Ela Foundation

# Ela Journal of Forestry and Wildlife

ISSN 2319-4361
(Indexed in Google Scholar)
Volume 11 | Issue 3
July - September 2022

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

**Listed in UGC- CARE**

# Vegetation Along The Roadway To A Tourist Destination: Aliyar To Valparai

**Ajayla Karthika T *1 And C. Ravichandran 2**

*1Department of Environmental Sciences, Bishop Heber College, (Affiliated to Bharathidasan University), Tiruchirappalli, Tamil Nadu, India (ajaylastanite@gmail.com)

[2]Department of Environmental Sciences, Bishop Heber College, (Affiliated to Bharathidasan University), Tiruchirappalli, Tamil Nadu, India (ravichandran.es@bhc.edu.in), ORCID: 0000-0002-9105-4893

**Citation:** Karthika Ajayla T. and Ravichandran C. Vegetation along the roadway to a tourist destination: Aliyar to Valparai
*Ela Journal of Forestry and Wildlife*
11 (3): 1277-1289

**Date of Publication:** 30 September 2022

ISSN 2319-4361



**Abstract**

The study was undertaken in order to emphasize the diversity of vegetation present along the main roadway, State Highway (SH 78) to Valparai, a tourist area, in spite of the threats posed due to vehicular pollution, physical damage as well as infrastructure development. Valparai is known for its scenic beauty and tea plantations, the vast faunal and floral diversity that attracts tourists from all over the country for bird watching, trekking, biking, sight-seeing and also a holiday spot for a road trips. The Wildlife Sanctuary which is a part of the Anamalai Tiger Reserve harbors a huge number of fauna and flora. This paper lists the various types of flora, along the route including the endemic species of the Western Ghats that can be lost if not conserved. A total of 136 species of flora were identified along the State Highway SH 78 from Aliyar to Valparai, of which 51 are herbs, 4 are terrestrial herbs, 5 are epiphytic herbs, 31 climbers, 21 shrubs and 24 are trees. Among these, there are 26 endemic species of herbs, 4 endemic species of climbers, 11 endemic species of shrubs and 7 endemic species of trees. 1 climber and 1 epiphytic herb species, was identified to belong to the critically endangered category. However, the major threats can be avoided with increased awareness and better tourism and forest management plans.

**Keywords**

Valparai, Vegetation, threats, endemic species, Roadway

## Introduction

The Western Ghats traverse the States of Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra and Gujarat. These mountains cover an area of around 140,000 km² in a 1,600 km long stretch that is interrupted only by

the 30 km Palghat Gap at around 11°N (whc.unesco.org). The Southern states of India namely Kerala and Tamil Nadu have the Western Ghats which is a major biodiversity hotspot. The Southern Western Ghats (SWG) cover an area of 7000km$^2$ through the states of Kerala and Tamil Nadu and harbour a very rich floral and faunal biodiversity (www.wwfindia.org). The central Western Ghats passing through the state of Karnataka is blessed with a good percentage of this biodiversity hotspot and has a rich natural resource. The central Western Ghats encompasses the districts of Uttara Kannada, Shimoga, Chikmagalur, Hassan, Kodagu and parts of Dakshina Kannada (Ramachandra et al, 2012). The northern Western Ghats comprises of the western stretch of Maharashtra, ending just south of the Kutch peninsula of Gujarat (Khare, 2017).

Valparai, located in Tamil Nadu, being one of the tourist attractions, is a hill station located in the South Western Ghats. This place lies amidst a rich vegetation of endemic flora as well as crops. The richness of the flora contributes to the rich diversity of birds and other fauna. Plantation crops in the region include tea, coffee, and fragmentary plantations of eucalyptus, pepper and cardamom, which are a result of anthropogenic activities that has led to the loss of many endemic flora.

Tropical forests harbor over 50% of global biodiversity and constitute among the largest terrestrial reservoirs of carbon (Pimm et al. 1995, Bonan 2008). Tiger reserves are protected areas and they are the important media of conservation throughout the globe, and tourism is the only window through which the public can access the protected area. This however has a broad range of downsides where the resources suffer negative impacts. Impacts of human activities of entertainment such as hiking, trekking, bird watching, rides include decrease in biodiversity, and also biomass of sensitive species. (Roe et al, 1997). It can also be a cause for increase in more tolerant exotic species which are considered as weeds and invasive species to the native environment. Tourist activities can cause seed dispersal of invasive species and also reduce the propagation of sensitive and endemic species.(K. Lukacs and O. Valko, 2021).

Habitat corridors have a great impact on the ecosystem. Disturbances to habita t corridors include railway lines, roads, cleared transmission lines and other features that result from sustained disturbance within a linear strip. The connecting feature is a line of disturbed land that differs from the surroundings (Bennett, 1999). In fragmented tropical forests, multiple abiotic and biotic factors act as barriers to natural recovery and can result in the persistence of species-poor ecosystems (Tabarelli et al., 2008).

The forest fragments, important as biodiversity refuges and animal corridors, have been affected by habitat degradation and fragmentation, while other threats such as roads, monoculture plantations, invasive alien species and unsustainable tourism impact fragments as well as continuous forest tracts in ATR (Mudappa et al, 2014). Plants are the most important asset of any protected area, as they are the source of food and shelter to the other biotic entities of the forest. Several invertebrates are also affected when there is a negative impact on the vegetation of any region. (Jakobsson et al., 2018)

Tourists to Valparai and the locals commute only by road, which is a State Highway. Though the expansion of roads help in the control of traffic, it poses a serious threat to the flora that are found along the sides of the road, which are not only trees, but also other smaller species like herbs and climbers which can be of great importance to the ecosystem. The region which houses numerous endemic species, has been suffering a lot of environmental pressure wherein loss of such species is to be addressed with care.

The study was undertaken to record the vegetation along the State Highway 78 that leads to Valparai, thereby to provide an insight of the status of various species present at the vicinity.

**Methods**

A field survey was undertaken along the State Highway (SH 78), which is the roadway from Aliyar (10$^o$48’ N, 76$^o$96’ E) to Valparai (10$^o$32’ N, 76$^o$96’ E). The plant species including trees, shrubs, epiphytes, climbers and herbs found at the vicinity were considered for the study. The vegetation apart from the plantation crops like tea, coffee and eucalyptus and other weeds, were identified and listed down by random sampling. Samples such as leaves and twigs of few plants were collected. The plants were identified using online databases, consultation with experts and botanists in the Forest Department and using reference books, such as Flora of the Presidency of Madras by J S Gamble. The IUCN Red List category was obtained by referring the Red Data book of Indian Plants

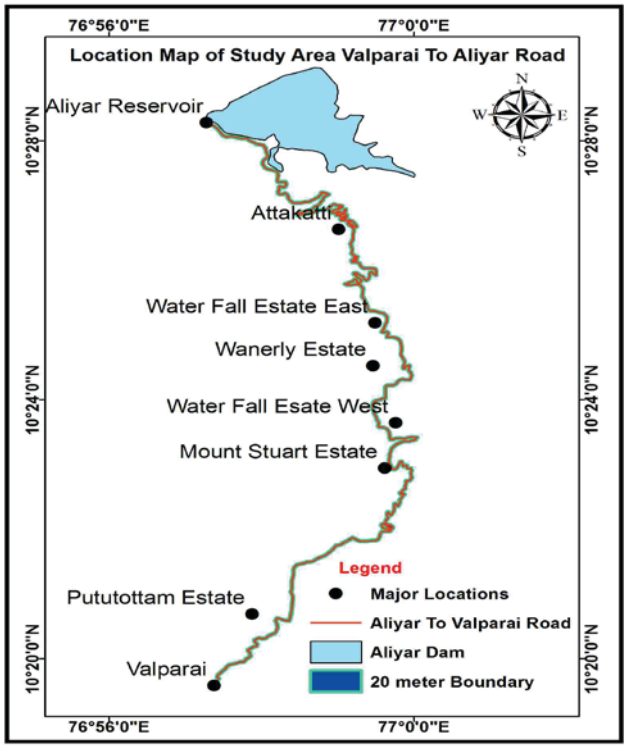



**Figure: 1**

published by the Botanical Survey of India and the online databases like iucnredlist.org.

The map shows the route from Aliyar to Valparai which is the study area.

## RESULTS AND DISCUSSION

The tables show a list of plants identified in the study area. It includes herbs, epiphytic herbs, terrestrial herbs, climbers, shrubs and trees. Herbs are at a greater risk of being trampled on, while trees can mostly strive in such stress.

