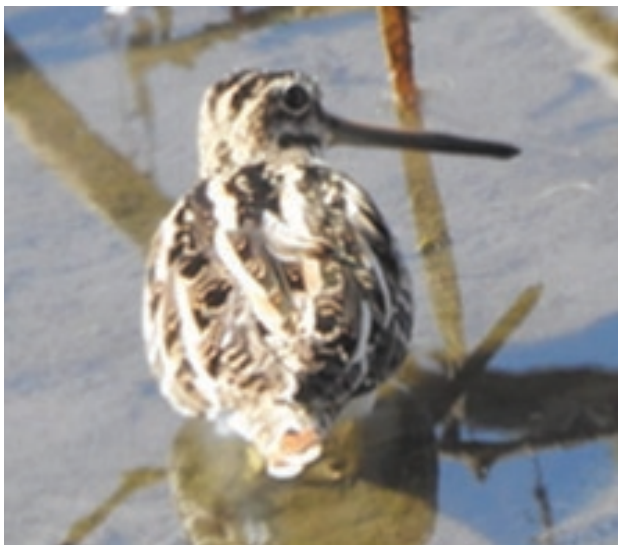
*Milind Dange[1] and Pradip Kumar[2]
[1]Department of Zoology Government College Kalukheda (Ratlam) MP
email: d.milind16@gmail.com
[2]Department of Zoology Government PG Arts and Science College
Ratlam MP 457001

**Citation:** Dange Milind and Kumar Pradip. Charadriiformes avifauna in Ratlam, Madhya Pradesh.
*Ela Journal of Forestry and Wildlife*
*Vol.10 (1): 900-905*

**Date of Publication:**
31 March 2021

ISSN 2319-4361





**Pintail Snipe *Gallinago stenura***

**Abstract**

Charadriiformes is an order of small to medium sized aquatic birds which comprises of about 350 species. They consume insects and other invertebrates. The avian diversity of this avian order from Ratlam was studied from June, 2015 to June, 2019. A total of 29 species of birds belonging to six families and 16 genera were recorded.

**Keywords**: Charadriiformes, Scolopacidae, Jacanidae, Charadriidae

## Introduction

More than ten thousand bird species are found world wide (Gill *et. al*.2020). Almost half of them are passerines. Birds are bioindicators and are useful for understanding the key issues in ecology, animal behavior, evolution and conservation (Urfi, 2011). Diversity of birds is one of the most important ecological indicators to evaluate the quality of habitats. The diversity of birds however is decreasing day by day due to destruction of habitats and human intervention (Bhadja and Vaghela, 2013). Their abundance indicates healthy status of environment and food sources (Joshi, 2012). Charadriiformes is a diverse order of small to medium sized aquatic birds that consume invertebrates or other small animals.

Several birds undertake annual long distance migrations, usually triggered by the length of daylight and weather conditions to procure food sources and suitable feeding habitat. (Ali and Daniel 1941).

Some reports on Charadriiformes birds are available from Madhya Pradesh (Pasha and Sankar 1996, Pasha 1998), Milind Dange and Pradip Kumar 2013, 2019a.b). Ratlam city (23°19′0″N 75°04′0″E) is situated in the northwestern part of the Malwa region of Madhya Pradesh. It has humid subtropical climate (Cfa) zone. Three distinct seasons are observed here: summer, monsoon and winter. Ratlam gets moderate rainfall of 35 to 38 inches (890 to 970 mm) from July through September, due to the southwest monsoon. Six families in order Charadriiformes

are Burhinidae (Thick-knees), Recurvirostridae (Stilts), Charadriidae (Plovers and Lapwings), Jacanidae (Jacanas), Scolopacidae (Godwits, Sandpipers, Dunlins, Stints, Snipes, Greenshanks and Redshanks) and Laridae (Skimmers, Gulls and Terns). These families exhibit cosmopolitan distribution. India being a mega diversity centre harbors 1334 species of birds which contributes to more than 13 percent of the world avian species (Praveen J., Jayapal, R., & Pittie, A., 2016). We studied the diversity of birds from order Charadriiformes. Only two orders of modern birds were present in Cretaceous as per fossil records Charadriiformes is one of them along with Anseriformes (Dyke and Tuinen 2004). So also, in the modern scenario, several species from this order have been reported positive for avian influenza. (Pawar et al 2004).

**Material and Methods**

The area under the present study included wetland habitats around Ratlam city (23°19′0″N 75°04′0″E) to evaluate avian diversity and distribution in Ratlam. Identification of birds was done with the help of Ali 1941. The study was conducted from June, 2015 to June, 2019. The area was regularly surveyed each month for birds by direct observation with the help of Olympus 10X50 DPS I field binocular in all the major habitats. Observations were made using distance count method (Marsden, 1999). Birds from the order Charadriiformes were identified and recorded along with habitat type and status (resident or winter visitor). On the basis of the frequency of sighting, the bird species were assigned categories of abundance (uncommon, common, rare, and occasional). Common birds were found on most visits, uncommon birds were observed on less visits, birds of occasional category were observed on few visits whereas rare category birds were observed on just one or two visits. Photographs were taken with Nikon coolpix p900 camera.

**Results and discussion**

During the study period, a total of 29 species of birds belonging to 16 genera in six families from the order Charadriiformes were observed. Major habitat in which the birds were observed were wetland and grass land. A checklist of the birds along with their IUCN conservation status and residential status is given in Table 1. Out of the 29 species of birds, most were Winter Migrants (W). According to IUCN Red List (version 3.1), 27 species were Least Concern (LC) and two were Near Threatened (NT, River Lapwing *Vanellus duvaucelii* and River Tern *Sterna aurantia* and Indian Skimmer *Rynchops albicollis* was endangered.

Although Ratlam city supports a large variety of birds (Dange and Pradip Kumar, 2013), various threats were observed in and around the study site which are responsible for habitat degradation. These include

developmental projects and other anthropogenic pressures such as fishing, pollution and increasing turbidity due to excessive soil use. All these factors are adversely affecting the avian diversity of this site. Proper action plan and regulation strategies are needed for the survival of habitats and species. Eurasian Thick-knee *Burhinus oedicnemus,* River Tern *Sterna aurantia* and Indian Skimmer *Rynchops albicollis* were rare, Indian Thick-knee *Burhinus indicus*, Yellow-wattled Lapwing *Vanellus malabaricus* and Dunlin *Calidris alpina* are occasional where as Common Greenshank *Tringa nebularia*, Common Snipe *Gallinago gallinago* and Little Ringed Plover *Charadrius dubius* were uncommon species in this region in our study. Indian Skimmer was observed twice in pair November 2018 near a pond in village Kalukheda Ratlam.

R= Rare, O=Occasional, U=Uncommon, C=Common, LC=Least Concern, W=Winter Migrant, NT=Near Threatened, R=Resident, EN= Endangered

**Acknowledgements:**

We thank the Principal, Government PG Arts and Science College Ratlam, for providing necessary facilities and to UGC and Ministry of Social Justice & Empowerment and Ministry of Tribal Affairs government of India for providing RGNF fellowship to Pradip Kumar.