**Table: 1: LIST OF HERBS**

| S. No. | Botanical Name | Family | Habit | Ecological status |
|---|---|---|---|---|
| 1 | *Blepharis maderaspatensis* (L.) Heyne ex Roth | Acanthaceae | Herb | Common |
| 2 | *Justicia glauca* Rottl., | Acanthaceae | Herb | Common |
| 3 | *Justicia japonica* Thunb., | Acanthaceae | Herb | Common |
| 4 | *Rhinacanthus nasutus* (L.) Kuntze | Acanthaceae | Herb | Common |
| 5 | *Rungia repens* (L.) Nees | Acanthaceae | Herb | Common |
| 6 | *Asystasia dalzelliana* Sant. | Acanthaceae | Herb | E(SW) |
| 7 | *Barleria courtallica* Nees. | Acanthaceae | Herb | E(SW) |
| 8 | *Pancratium triflorum* Roxb. | Amaryllidaceae | Herb | Common |
| 9 | *Bidens pilosa* L. | Asteraceae | Herb | Common |
| 10 | *Blumea alata* (D.Don) DC. | Asteraceae | Herb | Common |
| 11 | *Impatiens balsamina* L. | Balsaminaceae | Herb | Common |
| 12 | *Impatiens cuspidata* Wight. | Balsaminaceae | Herb | E (SW) |
| 13 | *Impatiens disotis* Hook. f. | Balsaminaceae | Herb | E (SW) |
| 14 | *Impatiens campanulata* Wight. | Balsaminaceae | Herb | E (W) |
| 15 | *Impatiens cordata* Wight. | Balsaminaceae | Herb | E (W) |

R – Rare; W – Western Ghats.

| | | | | |
|---|---|---|---|---|
| 16 | *Impatiens elegans* Bedd. | Balsaminaceae | Herb | E (W) |
| 17 | *Impatiens goughi* Wight. | Balsaminaceae | Herb | E (W) |
| 18 | *Impatiens maculata* Wight. | Balsaminaceae | Herb | E (W) |
| 19 | *Impatiens chinensis* L. | Balsaminaceae | Herb | E/LC (W) |
| 20 | *Impatiens dasysperma* Wight. | Balsaminaceae | Herb | E/VU |
| 21 | *Begonia malabarica* Lam. | Begoniaceae | Herb | Common |
| 22 | *Begonia roxburghii* A.DC. | Begoniaceae | Herb | Common |
| 23 | *Cyanotis cerifolia* Rao & Kammathy | Commelinaceae | Herb | E(SW) |
| 24 | *Cyanotis burmanniana* Wight | Commelinaceae | Herb | E(W)/VU |
| 25 | *Drosera burmannii* Vahl. | Droseraceae | Herb | E(SW) |
| 26 | *Desmodium repandum* (Vahl) DC. | Fabaceae | Herb | Common |
| 27 | *Flemingia nilgheriensis* (Baker) Wight ex Cooke | Fabaceae | Herb | E(SW) |
| 28 | *Smithia gracilis* Benth. | Fabaceae | Herb | E(SW) |
| 29 | *Smithia hirsuta* Dalz. | Fabaceae | Herb | E(SW) |
| 30 | *Mimosa pudica* L. | Fabaceae | Herb | LC |
| 31 | *Smithia sensitiva* Aiton | Fabaceae | Herb | LC |
| 32 | *Gentiana pedicellata* wightii Kuzn. | Gentianeceae | Herb | Common |
| 33 | *Curculigo orchioides* Gaertn. | Hypoxidaceae | Herb | Common |
| 34 | *Leucas biflora* (Vahl) R. Br., | Lamiaceae | Herb | Common |
| 35 | *Leucas chinensis* (Retz.) R. Br., | Lamiaceae | Herb | Common |
| 36 | *Orthosiphon thymiflorus* (Roth) Sleesen | Lamiaceae | Herb | Common |
| 37 | *Plectranthus mollis (*Aiton*)* Spreng. | Lamiaceae | Herb | Common |
| 38 | *Scutellaria wightiana* Benth. | Lamiaceae | Herb | E(PI) |
| 39 | *Gomphostemma eriocarpon* Benth. | Lamiaceae | Herb | E(SW) |
| 40 | *Isodon wightii* (Benth.) H.Hara | Lamiaceae | Herb | E(W) |
| 41 | *Lindernia parviflora* (Roxb.) Haines | Linderniaceae | Herb | LC |
| 42 | *Osbeckia brachystemon* Naud., | Melastomataceae | Herb | E(SW) |
| 43 | *Sonerila barnesii* C.E.C. Fischer | Melastomataceae | Herb | E(SW) |
| 44 | *Biophytum sensitivum* (L.) DC. | Oxalidaceae | Herb | Common |
| 45 | *Ophiorrhiza mungos* L. | Rubiaceae | Herb | Common |
| 46 | *Ophiorrhiza barberi* Gamble | Rubiaceae | Herb | E(SW) |
| 47 | *Ophiorrhiza barnesii* C.E.C.Fisch. | Rubiaceae | Herb | E(SW) |
| 48 | *Ophiorrhiza brunonis* Wight & Arn. | Rubiaceae | Herb | E(SW) |
| 49 | *Hedychium coronarium* J.Koenig | Zingiberaceae | Herb | Common |
| 50 | *Hedychium flavescens* Carey ex Rosc. | Zingiberaceae | Herb | Common |
| 51 | *Amomum muricatum* Bedd. | Zingiberaceae | Herb | E(SW) |

**Key for the Table: E – Endangered; LC – Least Concern; SW – South Western Ghats; PI – Peninsular India; CR – Critically Endangered; VU – Vulnerable;**

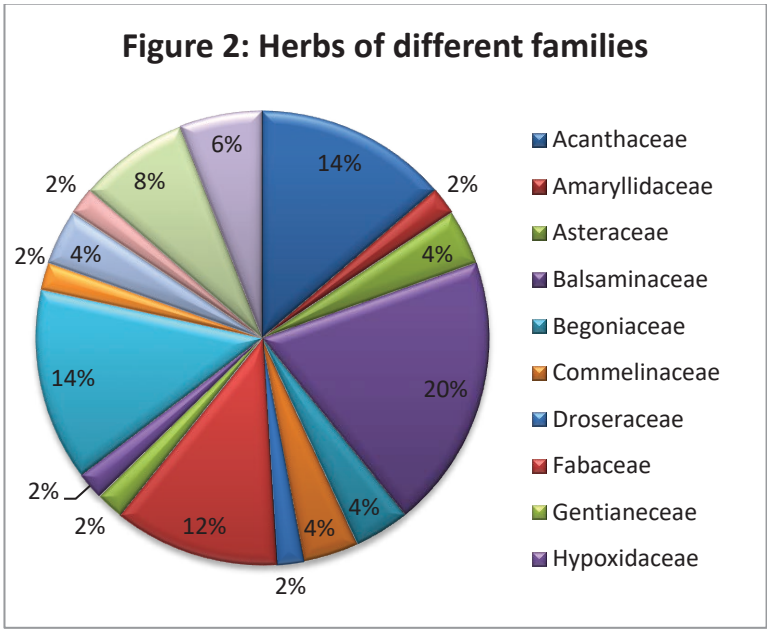



**Table: 2: LIST OF TERRESTRIAL HERBS**

| S. No. | Botanical Name | Family | Habit | Ecological status |
|---|---|---|---|---|
| 1 | *Zeuxine gracilis* (Breda) Blume | Orchidaceae | Terrestrial herb | Common |
| 2 | *Peristylus spiralis* A.Rich. | Orchidaceae | Terrestrial herb | Common |
| 3 | *Malaxis versicolor* (Lindl.) Abeyw. | Orchidaceae | Terrestrial herb | Common |
| 4 | *Habenaria longicorniculata* J.Graham | Orchidaceae | Terrestrial herb | Common |

**Table: 3: LIST OF EPIPHYTIC HERBS**

| S. No. | Botanical Name | Family | Habit | Ecological status |
|---|---|---|---|---|
| 1 | *Luisia birchea* Blume | Orchidaceae | Epiphytic herb | Common |
| 2 | *Xenikophyton smeeanum* (Rchb.f.) Garay | Orchidaceae | Epiphytic herb | E(SW) |
| 3 | *Oberonia swaminathanii* Ratheesh, Manudev & Sujanapal | Orchidaceae | Epiphytic herb | E(SW) |
| 4 | *Oberonia chandrasekharanii* Nair et al. | Orchidaceae | Epiphytic herb | E(SW)/CR |
| 5 | *Vanda tessellata* (Roxb.) Hook. ex G.Don | Orchidaceae | Epiphytic herb | LC |