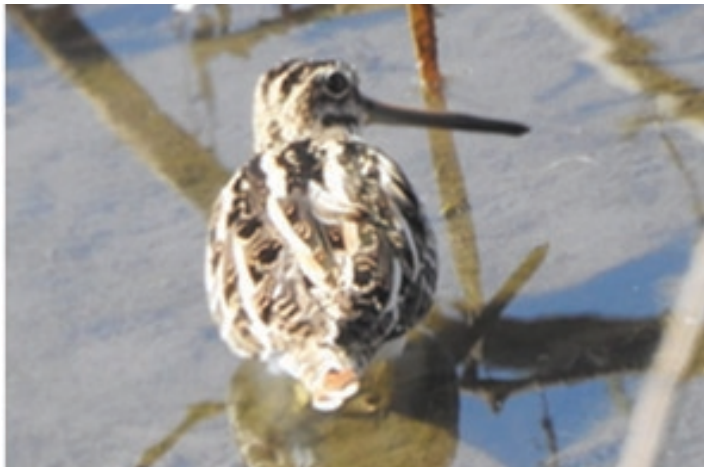
**Table**:

| S. No. | Common Name | Scientific Name | Frequency | Total count of birds | Seen on number of visits | IUCN status | Residential status | Month of Observation |
|---|---|---|---|---|---|---|---|---|
| Family: Burhinidae | | | | | | | | |
| 1 | Eurasian Thick-knee | *Burhinus oedicnemus* | R | 1 | 2 | LC | R | January |
| 2 | Indian Thick-knee | *Burhinus indicus* | O | 2 | 5 | LC | R | January |
| Family: Recurvirostridae | | | | | | | | |
| 3 | Black-winged Stilt | *Himantopus himantopus* | C | 8 | 50 | LC | R | January to December |
| Family: Charadriidae | | | | | | | | |
| 4 | Grey Plover | *Pluvialis squatarola* | | 2 | 6 | | | October |
| 5 | Pacific Golden Plover | *Pluvialis fulva* | C | 1 | 3 | LC | R | November |
| 6 | Little Ringed Plover | *Charadrius dubius* | C | 2 | 10 | LC | R | November |
| 7 | River Lapwing | *Vanellus duvaucelii* | C | 1 | 2 | NT | W | January |
| 8 | Yellow-wattled Lapwing | *Vanellus malabaricus* | O | 1 | 1 | LC | W | February |
| 9 | Red-wattled Lapwing | *Vanellus indicus* | C | 10 | 100 | LC | R | January to December |
| Family: Jacanidae | | | | | | | | |
| 10 | Pheasant-tailed Jacana | *Hydrophasianus chirurgus* | C | 1 | 2 | LC | W | October |
| 11 | Bronze-winged Jacana | *Metopidius indicus* | C | 6 | 15 | LC | R | January to December |
| Family: Scolopacidae | | | | | | | | |
| 12 | Black-tailed Godwit | *Limosa limosa* | C | 2 | 2 | LC | W | October |
| 13 | Broad-billed Sandpiper | *Calidris falcinellus* | C | 1 | 3 | LC | W | December |
| 14 | Curlew Sandpiper | *Calidris ferruginea* | C | 3 | 6 | LC | W | October |
| 15 | Temminck's Stint | *Calidris temminckii* | C | 2 | 3 | LC | W | October |
| 16 | Dunlin | *Calidris alpina* | O | 2 | 5 | LC | W | November |
| 17 | Little Stint | *Calidris minuta* | C | 15 | 23 | LC | W | November |
| 18 | Pintail Snipe | *Gallinago stenura* | C | 1 | 4 | LC | W | September |
| 19 | Common Snipe | *Gallinago gallinago* | U | 1 | 6 | LC | W | October |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20 | Jack Snipe | *Lymnocryptes minimus* | C | 2 | 3 | LC | W | November |
| 21 | Terek Sandpiper | *Xenus cinereus* | C | 2 | 5 | LC | W | November |
| 22 | Common Sandpiper | *Actitis hypoleucos* | C | 1 | 2 | LC | W | October |
| 23 | Green Sandpiper | *Tringa ochropus* | C | 3 | 20 | LC | R | November |
| 24 | Common Greenshank | *Tringa nebularia* | U | 2 | 10 | LC | W | November |
| 25 | Marsh Sandpiper | *Tringa stagnatilis* | C | 2 | 16 | LC | W | October |
| 26 | Common Redshank | *Tringa totanus* | C | 2 | 3 | LC | W | November |
| N | Wood Sandpiper | *Tringa glareola* | C | 13 | 10 | LC | W | October |
| Family: Laridae | | | | | | | | |
| 28 | Indian Skimmer | *Rynchops albicollis* | R | 1 | 1 | EN | W | November |
| 29 | River Tern | *Sterna aurantia* | R | 2 | 1 | NT | W | November |

**Black-winged Stilt *Himantopus himantopus***

**Bronze-winged Jacana *Metopidius indicus***



**Pintail Snipe *Gallinago stenura***

**River Tern *Sterna aurantia***

**Little Ringed Plover *Charadrius dubius***

**Indian Skimmer *Rynchops albicollis***

**Wood Sandpiper *Tringa glareola***

**Common Sandpiper *Calidris falcinellus***

**Marsh Sandpiper *Tringa stagnatilis***

**Green Sandpiper *Calidris ferruginea***

**Common Redshank *Tringa totanus***

**References:**


- Ali S. and J. C. Daniel 1941,The book of Indian birds. Thirteenth Edition (2002). New Delhi: Oxford University Press. 1-326
- Bhadja P and Vaghela A, 2013. Study on Avifaunal diversity from two freshwater reservoirs of Rajkot, Gujrat, India. *Int. J. of Research in Zoology*,3(2): 16-20
- Dyke, Gareth J. and Marcel Van Tuinen (2004). The evolutionary radiation of modern birds (Neornithes): reconciling molecules, morphology and the fossil record. *Zoological Journal of the Linnean Society*, Volume 141, Issue 2, June 2004, Pages 153–177, https://doi.org/10.1111/j.1096-3642.2004.00118.x
- Gill F, D Donsker & P Rasmussen (Eds). 2020. IOC World Bird List (v10.2). doi : 10.14344/IOC. ML.10.2.
- Joshi PS, 2012. An annotated checklist of aquatic avifauna of Rajura, Godada and Dhanora lakes of Buldhana district (M.S.) India. *Science Research Reporter,* 2(1): 30-33.
- Marsden, S.J. (1999), Estimation of parrot and hornbill densities using a point count distance sampling method. Ibis, 141: 327-390. https://doi.org/10.1111/j.1474- 919X.1999.tb04405.x
- Milind Dange and Pradip Kumar. 2013. Birds Of Ratlam, Madhya Pradesh, India *Cibtech Journal of Zoology Vol. 2 (3), 49-52*
- Milind Dange and Pradip Kumar. 2019 (a). Coraciiformes Birds of Ratlam Madhya Pradesh. *Remarking an analisation* Vol.4 issue-9, 33-36.
- Milind Dange and Pradip Kumar. 2019(b). Anseriformes Birds of Ratlam, Madhya Pradesh. *CIBTech Journal of Zoology.Vol.8 (2) p.1-4.*
- Pande Satish, Niranjan Sant, Pramod Deshpande, Kailash Chandra and Narmada P. Shukla.*Birds of Madhya Pradesh*. (2009). Published by Ela Foundation and Madhya Pradesh Council of Science and Technology.
- Pasha, M.K.S. and K. Sankar 1996. Sighting of Pied harrier Circus melanoleucos (Pennant) in Pench Tiger reserve, Madhya Pradesh. *Newsletter for Birdwatchers*. 36 (2): 38-39.
- Pasha, M. K. S. 1998. Spurfowls of Pench Tiger Reserve, Madhya Pradesh. WPA News 57.
- Pawar S, Pande S, Jamgaonkar A, Koratkar S, Pal B, Raut S, et al. (2009).Avian influenza surveillance in wild migratory, resident, domestic birds and in poultry in Maharashtra and Manipur, India, during avian migratory season 2006-07. Curr Sci India. 2009;97(4):550–4.
- Praveen J., Jayapal, R., & Pittie, A., 2016. A checklist of the birds of India. *Indian BIRDS*, 11:113-170.
- Urfi AJ, 2011. The Painted Stork: Ecology and Conservation Springer-Verlag New York ISBN 978-1-4419-8468-5 **1** XVII, 163

# Rescue of an Oriental Scops Owl *Otus sunia* at Shingave, Shirpur, Dhule, Maharashtra

**Abhijeet Patil [1], Rahul Kumbhar [1], Vivek Desai [2], and Manojkumar Z. Chopda[3]***
[1]Nature Conservation Forum, Shirpur
[2]Biologist Ideal Organization, Non-Government Organization, Jalgaon
[3]Department of Zoology, Moolji Jaitha College (Autonomous), Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
Corresponding author: mzczoo@gmail.com

**Citation:** **Patil Abhijeet, Kumbhar Rahul, Desai Vivek and Chopda Manojkumar Z.** Rescue of an Oriental Scops Owl *Otus sunia* at Shingave, Shirpur, Dhule, Maharashtra
*Ela Journal of Forestry and Wildlife*
*Vol.10 (1): 906-909*

**Date of Publication:**
31 March 2021

ISSN 2319-4361



**Abstract**

We report the first successful rescue and re-wilding of a juvenile Oriental Scops Owl *Otus sunia* from Shingave, Shirpur, Dhule, in Khandesh region.

**Key words:** Oriental Scops Owl, Dhule, Maharashtra, India

## Introduction and distribution

Oriental Scops Owl *Otus sunia* Family Strigidae has a worldwide distribution (Holt *et al.,* 2020). It is categorized as Least Concern and is included in CITES App.II; and Schedule 1 of Wildlife Protection Act 1972. It varies in abundance from locality to locality and is described as scarce and very local in Pakistan, and scarce but more widespread in Sri Lanka, but locally distributed and fairly common in the Indian Subcontinent; uncommon in Thailand; uncommon in Japan, but said to be the commonest Strigid in SE Siberia (Holt *et al.,* 2020). Wadatkar *et al*., (2015) reported the Oriental Scops Owl from Melghat Tiger Reserve (21°26′45″N 77°11′50″E) in northern part of Amravati District, Maharashtra and another report is from Nasik District (K. Kazmeirczak, 2000). It was also reported by Wadatkar *et al*., (2010) in "The checklist of the birds of Amaravati District". Mahajan *et al*., (2012) reported it from Mahendri Reserve Forest, Amravati. Wadatkar reported it from Chikhaldara on 3 Jan 2016 (https://ebird.org/india/region/IN-MH-AM?yr=all&m=&rank=lrec), N. Abhang reported it on 6 Jan 2019 from Chikhaldara (https://ebird.org/india/region/IN-MH-AM?yr=all&m=&rank=hc) and it was recently reported by S, Patil on 28 Mar 2019 from Melghat Tiger Reserve, Semadoh. (https://ebird.org/species/orsowl/IN-MH-AM). These areas are close to

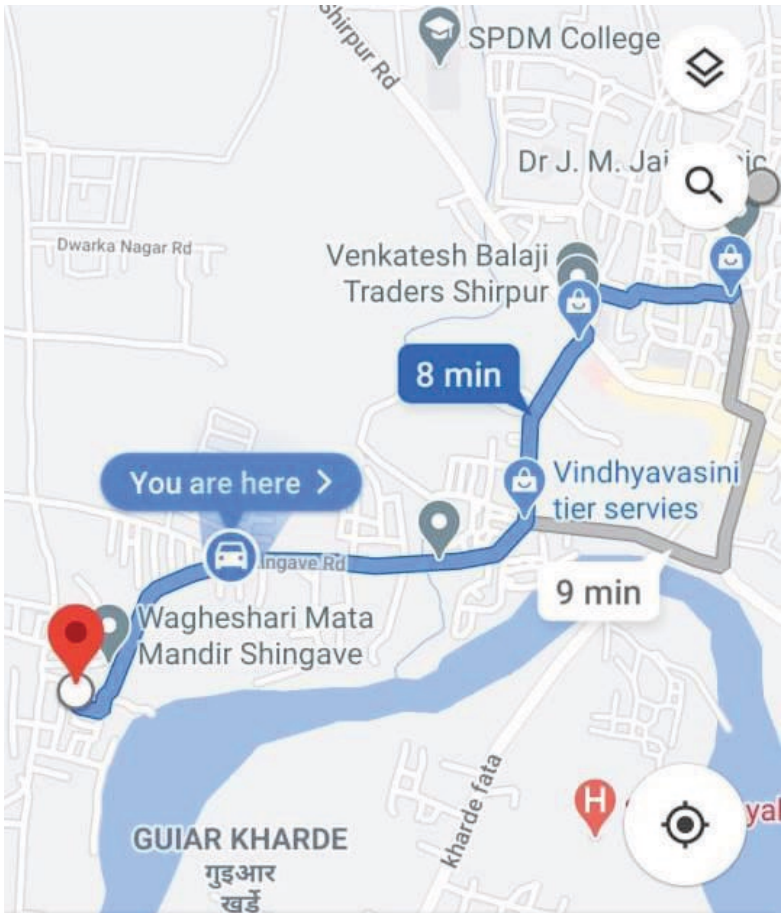



**Fig. 1** Location of the rescued bird


**Fig. 2** Location of the rescued bird with GPS location at upper left-hand corner

our study area and it proves that the Oriental Scops Owl is a resident species from this region.

**Description:**

The identification was carried out on the basis of some field tips like; Whether the owl has tufts or is round-headed, Eye and bill color, Plumage color and other distinct markings, Relative size of the owl, Details of the owl's habitat and Distribution of the owl in guide books and online websites *viz.* https://birdsoftheworld.org, https://ebird.org, https://www.owlpages.com etc.

Oriental Scops Owl is a small, variable plumaged, yellow eyed owl with small ear-tuft feathers. It can be distinguished from the Collared Scops Owl (Holt *et al.,* 2020) by its whitish scapular stripe, well-marked under parts, and lack of pale collar. There are two colour morphs, grey and rufous; intermediate forms also occur. Sexes are similar in appearance. Individuals may freeze with eyes half closed when disturbed. The species has a repeated liquid call sounding like "tuk tok torok" (Holt *et al.,* 2020). The biometrics are as follows: length 17–21 cm; wingspan 50–53 cm; biomass 75–95 g (König, C., *et al*., 2008. Owls of the World. 2nd ed. Christopher Helm, London). It occurs in gray-brown and rufous morphs (Wadatkar *et al*., 2015).

Gray-brown morph; eastern screech owl (*Megascops asio*) is similar to plumage of Oriental Scops Owl (*Otus sunia*), differing mainly in less patterned upperparts and stronger black streaking below, but could be variable. The rufous morph of Oriental Scops Owl (*Otus sunia*), is plain rufous above, apart from white scapular line and finely dark-streaked forehead and crown, and lighter below, breast with dark shaft streaks and thin horizontal pencil-lines; eyes yellow; bill blackish-gray (König, C., *et al*., 2008); feet yellowish-gray or grayish pink. Differs from Indian scops owl *O. bakka moena* in lack of prominent nuchal collar. Juvenile of Oriental Scops Owl (*Otus sunia*) as adult but with faint barring (https://birdsoftheworld.org).

**Fig. 3-a, 3-b:** The two photos taken after a gap of a few days, during the nursing period, after the rescue of the owl.

**Results**

On 02nd January 2020, the first author received a call from Rahul Kumbhar to inform that an unusual injured bird was found by a farmer from village Shigave, Shirpur Tehsil in District Dhule. The village is surrounded by agriculture fields and Aner Dam Wildlife Sanctuary is about 16 km from the village. It was subsequently identified as a nestling Oriental Scops Owl. The farmer described that the bird was lying in front of his house under an old *Ficus religiosa* tree for two days and had probably fallen from the nest. He had hoped that the bird would fly away but when he saw that it could not fly and was only hopping on the ground he had contacted Rahul who had contacted the first author.