**Key for the Table:**
**E – Endangered; LC – Least Concern; SW – South Western Ghats; CR – Critically Endangered**

**Table: 4: LIST OF CLIMBERS**

| S. No. | Botanical Name | Family | Habit | Ecological status |
|---|---|---|---|---|
| 1 | *Alstonia scholaris* (L.) R. Br. | Apocynaceae | Climber | Common |
| 2 | *Chonemorpha fragrans (*Moon*)* Alst. | Apocynaceae | Climber | Common |
| 3 | *Cryptolepis buchananii* Roem. & Schult. | Apocynaceae | Climber | Common |
| 4 | *Hemidesmus indicus* (L.) R. Br. | Apocynaceae | Climber | Common |
| 5 | *Sarcostemma acidum* (Roxb.) Voigt | Apocynaceae | Climber | Common |
| 6 | *Sarcostemma brunonianum* Wight & Arn. in Wight | Apocynaceae | Climber | Common |
| 7 | *Tylophora indica* (Burm. f.) Merr. | Apocynaceae | Climber | Common |
| 8 | *Ceropegia intermedia* Wight. | Apocynaceae | Climber | E(SW) |
| 9 | *Gymnema sylvestre* (Retz.) R. Br. ex Schult | Apocynaceae | Climber | EN |
| 10 | *Aristolochia tagala* Cham. | Aristolochiaceae | Climber | Common |
| 11 | *Argyreia elliptica* (Roth) Choisy | Convolvulaceae | Climber | Common |
| 12 | *Ipomoea alba* L. | Convolvulaceae | Climber | Common |
| 13 | *Ipomoea barlerioides* (Choisy) C. B. Cl. | Convolvulaceae | Climber | Common |
| 14 | *Ipomoea batatas* (L.) Lam. | Convolvulaceae | Climber | Common |
| 15 | *Ipomoea cairica (*L.*)* Sweet | Convolvulaceae | Climber | Common |
| 16 | *Ipomoea nil* (L.) Roth | Convolvulaceae | Climber | Common |
| 17 | *Ipomoea obscura (*L.*)* Ker Gawler | Convolvulaceae | Climber | Common |
| 18 | *Ipomoea pes-tigridis* L. | Convolvulaceae | Climber | Common |
| 19 | *Trichosanthes anaimalaiensis* Bedd. | Cucurbitaceae | Climber | E(SW) |
| 20 | *Dioscorea tomentosa* Koenig ex Spreng. | Dioscoriaceae | Climber | Common |
| 21 | *Mucuna hirsuta* Wight *&* Arn. | Fabaceae | Climber | Common |
| 22 | *Mucuna monosperma* Wight | Fabaceae | Climber | Common |
| 23 | *Vigna vexillata* (L.)A.Rich. | Fabaceae | Climber | Common |
| 24 | *Gloriosa superba* L., | Liliaceae | Climber | LC |
| 25 | *Cyclea peltata* (Lam.) Hook. f. & Thoms. | Menispermaceae | Climber | Common |
| 26 | *Ficus laevis* Blume var. *macrocarpa* (Miq.) Corner | Moraceae | Climber | E(SW)/R |
| 27 | *Jasminum malabaricum* Wight | Oleaceae | Climber | E(W) |
| 28 | *Clematis gouriana* Roxb. ex DC. | Ranunculaceae | Climber | Common |
| 29 | *Rubus ellipticus* Sm. | Rosaceae | Climber | Common |
| 30 | *Rubus niveus* Thunb. | Rosaceae | Climber | Common |
| 31 | *Rubia cordifolia* L. | Rubiaceae | Climber | Common |

**Key for the Table:**
**E – Endangered; LC – Least Concern; SW – South Western Ghats; CR – Critically Endangered; W – Western Ghats; R – Rare**

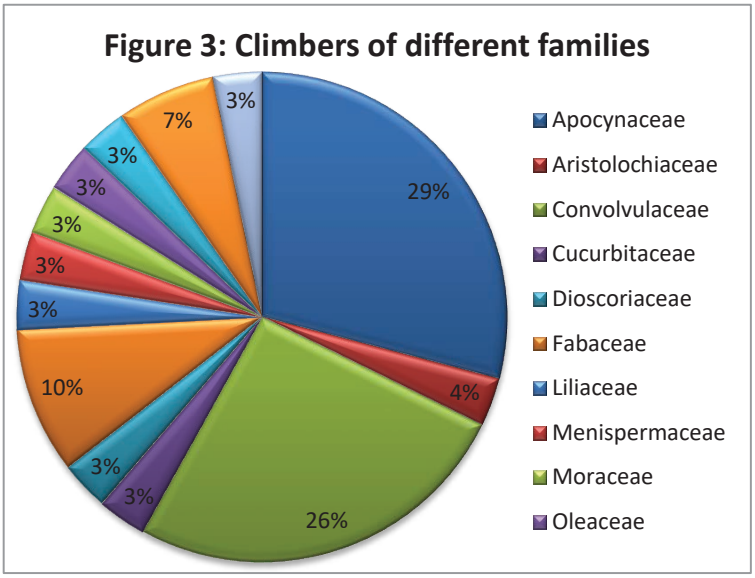



**Table: 5: LIST OF SHRUBS**

| S. No. | Botanical Name | Family | Habit | Ecological status |
|---|---|---|---|---|
| 1 | *Barleria mysorensis* Heyne. | Acanthaceae | Shrub | Common |
| 2 | *Strobilanthes consanguineous* (Nees) Clarke. | Acanthaceae | Shrub | E(P) |
| 3 | *Barleria buxifolia* L. | Acanthaceae | Shrub | E(PI) |
| 4 | *Dicliptera cuneata* Nees | Acanthaceae | Shrub | E(PI) |
| 5 | *Strobilanthes gracilis*Bedd. | Acanthaceae | Shrub | E(SW) |
| 6 | *Argyreia cuneata* Willd. ex Ker-Gawl. | Convolvulaceae | Shrub | E(SW) |
| 7 | *Senna occidentalis* (L.)Link | Fabaceae | Shrub | Common |
| 8 | *Crotalaria heyneana* Graham ex Wight & Arn., | Fabaceae | Shrub | E(SW) |
| 9 | *Crotalaria grahamiana* Wight & Arn. | Fabaceae | Shrub | E(SW)/EN |
| 10 | *Crotalaria micans* Link | Fabaceae | Shrub | LC |
| 11 | *Hypericum mysorense* Heyne | Hypericaceae | Shrub | Common |
| 12 | *Pogostemon benghalensis* (Burm. f.) O. Ktze. | Lamiaceae | Shrub | Common |
| 13 | *Osbeckia aspera* (L.) Blume | Melastomataceae | Shrub | Common |
| 14 | *Medinilla beddomei* C. B. Clarke | Melastomataceae | Shrub | E(SW) |
| 15 | *Hedyotis swertioides* Hook. f. | Rubiaceae | Shrub | Common |
| 16 | *Pavetta indica* L. | Rubiaceae | Shrub | Common |
| 17 | *Psychotria nilgiriensis* Deb & M.G.Gangop. | Rubiaceae | Shrub | Common |
| 18 | *Mussaenda frondosa* L. | Rubiaceae | Shrub | E(PI) |
| 19 | *Hedyotis articularis* R. Br. ex Wight & Arn. | Rubiaceae | Shrub | E(SW) |
| 20 | *Lasianthus ciliatus* Wight | Rubiaceae | Shrub | E(SW)/VU |
| 21 | *Grewia rhamnifolia* Heyne ex Roxb. | Tiliaceae | Shrub | Common |

**Key for the Table:**
**E – Endangered; LC – Least Concern; SW – South Western Ghats; PI – Peninsular India; CR – Critically Endangered; VU – Vulnerable**