We first saw the nestling on 16 January 2020 at 12:55 pm. The owl was about three weeks and its gender could not be determined. The nestling was exhausted but not injured. Biometry revealed following parameters: wing span – 54 cm; wing cord – 23 cm; beak length – 1.8 cm; tail length – 6 cm and biomass – 94 gm. We photographed the bird and decided to leave it where it where it was found and wait and watch for the parents during the night. However, since the parents did not visit the chick in the night, we brought it to our home. Being a raptor, it had sharp talons and was aggressive. The chick was fed boneless meat every day and was given water. On 7thFebruary 2020; it was released and it flew to the branch of the *Ficus* tree and subsequently disappeared in the wild. After 48 days after rescue, the owl was successfully released in the natural wild habitat.

**Acknowledgment**

Authors are thankful to the Authors are thankful to the Mr. Amitraj Ramesh Jadhav, ACF, Shirpur, Mr. Pradip Shamrao Roundhal, RFO, Shirpur and forest department for their constant support. Authors are also thankful to the NGO 'Biologist Ideal Organization', for their help during the rescue. forest department for their constant support. Authors are also thankful to the NGO 'Biologist Ideal Organization', for their help during the rescue.

**References**


- *Anonymous,* Birds of the world https://birdsoftheworld.org
- *Anonymous,* District Dhule Profile https://dhule.gov.in/district-profile/
- eBird India https://ebird.org/india/region/IN-MH-AM?yr=all&m=&rank=hc
- eBird India https://ebird.org/india/region/IN-MH-AM?yr=all&m=&rank=lrec
- eBird India https://ebird.org/species/orsowl/IN-MH-AM
- König, C., F. Weick, and J.-H. Becking. (2008) *Owls of the World*. 2nd ed. Christopher Helm, London, 1-528.
- Krys Kazmierczak. (2000) *Birds of India, Sri Lanka, Pakistan, Nepal, Bhutan, Bangladesh and the Maldives,* illustrated by Ber van perlo, Published by Om Books International Noida, 1-448.
- Mahajan, A., Lad, P., Ingole, V.T., Khode, M., Kasambe, R. and Wadatkar, J. (2012) Checklist of birds of Mahendri Reserve Forest, Amravati, Maharashtra. *Newsletter for Birdwatchers,* 52(2): 17-23.
- Wadatkar J. S., G. S. Kadu and M. K. Dhakulkar. (2015) *Newsletter of Bird Watchers,* 55(1):3.
- Wadatkar J. S., Kasambe R., Wagh G. (2010) Checklist of birds of Amravati District, Published by Amravati: Wildlife and Environment Conservation Society, 1-16.
- Holt, D. W., R. Berkley, C. Deppe, P. L. Enríquez, J. L. Petersen, J. L. Rangel Salazar, K. P. Segars, K. L. Wood, G. M. Kirwan, and J. S. Marks (2020). Oriental Scops-Owl (Otus sunia), version 1.0. In Birds of the World (J. del Hoyo, A. Elliott, J. Sargatal, D. A. Christie, and E. de Juana, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA, online https://doi.org/10.2173/bow.orsowl.01_
- *Anonymous,* https://www.owlpages.com
- Anonymous, species-id-guide, https://www.owlresearchinstitute.org/species-id-guide

# Endemic vertebrates of Arunachal Pradesh, India

**Kirty Prosad Nath* and Narender Sharma**
Arunachal Pradesh Regional Centre, Zoological Survey of India, Itangar-791113
*corresponding author
Email-kirtynth.hp@gmail.com

**Citation:** **Nath Prosad Kirty and Sharma Narender.** Endemic vertebrates of Arunachal Pradesh, India.
*Ela Journal of Forestry and Wildlife*
*Vol.10 (1): 910-917*

**Date of Publication:**
31 March 2021

ISSN 2319-4361



**Abstract:** A checklist of endemic vertebrates of Eastern Himalaya, i.e., Arunachal Pradesh has been compiled from literature. In Total, the state harbours 102 endemic species/sub-species of vertebrates represented by 67 (66%) Pisces, 16 (15%) Amphibians, 5 (5%) Reptiles, 6 (6%) Birds and 8 (8%) Mammals. A total of 23 endemic species (11 pisces spp., 4 avian spp. and 8 mammalian spp.) were listed under IUCN Red list categories. 12 endemic species (4 reptilian spp., 2 avian spp. and 6 mammalian spp.) of the state are protected under different schedule of Wildlife (Protection) Act, 1972.

**Key Words:** Eastern Himalaya, Endemism, Biodiversity hot spots, Vertebrates, IUCN Conservation, WPA Schedule.

**Introduction:**

Endemism is the ecological state of a species being unique to a defined geographic region, such as an island, nation, or other defined zone, or habitat type (Darlington, 1957). The species inhabiting such a particular geographical location or in a defined place are referred as 'Endemic species'. Area of the endemism may be relatively large with wide distribution or may be small with restricted distribution. An endemic species stands as the true representative of the specific environment of its habitat and such species may also serve as biological indicators and have been termed as Flagship species (Foissner, 2005; Foissner & Stoeck, 2006).

The Eastern Himalayan i.e., Arunachal Pradesh is rich in its faunal as well as floral resources. Most part of the state falls under the Eastern Himalayan Biodiversity hotspot (Myers et al., 2000) and it is also a faunal gateway of Indo-Chinese and Indo- Malayan elements. Being in the transition zones of Palaearctic and Oriental Bio-geographic regions, due to edge effect, the state possess biotic elements from both the

regions, as well as have its exclusive components and thus it represents Indo-Chinese, Indo-Malayan, Indo-Burmese and Indian biotic components (Captain and Bhatt, 2000).

In India, vertebrate diversity is represented by 3429 species of Pisces (Chandra et al.,2020), 447 species of Amphibian (Dinesh et al., 2020), 641 species of Reptiles, 1343 species of Aves and 429 species of mammals (Chandra et al., 2020); whereas in Arunachal Pradesh is the home of 231 species of Pisces (Chandra et al., 2018), 65 species of Amphibia (Ohler et al., 2018) and 108 species of Reptiles 539 species of Aves and 154 Mammalian species (Chandra et al.,2018).

Majority of the endemic fauna in India have their occurrence in the Eastern Himalayas, Indo-Myanmar region and Western Ghats of India. Among the Indian Vertebrate fauna, species endemism in Amphibian and Reptilian are found to be as high as 61.2 % and 41 % of the species, respectively (Venkataraman, 2013). Altogether, 81 avian species are found to be endemic in India and distributed in all the Endemic Bird Areas of the country (De and Maheswaran, 2013). There are 46 endemic mammalian species in India (De and Sarma, 2013). Nine genera of Pisces are endemic to India and near about 40% of endemic fresh water fishes of India are reported from each Western Ghats and Northeast India (Mishra et al., 2013). As there is no comprehensive list on endemic vertebrates of Arunachal Pradesh; in this regards, the authors have compiled the present list from the available literature.

**Materials and Methods:**

The present paper is truly based on extensive literature studied by the authors. Systematic classification was followed after Jayaram (1999) for fishes, Frost (2020) for amphibians, Uetz (2020) for reptilian, Lepage (2020) for birds and Wilson and Reeder (2005) for mammalian fauna.

**Result and Discussion:**

A total of 102 species and sub-species of vertebrate fauna are endemic to Arunachal Pradesh which is 9.3% of total vertebrate fauna found in the state. The endemic chordates of the state comprises of 67 species of Pisces, 16 species of Amphibian, 5 species of Reptiles, 6 species/sub-species of Birds and 8 species/sub-species of Mammals (Table.1). Vertebrate endemism of the state is dominated by Pisces (66%), followed by Amphibians (15%), Mammals (8%), Aves (6%) and Reptiles (6%) (Fig.1). In Pisces, order Cypriniformes has 40 endemic spp., Siluriformes has 22 endemic spp., Anabantiformes has 3 endemic spp. and each Synbranchiformes and Perciformes has 1 endemic spp. In case of Amphibian, order Anura has 15 endemic spp. while order Gymnophiona has 1 endemic spp. Among avian endemic fauna of the state, order Passeriformes has 5 endemic spp. and order Galliformes has one endemic spp. Whereas, in Mammalia, Rodentia has 5 endemic spp., Primates has 2 endemic spp. and order Atiodactyla has 1 endemic spp.