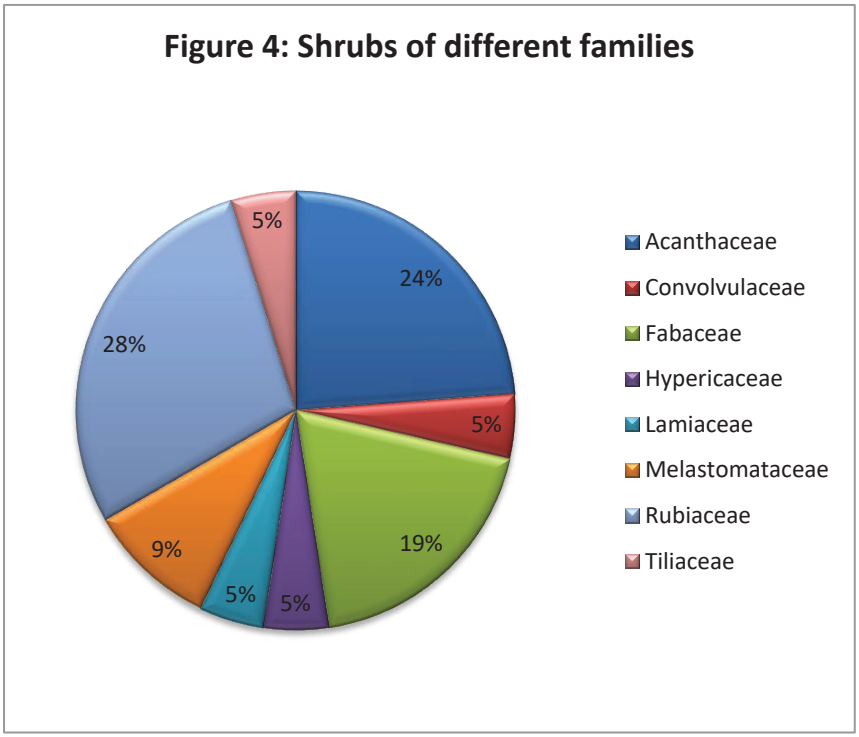
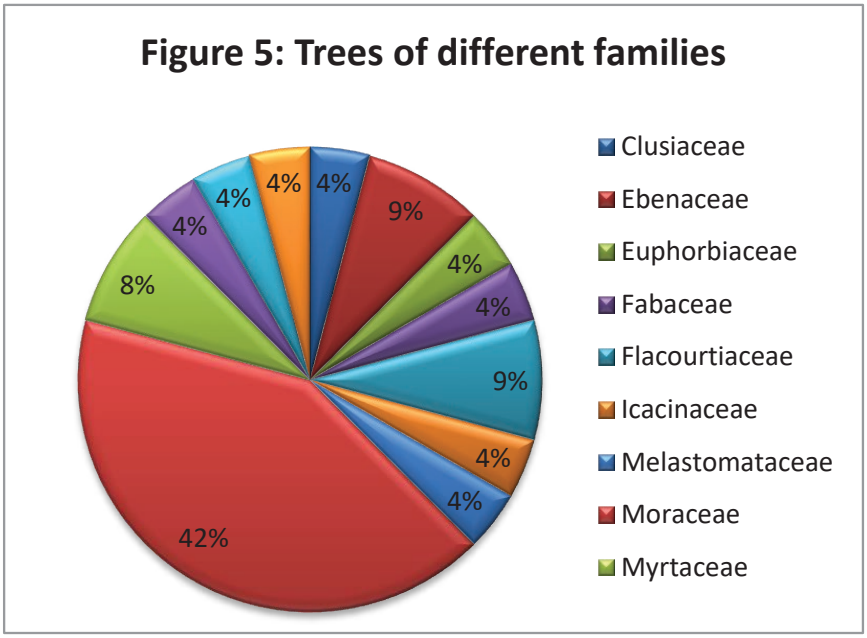



**Table: 6: LIST OF TREES**

| S. No. | Botanical Name | Family | Habit | Ecological status |
|---|---|---|---|---|
| 1 | *Garcinia morella* (Gaertn.) Desv. in Lam. | Clusiaceae | Tree | Common |
| 2 | *Diospyros insignis* Thwaites | Ebenaceae | Tree | Common |
| 3 | *Diospyros barberi* Ramaswami | Ebenaceae | Tree | E(SW)/VU |
| 4 | *Phyllanthus anamalayanus* (Gamble) G.L.Webster | Euphorbiaceae | Tree | CR |
| 5 | *Xylia xylocarpa* (Roxb.)Taub. | Fabaceae | Tree | LC |
| 6 | *Hydnocarpus alpina* Wight | Flacourtiaceae | Tree | Common |
| 7 | *Hydnocarpus macrocarpa* (Bedd.) Warb. | Flacourtiaceae | Tree | Common |
| 8 | *Nothapodytes nimmoniana* (J. Grah.) D.J. Mabberley | Icacinaceae | Tree | Common |
| 9 | *Memecylon umbellatum* Burm. f. | Melastomataceae | Tree | Common |
| 10 | *Ficus callosa* Willd. | Moraceae | Tree | Common |
| 11 | *Ficus drupacea* Thunb. | Moraceae | Tree | Common |
| 12 | *Ficus elastica* Roxb. ex Hornem. | Moraceae | Tree | Common |
| 13 | *Ficus exasperata* Vahl | Moraceae | Tree | Common |

| | | | | |
|---|---|---|---|---|
| 14 | *Ficus hispida* L. f. | Moraceae | Tree | Common |
| 15 | *Ficus microcarpa* L. f. | Moraceae | Tree | Common |
| 16 | *Ficus anamalayana* J.V. Sudhakar & G.V.S. Murthy | Moraceae | Tree | E(SW) |
| 17 | *Ficus beddomei* King | Moraceae | Tree | E(SW) |
| 18 | *Ficus dalhousiae* Miq. | Moraceae | Tree | E(SW) |
| 19 | *Ficus guttata* Kurz ex Hook.f. | Moraceae | Tree | E(SW) |
| 20 | *Syzygium hemisphericum* (Wt.) Alston | Myrtaceae | Tree | E(SW)/LC |
| 21 | *Syzygium laetum* (Buch.-Ham.) Gandhi | Myrtaceae | Tree | E(SW)/LC |
| 22 | *Sapindus emarginatus* Vahl | Sapindaceae | Tree | Common |
| 23 | *Grewia serrulata* DC | Tiliaceae | Tree | Common |
| 24 | *Celtis tetrandra* Roxb., | Ulmaceae | Tree | Common |

**Key for the Table:**
**E – Endangered; LC – Least Concern; SW – South Western Ghats; CR – Critically Endangered; VU – Vulnerable**




The plants identified as herbs are listed in table 1. Among the 51 different species of the herbs, 10 species belong to the genus Impatiens of family Balsaminaceae and 26 species of the 51 are Endemic to the Western Ghats.

Among the 10 species of Impatiens, listed in the table 1, 9 are Endemic to the Western Ghats. *Impatiens cuspidata* Wight. and *Impatiens disotis* Hook. f. are endemic to the Southern Western Ghats, and *Impatiens dasysperma* Wight. belongs to the Vulnerable category.

All the 4 terrestrial herbs shown in Table 2 belong to the family Orchidaceae. These are some commonly found herbs.

Table 3 also shows a list of herbs that are epiphytic. 5 epiphytic herbs were identified in the area of study, of which *Xenikophyton smeeanum*, *Oberonia swaminathanii* and *Oberonia chandrasekharanii* is

endemic to the Southern Western Ghats. *Oberonia chandrasekharanii* belongs to the Critically Endangered category according to the IUCN Redlist.

The table 4 gives a list of climbers identified in this study area. There are 9 species of climbers belonging to the family Apocynaceae, of which *Gymnema sylvestre* is listed as Endangered. The study area houses 4 species of climbers that are Endemic to the Western Ghats. *Ficus laevis* Blume var. *macrocarpa*, of the family Moraceae, is quite a rare climber of the Ficus species.

Table 5 shows 21 different shrubs that were identified along the road to Valparai of which 11 species are Endemic. The shrubs play a vital role in this area of vegetation as it provides a hiding place for small fauna, a place to graze and also camouflage from the predators.

Some important tree species are listed in table 6. Out of the 24 different tree species, 10 species belong to the genus Ficus of the family Moraceae. These Ficus species play an important role in this region. There is fruiting in these trees throughout the year in at least one of the species of Ficus, no matter how exposed the tree is. They render a great support for maintaining an ecological balance. The trees not only provide shade but also give a canopy cover for the entire area thus maintaining the microclimate. (Shanahan, 2000). They contribute to the weather in this area taken for study. Among these 24 tree species, 7 are identified as endemic to the South Western Ghats. (Ganesan et al, 2019).

About 136 different plant species were identified at the vicinity of the public route to the tourist spot. These plants along the route are not exotic weeds, but include species which are endemic to the Western Ghats. These plants are vulnerable to the threats posed on them due to anthropogenic activities. It is necessary to conserve these plants and protect them from being exploited.

## CONCLUSION

Tourism is a major industry which is both a boon as well as a bane to the environment. Roadways are indeed an infrastructure development that poses threat to the local vegetation. Ecotourism is considered one of the most viable tools to enable economic growth and ecological security. The state of Tamil Nadu has a great potential for the development of eco-tourism (Selvam et al, 2015).

With increasing transformation and anthropogenic pressures on tropical forest tracts creating fragmented landscapes, it becomes important to understand their effects on patterns of biological diversity and to assess conservation values and needs of such sub-optimal areas. (Muthukumar et al, 2006). The flora along the roadside is harmed by activities like road laying or being trampled on by foot or vehicles. However, development of roads is not the only threat to the plants, while pollution and other factors contribute to the damage.

Road corridors are conspicuous artificial structures in the natural landscape that evolved from foot trails to complex highway systems. Road corridors are becoming a focus of ecological research because of their distinctive structure, function and impact on surrounding ecosystems (Karim et al, 2008). A detailed and proper awareness to the tourists can help in the conservation of this vegetation. Conservation practices need to be streamlined in order to preserve the rich floral diversity.

## REFERENCE


- Bennett A. F., Linkages in the Landscape: The Role of Corridors and Connectivity in Wildlife Conservation, Bennett1999LinkagesIT, 1999
- Gamble, J. S. , Flora of the Presidency of Madras.
- Ganesan, V., Panneerselvam, S. T., Sivaprasad, P. S., & Subbaiyan, B. (2019). Endemic Flora of Western Ghats Anamalais, Anamalai Tiger Conservation Foundation, Tamil Nadu Trust, Volume 1, 2019.
- Jakobsson, S., Bernes, C., Bullock, J. M., Verheyen, K., & Lindborg, R. (Year). How does roadside vegetation management affect the diversity of vascular plants and invertebrates? A systematic review. Environmental Evidence, Volume 7, Issue 1.
- Jeganathan P., Mudappa D., Kumar M. A. and Raman T. R. S., Seasonal variation in wildlife roadkills in plantations and tropical rainforest in the Anamalai Hills, Western Ghats, India, Nature Conservation Foundation, India Article in Current Science · February 2018
- Karim M.N., Mallik A. U., Roadside revegetation by native plants I. Roadside microhabitats, floristic zonation and species traits, Ecological Engineering 32 (2008) 222–237.
- Khare, D. (2017, July 10). Northern Western Ghat: a research niche in the biodiversity hotspot. Retrieved from https://threatenedtaxa.org/jottings/conservation/

northern-western-ghats-a-research-niche-in-the-biodiversity-hotspot/
- Lukacs, K., & Valko, O. Human-vectored seed dispersal as a threat to protected areas: Prevention, mitigation and policy. Lendület Seed Ecology Research Group, Institute of Ecology and Botany, Centre for Ecological Research, Vacratot, Hungary; Juhasz Nagy Pal Doctoral School, University of Debrecen, Debrecen, Hungary.
- Mudappa D. and Raman T. R. S., Rainforest restoration and wildlife conservation on private lands in the Western Ghats, Researchgate.
- Mudappa, D., Kumar, M. A. and Raman, T. R. S., Restoring nature: wildlife conservation in landscapes fragmented by plantation crops in India. In Nature without Borders (eds Rangarajan, M., Madhusudan, M. D. and Shahabuddin, G.), Orient Blackswan, Hyderabad, 2014, pp. 178–214.
- Muthuramkumar S., Ayyappan N., Parthasarathy N., Plant Community Structure in Tropical Rain Forest Fragments of the Western Ghats, India, BIOTROPICA 38(2): 143–160 2006.
- Osuri, A. M., Kasinathan S., Siddhartha M. K., Mudappa D., and Raman T. R. S., Effects of restoration on tree communities and carbon storage in rainforest fragments of the Western Ghats, India. Ecosphere, 2019.
- Pimm, S. L., G. J. Russell, J. L. Gittleman, and T. M. Brooks. 1995, The future of biodiversity, Science 269:347–350.
- Ramachandra, T. V., Chandran, M. D. S., Joshi, N. V., & Dudani, S., Exploring Biodiversity And Ecology Of Central Western Ghats, Retrieved from https://wgbis.ces.iisc.ac.in/biodiversity/pubs/ETR/ETR39/overview.htm
- Roe, D., Leader-Williams, N., & Dalal-Clayton, D. B. (1997). Take Only Photographs, Leave Only Footprints: The Environmental Impacts of Wildlife Tourism (Issue 10 of Wildlife and development series, ISSN 1361-8628). International Institute for Environment and Development. Environmental Planning Group.
- Selvam K., Gangai P. and Ganesh A., The Study of Hill Tourism in Tamil Nadu: A Geographical Perspective, International Research Journal of Management Sociology & Humanity ( IRJMSH ), Vol 6 Issue 7 [Year 2015] **ISSN** 2277 – 9809 (Online) 2348–9359 (Print)
- Shanahan, M. J. (Year). Ficus seed dispersal guilds: ecology, evolution and conservation implications. Doctoral dissertation, The University of Leeds Centre for Biodiversity and Conservation School of Biology.
- Tabarelli, M., A. V. Lopes, and C. A. Peres 2008, Edgeeffects drive tropical forest fragments towards an early-successional system, Biotropica 40:657–661.
- https://whc.unesco.org/en/list/1342/
- https://www.wwfindia.org/about_wwf/critical_regions/western_ghats2/about_the_western_ghats/
- http://www.ibiblio.org/unc-biology/herbarium/courses/CHPT25.html
- https://eunis.eea.europa.eu/species/175250
- https://indiabiodiversity.org/species/show/266607#conservation-status
- https://www.iucnredlist.org/

*Trichosanthes anaimalaiensis Bedd*

Valparai

*Ceropegia intermedia*

*Crotalaria grahamiana*

*Impatiens elegans*

*Impatiens goughi*

*Ficus dalhousiae*

*Impatiens maculata*

*Smithia hirsuta*

*Ficus laevis*

*Strobilanthes consanguineus*

*Syzygium lactum*

# Avian Diversity In Smruti Udyan, District Solapur (M.S.) India

**Satish N. Salgar, Vidhya V. Shagalolu and Laxmikant B. Dama**
(Email: satishsalgar2020@gmail.com; southvidhya@gmail.com; lamalaxmikant@gmail.com)
Department of Zoology and Research Centre, D.B.F.Dayanand College of Arts and Science, Solapur.

**Citation:** Salgar Satish N., Shagalolu Vidhya V. and Dama Laxmikant B. Avian Diversity In Smruti Udyan, District Solapur (M.S.) India.
*Ela Journal of Forestry and Wildlife*
11(3): 1290-1294

**Date of Publication:** 30 September 2022

ISSN 2319-4361




**Abstract:**
The Smruti Udyan is located beside Dharmaveer Sambhaji Lake (17°64'35.6"N 75°90'79.5"E") survey No. 308,309 and 313, in Solapur city, Maharashtra. The Total area is 20.24 hector of which 7.26 hectar is reserved for forest area. The study was carried out from January 2022 to December 2022. Total 41 bird species belonging to 25 families were recorded during the study period. The birds are categorized as residential, local migratory, winter migratory and migratory, throughout the study period.

**Key words:** Avifauna, Biodiversity, Dharmaveer Sambhaji lake, Smruti Udyan.

## Introduction:

The Smruti Udyan was established as a community social forestry pilot project on 3rd January 1996. Here plant and animal are protected but a checklist of birds was not available. We have addressed this lacuna.

## Materials and Methods:

Smruti Udyan is located besides the Dharmaveer Sambhaji Lake and near Solapur Vijapur national highway (17°64'35.6"N 75°90'79.5"E") survey No. 308,309 and 313, in Solapur city, Maharashtra. We studied the avifaunal diversity from January 2022 to December 2022. In this study observations were carried out using binoculars, photographic documentation was done with the help of Nikon D-5300 camera with zoom lens of 55mm to 200mm. The identification of bird species was done by referring pictorial guide Ali.S (2002).

## Results and Discussion:

During the study period 41 species of birds belonging to 25 families were recorded from Jan 2022 to Dec 2022 of which 25 birds are resident, 8 winter migratory, 2 summer migratory and 6 are local migratory. This study site needs protection by reducing human interference and pollution of the lake.