As per IUCN conservation concern, three endemic

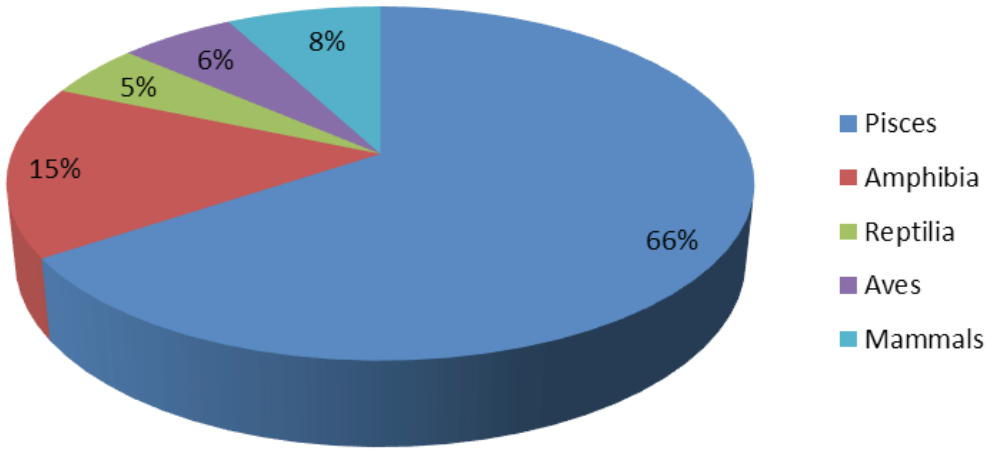



Fig.1. Composition of vertebrate endemism in Arunachal Pradesh

fishes namely, *Devario horai* (Barman, 1983) found only in Namdapha river, *Lepidocephalichthys arunachalensis* (Dutta & Barman, 1984) distributed in drainage of Tirap, East Siang and West Siang district and *Amblyceps arunachalensis* Nath & Dey (1990) which is known to occur in rivers of Papumpare, Lower Subansiri, Upper Subansiri and West Siang district are endangered(EN). Two Pisces are vulnerable(VU) namely *Aborichthys tikaderi* Barman,1985 which is native to Namdapha river system and *Pseudechansis sinerica* (Vishwanath & Darshan,2007) found in Siren river of Upper Siang; two endemic Pisces (*Schistura tirapensis* Kottelat,1990 and *Amblyceps apangi* Nath and Dey, 1989) are least concern (LC) and four endemic Pisces (*Psilorhynchus arunachalensis* (Nebeshwar et al.,2007), *Creteuchilonglanis kamengensis* (Jayram,1996), *Pterocryptis indicus* (Dutta, Barman and Jayram,1987) and *Monopterus hodgarti* (Choudhri,1913)) of the state are data deficient (DD) (Table.1). There is no amphibian and reptilian endemic fauna of the state listed under IUCN Red list. Among endemic avian fauna of the state, Liocichla bugunorum Athreya, 2006 is critically endangered, which is distributed only in isolated pockets of Eaglenest Wildlife Sanctuary of the state; *Lophophorus scaleteri arunachalensis* (Kuma & Singh, 2003) and *Spelaeornis badeigularis* Ripley, 1948 are vulnerable and *Actinodura waldeni daflaensis* Godwin-Austen, 1874 is least concern. In case of mammals, *Biswamoyopterus biswasi* Saha, 1981 is critically endangered (CR), which is found only in Namdapha Tiger Reserve of Arunachal Pradesh. Both endemic primates *Macaca munzala* Sinha et al., 2005 which is distributed in Western part of the state and Hoolock hoolock mishmiensis Choudhury found in Mishmi hills, 2013 are endangered, while only endemic goat, Budorcas taxicolor Hudgson, 1850 is vulnerable which is distributed in Mishimi hills above 2000m altitude.

Out of 102 endemic vertebrate species/ sub-species of the state, 12 endemic vertebrates are protected under schedules of Wildlife (Protection) Act, 1972. There is no any endemic species of pisces and amphibian of the state in legal protection under schedule of Wildlife Protection Act, 1972. All the five endemic Ophidian species are protected under Schedule-IV. Among birds, *L. scaleteri arunachalensis* is protected under Schedule-I and *S. badeigularis* is protected under Schedule-IV. *H. hoolock mishmiensis* and *B. taxicolor* are the mammalian species protected under Schedule-I, while all three endemic species of genus *Petaurista* i.e., *P. mechukaensis* Choudhury, 2007, *P. mishmiensis* Choudhury, 2009 and *P. siangensis* Choudhury, 2013 are protected under Schedule- II.

As compared to Western Ghats, Northeast region of India has greater endemism in freshwater fish fauna and this region also known as hot spots for endemic freshwater biota (Sarma et al., 2018). On the other hand, though herpetofaunal diversity is higher in Western Ghats, yet there is great potential to record new species from Northeast India. Recently, some herpetologists described several taxa from the Himalayan state Arunachal Pradesh which are new to science, such as Saikia et al. (2017), Mahoney et al. (2018), Biju et al. (2019), Saikia and Sinha (2019), Apte (2019), Captain et al. (2019), etc.

**Table.1. Checklist of Endemic Vertebrates of Arunachal Pradesh**

| S/L No. | Species Name | IUCN Status | WPA Schedule |
|---|---|---|---|
| | **Phylum: Chordata** | | |
| | **Class : Pisces** | | |
| | **Order :Cypriniformes** | | |
| | **Family : Cyprinidae** | | |
| 1 | *Barilius arunachalensis* Nath, Dam & Kumar, 2010 | -- | -- |
| 2 | *B.jayarami* Barman, 1985 | -- | -- |
| 3 | *Devario horai* (Barman, 1983) | EN | |
| 4 | *Opsarius arunachalensis* (Nath, Dam and Kumar, 2010) | -- | -- |
| 5 | *Rasbora kobonensis* Choudhuri, 1913 | -- | -- |
| 6 | *Pethia arunachalensis* Shangningam, Kosygin and Chowdhury, 2019 | -- | -- |