**Spot-billed duck**

**Little Egret**

**Red-wattled lapwing**

**Eurasian Coot**

**Asian Green Bee-eater**

**Black-winged Stilt**


**Photo 2: Smruti Udyan in Solapur District (google.com)**

**Table: 1 Checklist of birds in Smruti Udyan.**

| Sr. No. | Common Name | Scientific Name | Family | Status |
|---|---|---|---|---|
| 1 | Little Grebe | *Tachybaptus ruficollis* | Podicipedidae | R |
| 2 | Great Cormorant | *Phalacrocorax niger* | Phalacrocoracidae | R |
| 3 | Little Cormorant | *Microcarboniger* | | R |
| 4 | Cattle Egret | *Bubulcus ibis* | Ardeidae | R |
| 5 | Little Egret | *Egrettagarzetta* | | R |
| 6 | Pond Heron | *Ardeolagrayii* | | R |
| 7 | Purple Heron | *Ardea purpurea* | | LM |
| 8 | Red-rumped swallow | *Cecropisdaurica* | Anatidae | R |
| 9 | Garganey | *Querquedulaquerquedula* | | WM |
| 10 | Common Teal | *Anas actuta* | | WM |
| 11 | Spotbill Duck | *Anas poecilorhyncha* | | LM |
| 12 | Northern Shoveler | *Anas clypeata* | | M |
| 13 | Brahminy Kite | *Haliasturindus* | Accipitridae | LM |
| 14 | Black Kite | *Milvus migrans* | | R |
| 15 | Purple Moorhen | *Porphyrioporphyrio* | Rallidae | R |
| 16 | Eurasian Coot | *Fulicaatra* | | R |
| 17 | Indian Moorhen | *Gallinula chloropus* | | R |

| | | | | |
|---|---|---|---|---|
| 18 | Black Drongo | *Dicrurusadsimilis* | Dicruridae | LM |
| 19 | Red-wattled Lapwing | *Vanellus indicus* | Charadriidae | R |
| 20 | Indian River Tern | *Sterna aurantia* | Laridae | WM |
| 21 | Little Stint | *Ereunetesminuta* | Scolopacidae | WM |
| 22 | Common Sandpiper | *Actitishypoleucos* | | WM |
| 23 | Crow Pheasant | *Centropus sinensis* | Cuculidae | R |
| 24 | Indian Myna | *Acridotheres tristis* | Strigidae | R |
| 25 | White-throated Kingfisher | *Halcyon smyrnensis* | Alcedinidae Meropidae | R |
| 26 | Small Blue Kingfisher | *Alcedoatthis* | | LM |
| 27 | Asian Green Bee-eater | *Meropsorientalis* | | LM |
| 28 | Barn Swallow | *Hirundo rustica* | Hirudinidae | WM |
| 29 | Wire-tailed Swallow | *Hirundosmithii* | | R |
| 30 | Indian Robin | *Saxicoloidesfulicatus* | Muscicapidae Cisticolidae | R |
| 31 | Pied Bushchat | *Saxicola caprata* | | R |
| 32 | Ashy Prinia | *Priniasocialis* | | R |
| 33 | White Wagtail | *Motacilla alba* | Motacillidae | WM |
| 34 | Yellow Wagtail | *Motacillacitreola* | | M |
| 35 | Grey Wagtail | *Motacilla cinerea* | | WM |
| 36 | Purple-rumped Sunbird | *Aethopygasiparaja* | Nectarinidae | R |
| 37 | House Sparrow | *Passer domesticus* | Ploceidae | R |
| 38 | Indian Jungle Crow | *Corvus culminaatus* | Corvidae | R |
| 39 | House Crow | *Corvus splendens* | | R |
| 40 | Bronze-winged Jacana | *Metopidius indicus* | Jacanidae | R |
| 41 | Pheasant-tailed Jacana | *Hydrophasianuschirurgus* | | R |
| **Total** | **Species = 41** | | **Families = 22** | **R=25, SM = 02 LM=06, WM=08** |

**WM: Winter Migratory, R: Resident, LM: Local Migratory**

**Conclusion:**

Avifaunal diversity of Smruti Udyan, Solapur confirms that this site has suitable habitat for the residential and some migratory birds. Birds present in and around Smruti Udyan and Sambhaji Lake are affected by anthropogenic disturbances like washing clothes, direct bathing in lake, boating in lake, washing livestock, immersing of idols, fishing practices. We feel that steps should be taken to stop boating in lake and carry out regular maintenance.

**Acknowledgement:**

We thank the Principal, D.B.F.Dayanand College of Arts and Science and Head, Department of Zoology for providing library and laboratory facilities.We thankMr. Sanjay Bhoite from the forest department.

**Authors Contribution:**

Designing survey and data collection by Satish Salgar, Manuscript preparation and correction by Vidhya Shagalolu, and data analysis by Laxmikant Dama.

**References:**

- Ali S. and Ripley S.D. (1983). A pictorial guide to the birds of the Indian Subcontinent. Delhi: *Oxford University Press*, New Delhi: 1-7.
- Ali S (1939) The birds of central India, Part-1. *J. Bom. Nat. Hist. Soc*., 41 (1): 82- 106.

- Arun M. Chilke (2012). Avian diversity in and around Bamanwada lake of Rajura, District-Chandrapur (Maharashtra).*Scholars Research Library. Ann. Biol. Res*.3 (4): 2014-2018.
- Champion, H.G. & S.K. Seth (1968). A Revised Survey of the Forest Types of India. Government of India, Delhi, 402pp.
- Grimmett R Inskipp C. and Inskipp T (2015). Birds of the Indian Subcontinent.
- Gavande S. (2009). Remote sensing & GIS studies of solapur city, M.S. providing geospatial information and solutions for sustainable development.*UGC File No*.47-1251/09 (WRO).
- Hippargi RV, Bolde PM, Manthen SV and Aland SR (2012) Population and breeding status of avifauna in a highly fragmented grassland patch near Solapur, Maharashtra. *Avishkar Solapur University Research Journal,* (2):22-30.
- Kumbhar A. C., Ghorpade B. N. and Deshmukh A. L. (2014). Ecology of Purple
- Moorhen (Porphyrioporphyrio) in Dharmaveer Sambhaji tank in Solapur city, Maharashtra. *Ecol. Fish*. 7(2): 81-84.
- Ninad Shah (2018): Checklist of birds, Siddheshwar van-vihar Solapur. Van-Vibhag Solapur. Pp 1-22.
- Mahesh Nilange, Savita Nilange and Arvind Kumbhar (2021): Diversity of bird in and around Dharmveer Sambhaji lake, district solapur (Maharashtra).*Ela journal of Forestry and Wildlife. Vol.10 (4) :1003-1006*
- Pande S. Deshapande P. and Sant N. (2013): Birds of Maharashtra. Publ. *Ela Foundation, Pune, India. Second edition. Pp 1-329*
- Puri S. D. (2015). Avifaunal diversity of Malguzari lake at Zaliya near Amgaon in
- Gondia district (M.S.) *Ind. Int. J. Life Sci*. 3(3): 219-224.
- https://google.com


# Diversity of Odonata and its Distribution Profile in Kagdi Pickup area of Banswara (Southern Rajasthan)

**Teena Sharma[1], Lalit Choudhary[2] and Seema Bharadwaj[3]**

[1,2] Limnology and Fish Biology Research Laboratory, Department of Zoology, LEO College, Banswara, Rajasthan. Lalit540@gmail.com.

[3] Limnology and Fish Biology Research Laboratory, Department of Zoology HDJ Govt. Girls College, Banswara, Rajasthan. Seema377@gmail.com.

**Citation:** Sharma Teena, Choudhary Lalit and Bharadwaj Seema. Diversity of Odonata and its Distribution Profile in Kagdi Pickup area of Banswara (Southern Rajasthan) *Ela Journal of Forestry and Wildlife* 11(3): 1295-1302

**Date of Publication:** 30 September 2022

ISSN 2319-4361



## Abstract

This study conducted from July 2021 to December 2021 offers baseline data on the diversity of odonatan in the Kagdi Pickup area of the Banswara district. A total of 1422 individuals from five odonate families (dragonflies and damselflies) and 28 species were identified from six stations throughout the research period. The order Anisoptera (Dragonflies) has 17 species belonging to 2 families, followed by Zygoptera (damselflies), with 11 species belonging to 3 families. The suborder Anisoptera was widely scattered and its dominant family was Libellulidae (number of species n=15, 53.57%) and Gomphidae (n=2, 7.14%), followed by the suborder Zygoptera and its dominant family Coenagrionidae (n=9, 32.14%) while Platycnemididae and Lestidae showed equal population (n=1, 3.14%) but the Family Lestidae was the rarest. In this study, the most dominating species was *Ceriagrion cerinorubellum*, followed by *Enallagma exsulans* and *Orthetrum luzonicum*.

**Keywords:**

Odonata, Kagdi Pickup area, Conservation importance, Statistical details, Distribution profile.