| | | | |
|---|---|---|---|
| 7 | *Garra arupi* Nebeshwar, Vishwanath & Das, 2009 | -- | -- |
| 8 | *G. kalpangi* Nebeshwar, Bagra & Das, 2012 | -- | -- |
| 9 | *G. tirapensis* Dutta & Barman, 1984 | -- | -- |
| 10 | *G. arunachalensis* Nebeshwar and Vishwanath, 2013 | -- | -- |
| 11 | *G. tamangi* (Gurumayum & Kosygin, 2016) | -- | -- |
| 12 | *G. nagnacavus* Shangningam, Kosygin and Sinha, 2019 | -- | -- |
| 13 | *G. ranganensis Tamang* et al., 2019 | -- | -- |
| 14 | *G. magnidiscus* Tamang, 2013 | -- | -- |
| 15 | *G. birostris* Nebeswar and Viswanath, 2012 | -- | -- |
| 16 | *G. kimini* Arunachalam, Nandagopal and Mayden, 2013 | -- | -- |
| 17 | *G. minimus* Arunachalam, Nandagopal and Mayden, 2014 | -- | -- |
| 18 | *G. quadratriostris* Nebeswar and Viswanath, 2013 | -- | -- |
| 19 | *G.nigeicauda* Nandagopal and Mayden, 2013 | -- | -- |
| 20 | *Schizothorax sikusirumensis* Jha, 2020 | -- | -- |
| | **Family :Psilorhynchidae** | | |
| 21 | *Psilorhynchus arunachalensis* (Nebeshwar et al., 2007) | DD | |
| 22 | *P. kamengensis* Dey et al., 2020 | -- | -- |
| 23 | *Psilorhynchus bichomensis* Shangningam, Kosygin and Gopi, 2019 | -- | -- |
| | **Family : Cobitidae** | | |
| 24 | *Lepidocephalichthys arunachalensis* (Dutta & Barman, 1984) | EN | |
| | **Family : Balitoridae** | | |
| 25 | *Bhavania arunachalensis* Nath et al., 2007 | -- | -- |
| 26 | *Schistura rebuwa* Choudhury et al., 2019 | -- | -- |
| 27 | *S. tirapensis* Kottelat, 1990 | LC | |
| 28 | *Physoschistura dikrongensis* Lokeshwar and Vishwanath, 2012 | -- | -- |
| 29 | *P. walongensis* Tamang and Sinha, 2016 | -- | -- |
| 30 | *P. horkishori* Darsan et al., 2019 | -- | -- |
| 31 | *Aborichthys tikaderi* Barman,1985 | VU | -- |
| 32 | *A. iphipaniensis* Gurumayum, Singh and Chowdhury, 2019 | -- | -- |
| 33 | *A. koilashi* Shangningam et al., 2019 | -- | -- |
| 34 | *A. pangensis* Shangningam et al., 2019 | -- | -- |
| 35 | *A. cataracta* Arunachalam et al., 2014 | -- | -- |
| 36 | *A. verticauda* Arunachalam et al., 2015 | -- | -- |
| 37 | *A. waikhomi* Kosygin, 2012 | -- | -- |
| 38 | *Mustura dikrongensis* Lokeshwar and Viswanath, 2012 | -- | -- |
| 39 | *M. harkishori* Das and Darshan, 2019 | -- | -- |
| 40 | *M. walongensis* Tamang and Sinha, 2016 | -- | -- |
| | **Order : Siluriformes** | | |
| | **Family : Bagridae** | | |
| 41 | *Mystus prabini* Darsan et al., 2019 | -- | -- |

| | | | |
|---|---|---|---|
| | **Family : Amblycipitidae** | | |
| 42 | *Amblyceps arunachalensis* Nath & Dey, 1990 | EN | -- |
| 43 | *A. waikhomi* Darshan et al., 2016 | -- | -- |
| | *A. apangi* Nath and Dey, 1989 | LC | -- |
| | **Family : Sissoridae** | | |
| 44 | *Oreoglanis majusculus* Linthoiagambi & Vishwanath, 2011 | -- | -- |
| 45 | *O.pangenensis* Sinha & Tamang, 2015 | -- | -- |
| 46 | *Glypothorax dikrongensis* Tamang & Choudhury, 2011 | -- | -- |
| 47 | *G. mibangi* Darshan et al.,2015 | -- | -- |
| 48 | *G. pantherinus* Anganthoibi and Viswanath, 2013 | -- | -- |
| 49 | *G. pasighatensis* Kumar, 2016 | -- | -- |
| 50 | *Exostoma tenuicaudata* Tamang, Sinha & Gurumayum, 2015 | -- | -- |
| 51 | *E. kottkelati Darsan* et al., 2019 | -- | -- |
| 52 | *Creteuchilonglanis payjab* Darsan et al., 2014 | -- | -- |
| 53 | *C. kamengensis* (Jayram,1996) | DD | -- |
| 54 | *C. arunachalensis* Sinha and Tamang, 2014 | -- | -- |
| 55 | *C. tawangensis Darsan* et al., *2019* | -- | -- |
| 56 | *Pseudechansis sinerica* (Vishwanath & Darshan, 2007) | VU | -- |
| 57 | *Pseudolaguvia magna* Tamang & Sinha, 2014 | -- | -- |
| 58 | *P. jiyaensis* Tamang & Sinha, 2014 | -- | -- |
| 59 | *P. viriosa* (Ng & Tamang, 2012) | -- | -- |
| 60 | *Pterocryptis indicus* (Dutta, Barman and Jayram, 1987) | DD | |
| 61 | *Erethistoides senkhiensis* Tamang, Choudhury & Choudhury, 2008 | -- | -- |
| | **Order : Synbranchiformes** | | |
| | **Family: Synbranchidae** | | |
| 62 | *Monopterus hodgarti* (Choudhri, 1913) | DD | -- |
| | **Order : Perciformes** | | |
| | **Family : Chandidae** | | |
| 63 | *Parambassis bistigmata* Geetakumari, 2012 | -- | -- |
| | **Order : Anabantiformes** | | |
| | **Family : Badidae** | | |
| 64 | *Badis singenensis* Geetakumari & Kadu, 2011 | -- | -- |
| | **Family: Channidae** | | |
| 65 | *Channa melanostigma* Geetakumari & Vishwanath, 2010 | -- | -- |
| 66 | *C. pomanensis* Gurumayum and Tamang, 2016 | -- | -- |
| | **Family : Olyridae** | | |
| 67 | *Olyra parviocula* Kosygin, Shangningam and Gopi, 2018 | -- | -- |
| | **Class : Amphibia** | | |
| | **Order :Anura** | | |
| | **Family :Megophryidae** | | |
| 68 | *Megophrys ancrae* Mahony, Teeling and Biju, 2013 | -- | -- |

| | | | |
|---|---|---|---|
| 69 | *M. vegrandis* Mahony, Teeling and Biju, 2013 | -- | -- |
| 70 | *M. hymalayana* Mahony et al., 2018 | -- | -- |
| 71 | *M. periosa* Mahony et al., 2018 | -- | -- |
| | **Family : Microhylidae** | | |
| 72 | *Microhyla eos* Biju et al, 2019 | -- | |
| | **Family : Dicroglossidae** | | |
| 73 | *Nanorana arunachalensis* (Saikia, Sinha & Kharkongor, 2017) | -- | -- |
| | **Family : Rhacophoridae** | | |
| 74 | *Chiraomantis shyamrupus* (Chanda & Ghosh, 1985) | -- | -- |
| 75 | *Philautus sahai* (Sarkar and Roy, 2006) | -- | -- |
| 76 | *P. microdiscus* (Annandale, 1912) | -- | -- |
| 77 | *Philautaus argus* (Annandale, 1912) | -- | -- |
| 78 | *Rhacophorus subansiriensis* Methew & Sen, 2009 | -- | -- |
| 79 | *Polypedates subansiriensis* Methew & Sen, 2009 | -- | -- |
| | **Family: Ceratobatrachidae** | | |
| 80 | *Liurana himalayana* Saikia & Sinha, 2020 | -- | -- |
| 81 | *L. indica* Saikia & Sinha, 20119 | -- | -- |
| 82 | *L. minuta* Saikia & Sinha, 2019 | -- | -- |
| | **Order : Gymnophiona** | | |
| | **Family : Chikilidae** | | |
| 83 | *Chikila darlong* Kamei et al., 2013 | -- | -- |
| | **Class : Reptilia** | | |
| | **Order : Squamata** | | |
| | **Family : Gekkonidae** | | |
| 84 | *Cyrtodactylus arunachalensis* Mirza et al., 2021 | -- | -- |
| | **Family: Colubridae** | | |
| 85 | *Trachischium apteii* Apte, 2019 | -- | IV |
| 86 | *Smithophis arunachalensis* Das et al., 2019 | -- | IV |
| 87 | *Pareas kaduri* Bhosale et al.,2020 | -- | IV |
| | **Family : Viperidae** | | |
| 88 | *Trimeresurus arunachalensis* Captain et al., 2019 | -- | IV |
| | **Class : Aves** | | |
| | **Order : Galliformes** | | |
| | **Family : Phasianidae** | | |
| 89 | *Lophophorus scaleteri arunachalensis* (Kuma & Singh, 2003) | VU | I |
| | **Order: Passeriformes** | | |
| | **Family: Leiothrichidae** | | |
| 90 | *Liocichla bugunorum* Athreya, 2006 | CR | -- |
| 91 | *Actinodura waldeni daflaensis* Godwin-Austen, 1874 | LC | -- |
| 92 | *Actinodura egertoni lewisi* Ripley, 1948 | -- | -- |

| | | | |
|---|---|---|---|
| | **Family : Phylloscopidae** | | |
| 93 | *Seicercus xanthoschistos flavogularis* (Gray& Gray, 1846) | -- | -- |
| | **Family : Timaliidae** | | |
| 94 | *Spelaeornis badeigularis* Ripley, 1948 | VU | IV |
| | **Class : Mammalia** | | |
| | **Order: Rodentia** | | |
| | **Class : Sciuridae** | | |
| 95 | *Biswamoyopterus biswasi* Saha,1981 | CR | -- |
| 96 | *Petaurista mechukaensis* Choudhury, 2007 | DD | II |
| 97 | *P. mishmiensis* Choudhury, 2009 | DD | II |
| 98 | *P. siangensis* Choudhury, 2013 | DD | II |
| | **Family : Cricetidae** | | |
| 99 | *Eothenomys melanogaster libonotus* (Milin-Edwards,1871) | LC | IV |
| | **Family : Sciuridae** | | |
| | **Order : Primates** | | |
| | **Family: Cercopithecidae** | | |
| 100 | *Macaca munzala* Sinha et al., 2005 | EN | -- |
| | **Family : Hylobatidae** | | |
| 101 | *Hoolock hoolock mishmiensis* Choudhury, 2013 | EN | I |
| | **Order : Artiodactyla** | | |
| | **Family :Bovidae** | | |
| 102 | *Budorcas taxicolor* Hudgson,1850 | VU | I |

**Acknowledgement**

The authors are grateful to the Director, Zoological Survey of India, Kolkata and Officer-in-Charge, Arunachal Pradesh Regional Centre, ZSI, Itanagar for providing the necessary facilities.

**References**


- Bhosale, H. S., Gowande, G. G. & Mirza, Z. A. 2019. A new species of fossorial natricid snakes of the genus Trachischium Günther, 1858 (Serpentes: Natricidae) from the Himalayas of northeastern India. Comptes Rendus Biologies, 342(9-10): 323-329.
- Biju, S. D., S. Garg, R. G. Kamei, and G. Maheswaran. 2019. A new *Microhyla* species (Anura: Microhylidae) from riparian evergreen forest in the eastern Himalayan state of Arunachal Pradesh, India. *Zootaxa* 4674: 100–116.
- Captain, A. and Bhatt, B.B.2000. An interim checklist of the snakes of Arunachal Pradesh. The RFNEI newsletter, 3: 10-13.
- Captain, A., Deepak, V., Pandit, R., Bhatt, B. and Athreya, R. (2019). A New Species of Pitviper (Serpentes: Viperidae: *Trimeresurus* Lacepède, 1804) from West Kameng District, Arunachal Pradesh, India. *Russ. J. Herpetol*., **26** (2): 111-122.
- Chandra, K, Gupta, D, Gopi, K.C., Tripathy B, Kumar V, Mandal K, Kumar H and Saini J. 2018. Faunal Diversity of Indian Himalaya: An Overview.Chandra, K., Gupta, D., Gopi, K.C., Tripathy, B. and Kumar, V. (Eds). *Faunal Diversity of Indian Himalaya*: 1-44. (Published by Director, Zool. Surv. Ind., Kolkata).
- Chandra, K., Raghunathan, C. and Sheela, S. (2020). Animal Discoveries-2019: New Species and New Records. Pp-1-184 (Published by Director, Zool. Surv. Ind., Kolkata)
- Darlington, P. J.Jr. (1957). Zoogeography: the geographical distribution of animals. *Museum of Comparative Zoology*, Harvard University, 24pp.
- Das, A., Deepak, V., Captain, A., Wade, E. and Gower, D. J. (2020). Description of a new species of

*Smithophis* Giri *et al.* 2019 (Serpentes: Colubridae: Natricinae) from Arunachal Pradesh, India. *Zootaxa* **4860** (2): 267-283.

- De, J.K. and Maheswaran, G. (2013). Aves. Venkataraman, K.,Chattapodhay,A and Subramanian, K. A. ed. *Endemic Animals of India(Vertebrates). (Published by Director, Zool. Surv. Ind., Kolkata).*
- De, J.K. and Sarma, G. (2013). Mammals. Venkataraman, K.,Chattapodhay,A and Subramanian, K. A. ed. *Endemic Animals of India(Vertebrates). (Published by Director, Zool. Surv. Ind., Kolkata).pp 229-238.*
- Dinesh, K.P., Radhakrishnan, C., Channakeshavamurthy, B.H., Deepak, P. And Kulkarani, N.U.(2020). A Checklist of amphibians of India with IUCN conservation status., updated till September,201, http://zsi.gov.in//Checklist//Amphibia_Checklist.pdf//
- Foissner, W (2005). Two new "flagship" ciliates (Protozoa, Ciliophora) from Venezuela: Sleighophrys pustulata and Luporinophrys micelae. *European Journal of Protistology, 41: 99-117.*
- Foissner, W and Stoeck, T. (2006). Rigidothrix goiseri nov gen., nov spec. (Rigidotrichidae nov fam.), a new "flagship" ciliate from the Niger floodplain breaks the flexibility-dogma in the classification of stichotrichine spirotrichs (Ciliophora, Spirotrichea). *European Journal of Protistology, 42: 249-267.*
- Frost, D. R. (2020). Amphibian Species of the World: an online reference. Version 6.1 (04.01.2021). Electronic Database accessible at https://amphibiansoftheworld.amnh.org/index.php. American Museum of Natural History, New York, USA.
- Jayaram, K. C. (1999). *The Fresh Water Fishes of the Indian Region*. Pp-1-551. Narender Publishing House, New Delhi.
- Lepage, D. (2021). Checklist of the Birds of Arunachal Pradesh. Avibase, the world bird database. Retrieved from https://avibase.bsc-eoc.org/checklist.jsp (07/01/2021)
- Mahony, S., Kamei, R.G., Teeling, E.C., and Biju, S.D. (2018).Cryptic diversity within the Megophrys major species group (Amphibia- Megophryidae) of Asian Horned Frogs: Phylogenetic perspectives and a taxonomic revision of South Asian taxa, with descriptions of four new species. *Zootaxa*, 4523: 1-96
- Mishra, S.S., Kosygin, L., Rajan P.T. and Gopi., K.C. (2013). Pisecs. Venkataraman, K.,Chattapodhay,A and Subramanian, K. A. ed. *Endemic Animals of India(Vertebrates). (Published by Director, Zool. Surv. Ind., Kolkata).pp 6-106*
- Myers, N., Mittermeier, R. A., Mittermeier, C.G., de Fonseca, G.A.B. and Kent, J. 2000. Biodiversity hotspots for conservation priorities. Nature, 403: 853-858.
- Myers, N., Mittermeier, R. A., Mittermeier, C.G., de Fonseca, G.A.B. and Kent, J. 2000. Biodiversity hotspots for conservation priorities. Nature, 403: 853-858.
- Ohler, A., Borah, M.M., Das, M.K., Tesia, C. and Bordoloi, S., (2018). A study on amphibian fauna of Arunachal Pradesh (India), *Alytes*,36(1-4): 276-288
- Saikia, B., and B. Sinha. (2019). On the *Liurana* (Anura: Ceratobatrachidae) of India with the description of three new species from Tale Valley Wildlife Sanctuary in Arunachal Pradesh, eastern Himalayas. *Records of the (Published by Director, Zool. Surv. Ind., Kolkata),* **119**: 303–315
- Saikia, B., B. Sinha, and I. J. Kharkongor. (2017). *Odorrana arunachalensis*: A new species of Cascade Frog (Anura: Ranidae) from Talle Valley Wildlife Sanctuary, Arunachal Pradesh, India. *Journal of Bioresources*, 4: 30–41.
- Sarma, D., Singh, A. K. and Baruah, D. (2018). Checklist of endemic ichthyofauna of North-east India. *Indian J. Fish.,* **65(3):**1-15
- Uetz, P., Freed, P. & Hošek, J. (eds.) (2020) The Reptile Database, http://www.reptile-database.org, accessed [04.01.2021]
- Venkataraman, K.(2013). Prologue.Venkataraman, K.,Chattapodhay,A and Subramanian, K. A. ed. *Endemic Animals of India(Vertebrates). (Published by Director, Zool. Surv. Ind., Kolkata).pp1-5*
- Wilson, D. E. and M. Reeder, D. A. M (editors). (2005). Mammal Species of the World. A Taxonomic and Geographic Reference (3rd ed), Johns Hopkins University Press, 2,142 pp.