## Introduction

Dragonflies and damselflies (Odonata) are two of the most intriguing aquatic insects. The Indian Odonata checklist includes 474 species (Subramanian 2014). Sharma (2014, 2015) published a list of 47 species from Rajasthan, including species previously mentioned by Agrawal (1957), Bose & Mitra (1975), Kulshrestha & Kulshrestha (1990), Prasad & Thakur (1981), and Thakur (1985). This article provides a summary of the Odonate fauna of the Kagdi Pickup area of Banswara,

Fraser's (1933) "Fauna of the British Indian Subcontinent and Abroad" was the first to offer information on Odonata. Mitra (2002) established the

geographical distribution of odonates in eastern India. The Western Ghats have been extensively studied by Fraser (1933, 1934; 1936), Prasad and Varshney (1995), Emiliyamma and Radhakrishnan (2000), Subramanian (2005), and Subramanian et al. (2009). Kumar and Prasad (1981) examined 162 species and subspecies from Jammu & Kashmir (the western Himalayas). Furthermore, various researchers are studying the diversity of odonates in northern India (Lahiri 1979; Kumar and Mitra 1998; Sharma and Joshi 2007). Studies from central India have also been published (Tiple et al. 2011; Das et al. 2013). Prasad and Thakur (1981) added 16 species to Rajasthan state's odonata list; Thakur (1985) listed 18 species from Lake Kailana, Jodhpur. Palot and Soniya (2000) identified 16 species from Keoladeo National Park, Bharatpur; Husain and Sharma (2012) identified 20 species from the Thar desert and Agarwal (1957) identified 15 species from Pilani. We studied the odonate diversity in Kagdi Pickup near Banswara, Rajasthan.

## Material and method

### Study Area

Kagdi Pickup is three kilometers from Banswara city and it is a popular tourist destination located on Ratlam Road, (Latitude 74º28'44.38" E and Longitude 23º31'57.85" N) (Fig. 1). Odonates were surveyed and the fieldwork was carried out for a duration of three days each month from July 2021 to December 2021. This study was conducted in Kagdi Pickup's six stations: Kagdi dam site, right canal, left canal, opposite Anand Sagar site, Samaipura site and front road site (Ratlam road). The entire survey was conducted between 6.30 a.m. and 6.30 p.m. An aerial net and a sweep net were used to gather insects. Some species were photographed, but others were gathered using insect-collecting nets. The gathered and photographed (Nikon D7200 Camera, Nikkor 70-300mm lens) species were identified using the standard identification guidelines of Nair (2011), Mitra (2006), Subramanian (2009) and Subramanian & Babu (2017, 2020). Taxonomic keys of Fraser (1933, 1934, 1936) were also used in the laboratory to identify specimens collected in the field with the permission of the forest department and the nomenclature and classification utilised in this study adhere to the framework established by Schorr and Pulson (2021), founded upon a recent taxonomic revision conducted by Dijkstra et al. (2013). The %


**Fig. 1 – Study Area.**

distribution of various species was calculated using the following formula:

Percent distribution (%) = No. of species ÷ total no of species×100

The biodiversity indices (Dominance_D, Simpson_1-D, Shannon_H, Evenness_e^H/S, Margalef, Equitability_J) were calculated using Past 4.09 software (Hammer et al., 2001). On the other hand, the species distribution profile was measured using Microsoft Excel 365.

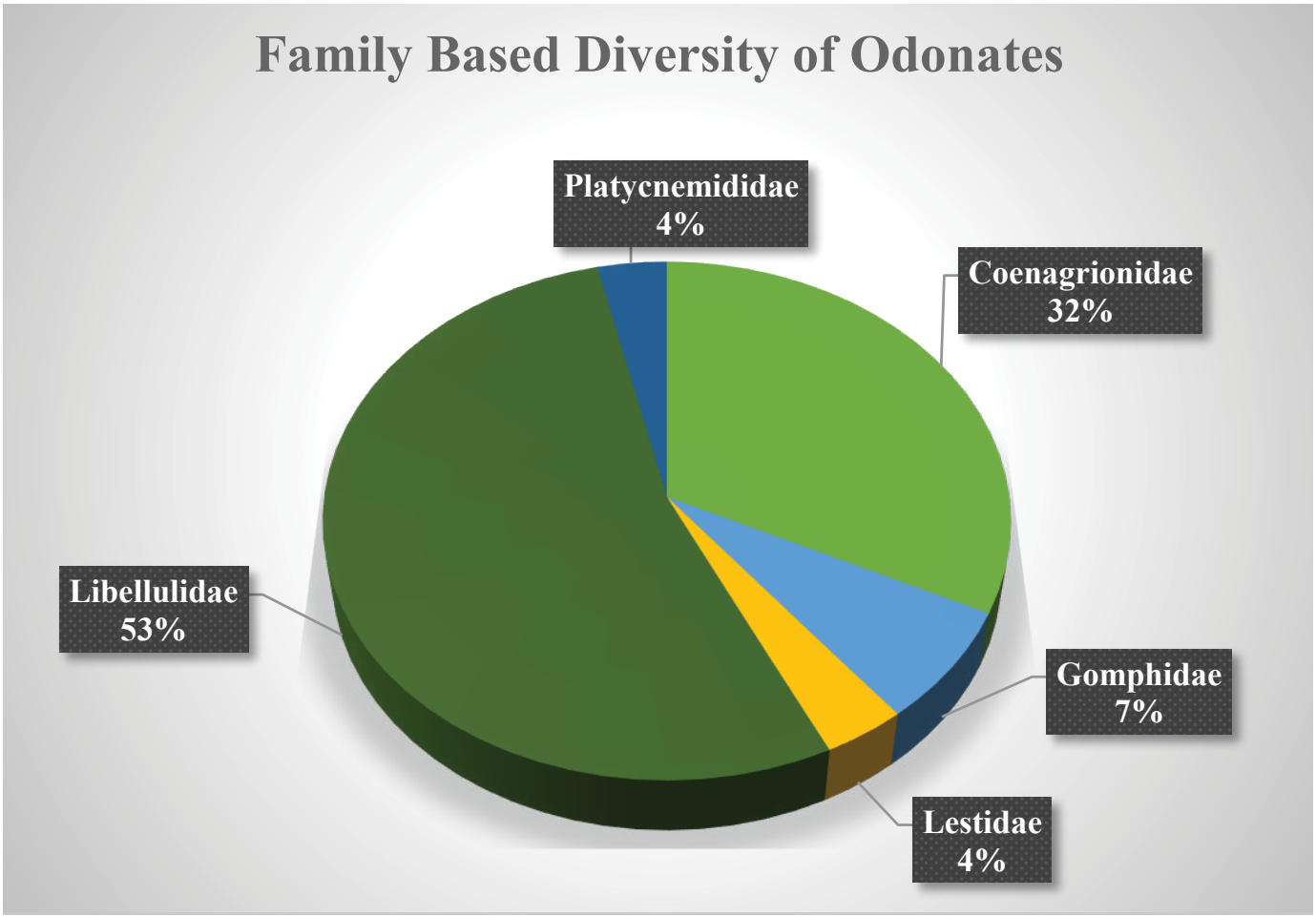
## Result and discussion

A total of 1422 individuals from five families and 28 species from odonatan were identified from six stations throughout the research period. The order Anisoptera (Dragonflies) has the most 17 species belonging to 2 families, followed by Zygoptera (damselflies), with 11 species belonging to 3 families. The suborder Anisoptera was widely scattered and its dominant family was Libellulidae (number of species n=15, 53.57%) with a high percentage composition and Gomphidae (n=2, 7.14%), followed by the suborder Zygoptera and its dominant family Coenagrionidae (n=9, 32.14%) while Platycnemididae and Lestidae show equal statistical status because both have n=1, 3.14% but the Family Lestidae was extremely rare all of them. In this study, the most dominating species was *Ceriagrion cerinorubellum* (n=232), followed by *Enallagma exsulans* (n=155), and *Orthetrum luzonicum* (n=144). This study records baseline data on odonatal diversity and conservation in the Kagdi Pickup area of the Banswara district (Table 1 and Graph 1).