# Rare sighing of Hepatic Morph of Grey-bellied Cuckoo *Cacomantis passerines* in Daundaj village, Taluka Purandar, Pune, Maharashtra

**Rahul Lonkar, Rajkumar Pawar and Satish Pande**
**(Email: rahul_nisarga@rediffmail.com )**

**Citation: Lonkar Rahul, Pawar Rajkumar and Pande Satish.** Rare sighing of Hepatic Morph of Grey-bellied Cuckoo *Cacomantis passerines* in Daundaj village, Taluka Purandar, Pune, Maharashtra.
*Ela Journal of Forestry and Wildlife*
*Vol.10 (1): 918*

**Date of Publication:**
31 March 2021

ISSN 2319-4361

- **Name of Species:** Grey-bellied Cuckoo
- **Scientific Name:** *Cacomantis passerinus*
- **Status:** Least concern, ICUN 2012
- **Date of sighting:** 30th September 2017
- **Time of sighting:** 10.27 AM
- **Weather:** Cloudy
- **Number of times sighted:** Once
- **Number of birds:** Single
- **Gender of bird:** Female
- **Locality:** Malharnagar, Daundaj, Tal. Purandar, District Pune, Maharashtra
- **Habitat description:** Agricultural cropland.
- **Distance from human habitation:-1 km**.
- **Any other bird/animal associates:** Ashy Prinia *Prinia socialis*, Large Grey Babbler *Turdoides malcolmi* and Baya Weaver *Ploceus philippinus*
- **Bird Behaviour: -** A hepatic morph of Grey-bellied Cuckoo was seen perching on bamboo sticks in agricultural cropland incessantly calling. The call attracted our attention.
- **Threats to the habitat:** Habitat modification and spraying of insecticides and weedicides.
- **Photographs: -** Attached.
- **Previous records: -** No documented record of hepatic morph of female Grey-bellied Cuckoo from the locality.

## Panel of Experts/Referees for Ela Journal of Forestry and Wildlife

| S. No. | Name & Designation | Area of Specialization | Address | Telephone No. | Email |
|---|---|---|---|---|---|
| 1 | **Dr. Satish A. Pande**<br>Professor<br>Chief Editor | Ornithology, Medicine | C-9, Bhosale Park, Sahakarnagar No. 2<br>Pune 411009 | +91-020-9822193707 | Pande.satish@gmail.com |
| 2 | **Jeet Singh**<br>APCCF | Forestry | APCCF-RET, Vanbhavan, Pune | +91-020-9422271814 | virk1962@rediffmail.com |
| 3 | **Reuven Yosef**<br>Professor | Ornithology, Ecology | Ben Gurion University of the Negev, Eilat Campus<br>P. O. Box 272<br>Eilat 88106, ISRAEL | +972 53 7671290 | ryosef60@gmail.com |
| 4 | **Dr. N.R. Karmalkar**<br>Prof. & Vice Chancellor | Geology & Environmental Sciences | Savitribai Phule Pune University (formerly University of Pune),<br>Ganeshkhind, Pune-411007 | +91-020-25693868<br>9823011747 | nrkarmalkar@gmail.com |
| 5 | **Dr. Kalpana Pai**<br>Professor | Biodiversity & Zooplankton ecology | Centre of Advanced Study, Department of Zoology, Savitribai Phule Pune University (formerly University of Pune),<br>Ganeshkhind<br>Pune-411007 | +91-020-25601436<br>9850936759 | kalpanapai@unipune.ac.in<br>drkalpanapai@gmail.com |
| 6 | **Dr. N.P. Gramapurohit**<br>Associate Professor | Behavioural ecology of Amphibians | Centre of Advanced Study, Department of Zoology, Savitribai Phule Pune University (formerly University of Pune),<br>Ganeshkhind<br>Pune-411007 | +91-020-25601436 | naraharipg@gmail.com |
| 7 | **Dr. Ramesh D. Gulati**<br>Emeritus Guest Scientist | Limnology Aquatic Ecology | Department of Aquatic Ecology,<br>NIOO/Netherlands Institute of Ecology,<br>6708 PB Wageningen<br>The Netherlands | +31.317473550 | R.Gulati@nioo.knaw.nl |
| 8 | **Dr. Aswini Pai**<br>Associate Professor and Co-Chair | Ethnobotanist and plant ecologist | Biology<br>Johnson Hall of Science, Room 227<br>St. Lawrence University<br>23 Romoda Drive,<br>Canton, NY 13617, USA | +001-(315) 229-5810<br>800-285-1856 | apai@stlawu.edu \| |

| S. No. | Name & Designation | Area of Specialization | Address | Telephone No. | Email |
|---|---|---|---|---|---|
| 9 | **Dr. Yogesh Shouche** Scientist 'G' | Microbial ecology, Microbial molecular taxonomy and biodiversity | National Centre for Microbial Resource, National Centre for Cell Science, Ganeshkhind Pune-411007 | +91-020-25329027 | yogesh@nccs.res.in |
| 10 | **Dr. Uma Shaanker** Professor in the Department of Agriculture and Life Sciences, Ashoka University, India. | Biodiversity, Endophytes, Plant Evolutionary Biology, Conservation Genetics, Bio-prospecting | R. Uma Shaanker Department of Crop Physiology, University of Agricultural Sciences Bangalore, India | +91- 080-23636713 | umashaanker@gmail.com rus@vsnl.com |
| 11 | **Suruchi Pande** Head, Dept. Of Ethno-Ornithology, OENSL -Ela Foundation & MES, A.G.College Campus | Ethno-Ornithology | C-9, Bhosale Park, Sahakarnagar No. 2 Pune 411009 | +91-020-9881144651 | suruchipande@gmail.com |
| 12 | **Gombobaatar Sundev** Professor, Department of Biology, National University of Mongolia | Ornithology Taxonomy | Director, Mongolian Ornithological Society P.O.Box 537, Ulaanbaatar 210646A, Ikh surguuli gudamj-1, Ulaanbaatar, MONGOLIA. Tel: Fax: 976-11-320159 E-mail | 976-99180148; 976-90112244 (mob.); 976-11-323970 (off.) | info@mos.mn; gomboo@num.edu.mn |
| 13 | **Hemant Ghate** Professor | Entomology | Prof. Emiritus, Department of Zoology, Modern College of Arts, Science and Commerce, Off J.M. Road, Pune, 411005 | +91-020-9960629667 | hemantghate@gmail.com |

Ela Foundation is a non-government registered charity devoted to nature education and conservation.
EJFW was preceded by Newsletter since 2012.

# TABLE OF CONTENTS



**Cover Photograph:**
Crested Hawk-Eagle
(Photograph: Pramod Deshpande)






ISSN 2319 - 2461
Journal for Private Circulation only




**You can contribute to conservation :**
**Please send your reports and research papers to the Editor EJFW (pande.satish@gmail.com)**
**Ela Foundation**
**Nature Conservation through Education and Research**