**Table – 1. Diversity of Odonates in Kagdi Pickup Area of Banswara, Rajasthan.**

| S. No. | Suborder | Family | Scientific Name | Common Name | IUCN category |
|---|---|---|---|---|---|
| 1. | Zygoptera | Coenagrionidae | *Agriocnemis pygmaea* (Rambur, 1842) | Pygmy Dartlet | LC |
| | | | *Ceriagrion coromandelianum* (Fabricius, 1798) | Coromandel Marsh Dart | LC |
| | | | *Pseudagrion rubriceps* (Selys, 1876) | Saffron-Faced Blue Dart | LC |
| | | | *Ischnura aurora* (Brauer, 1865) | Golden Dartlet | LC |
| | | | *Pseudagrion microcephalum* (Rambur, 1842) | Blue Grass Dartlet | LC |
| | | | *Pseudagrion decorum* (Rambur, 1842) | Three-Striped Blue Dart | LC |
| | | | *Ischnura senegalensis* (Rambur, 1842) | Senegal Golden Dartlet | LC |
| | | | *Enallagma exsulans* (Hagen, 1861) | Stream Bluet | LC |
| | | | *Ceriagrion cerinorubellum* (Brauer, 1865) | Orange-Tailed Marsh Dart | LC |
| | | Platycnemididae | *Copera marginipes* (Rambur, 1842) | Yellow Bush Dart | LC |
| | | Lestidae | *Lestes viridulus* (Rambur, 1842) | Emerald-Striped Spreadwing | LC |
| 2. | Anisoptera | Gomphidae | *Paragomphus lineatus* (Selys, 1850) | Lined Hooktail | LC |
| | | | *Ictinogomphus rapax* (Rambur, 1842) | Common Clubtail | LC |
| | | Libellulidae | *Bradinopyga geminata* (Rambur, 1842) | Granite Ghost | LC |
| | | | *Crocothemis servilia* (Drury, 1770) | Ruddy Marsh Skimmer | LC |
| | | | *Acisoma panorpoides* (Rambur, 1842) | Trumpet Tail | LC |
| | | | *Brachydiplax sobrina* (Rambur, 1842) | Little Blue Marsh Hawk | LC |
| | | | *Brachythemis contaminata* (Fabricius, 1793) | Ditch Jewel | LC |
| | | | *Diplacodes lefebvrii* (Rambur, 1842) | Black Ground Skimmer | LC |
| | | | *Diplacodes trivialis* (Rambur, 1842) | Ground Skimmer | LC |
| | | | *Neurothemis tullia* (Drury, 1773) | Pied Paddy Skimmer | LC |
| | | | *Orthetrum luzonicum* (Brauer, 1868) | Marsh Skimmer | LC |
| | | | *Tramea limbata* (Desjardins, 1832) | Black Marsh Trotter | LC |
| | | | *Tholymis tillarga* (Fabricius, 1798) | Coral-Tailed Cloudwing | LC |
| | | | *Trithemis aurora* (Burmeister, 1839) | Crimson Marsh Glider | LC |
| | | | *Trithemis arteriosa* (Burmeister, 1839) | Red-Veined Dropwing | LC |
| | | | *Palpopleura sexmaculata* (Fabricius, 1787) | Blue-Tailed Yellow Skimmer | LC |
| | | | *Orthetrum sabina* (Drury, 1770) | Slender Skimmer | LC |

(Abbreviation: LC (Least Concern)




**Graph – 1. Family-Based Diversity of Odonates in Kagdi Pickup Area of Banswara**

The distribution profile (Variance, Mean, Chi-square test, Standard deviation and Probability) are given in Table – 2 and statistical details (Shannon, Simpson index, Evenness, Dominance, Marglaf and Equitability) are given in Table – 3.

**Table – 2. Statistical details of Kagdi Pickup Area of Banswara**

| Scientific Name | Variance | Mean | Chi-Sq. test | Probability | Standard Deviation |
|---|---|---|---|---|---|
| *Agriocnemis pygmaea* (Rambur, 1842) | 9.766667 | 3.833333 | 132.8123931 | 0.53714447 | 3.125166662 |
| *Ceriagrion coromandelianum* (Fabricius, 1798) | 22.3 | 5.5 | 190.5569119 | 0.00116893 | 4.722287581 |
| *Pseudagrion rubriceps* (Selys, 1876) | 38.7 | 8.5 | 294.4970456 | 0 | 6.220932406 |
| *Ischnura aurora* (Brauer, 1865) | 31.06667 | 6.333333 | 219.4291713 | 0.00000591 | 5.573747991 |
| *Pseudagrion microcephalum* (Rambur, 1842) | 25.06667 | 17.33333 | 600.542995 | 0 | 5.006662228 |
| *Pseudagrion decorum* (Rambur, 1842) | 23.46667 | 3.333333 | 115.4890375 | 0.88664453 | 4.844240567 |
| *Ischnura senegalensis* (Rambur, 1842) | 35.2 | 6 | 207.8802675 | 0.00005662 | 5.93295879 |
| *Enallagma exsulans* (Hagen, 1861) | 34.96667 | 25.83333 | 895.0400407 | 0 | 5.913261931 |

| | | | | | |
|---|---|---|---|---|---|
| *Ceriagrion cerinorubellum* (Brauer, 1865) | 114.6667 | 38.66667 | 1339.672835 | 0 | 10.70825227 |
| *Copera marginipes* (Rambur, 1842) | 64 | 9 | 311.8204013 | 5.07E-16 | 8 |
| *Lestes viridulus* (Rambur, 1842) | 1.366667 | 0.833333 | 28.87225938 | 1 | 1.169045194 |
| *Paragomphus lineatus* (Selys, 1850) | 22.3 | 3.5 | 121.2634894 | 0.7954 | 4.722287581 |
| *Ictinogomphus rapax* (Rambur, 1842) | 56.4 | 7 | 242.5269788 | 3.91E-08 | 7.509993342 |
| *Bradinopyga geminata* (Rambur, 1842) | 48.66667 | 6.333333 | 219.4291713 | 0.000005914 | 6.976149845 |
| *Crocothemis servilia* (Drury, 1770) | 6.666667 | 2.333333 | 80.84232625 | 0.9999 | 2.581988897 |
| *Acisoma panorpoides* (Rambur, 1842) | 66.8 | 10 | 346.4671125 | 1.57E-20 | 8.173126697 |
| *Brachydiplax sobrina* (Rambur, 1842) | 15.86667 | 5.666667 | 196.3313638 | 0.0004485 | 3.983298466 |
| *Brachythemis contaminata* (Fabricius, 1793) | 13.9 | 5.5 | 190.5569119 | 0.001169 | 3.728270376 |
| *Diplacodes lefebvrii* (Rambur, 1842) | 15.76667 | 11.16667 | 386.8882756 | 3.78E-26 | 3.970726214 |
| *Diplacodes trivialis* (Rambur, 1842) | 12 | 3 | 103.9401338 | 0.9782 | 3.464101615 |
| *Neurothemis tullia* (Drury, 1773) | 12.56667 | 2.166667 | 75.06787438 | 1 | 3.544949459 |
| *Orthetrum luzonicum* (Brauer, 1868) | 25.6 | 24 | 831.52107 | 1.04E-100 | 5.059644256 |
| *Tramea limbata* (Desjardins, 1832) | 25.2 | 4 | 138.586845 | 0.3986 | 5.019960159 |
| *Tholymis tillarga* (Fabricius, 1798) | 28.16667 | 4.833333 | 167.4591044 | 0.03033 | 5.307227776 |
| *Trithemis aurora* (Burmeister, 1839) | 17.46667 | 3.666667 | 127.0379413 | 0.675 | 4.179314138 |
| *Trithemis arteriosa* (Burmeister, 1839) | 36 | 10 | 346.4671125 | 1.57E-20 | 6 |
| *Palpopleura sexmaculata* (Fabricius, 1787) | 17.6 | 3 | 103.9401338 | 0.9782 | 4.195235393 |
| *Orthetrum sabina* (Drury, 1770) | 37.06667 | 5.666667 | 196.3313638 | 0.0004485 | 6.08824003 |

**Table 3 – Statistical analysis of Kagdi Pickup Area of Banswara.**

| Different Statistical Status | STATIONS | | | | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | F |
| **Dominance_D** | 0.04715 | 0.05594 | 0.0862 | 0.1026 | 0.1503 | 0.09505 |
| **Simpson_1-D** | 0.9529 | 0.9441 | 0.9138 | 0.8974 | 0.8497 | 0.905 |
| **Shannon_H** | 3.207 | 3.061 | 2.784 | 2.582 | 2.194 | 2.676 |
| **Evenness_e^H/S** | 0.8819 | 0.8542 | 0.6741 | 0.661 | 0.5983 | 0.6601 |
| **Margalef** | 4.401 | 4.167 | 4.25 | 3.767 | 3.014 | 4.138 |
| **Equitability_J** | 0.9623 | 0.951 | 0.8759 | 0.8618 | 0.8103 | 0.8656 |

The findings from the present study were in similar to those by Sethy and Siddiqi (2007) discovered 16 odonate species from Similipal, classified into 14 genera and six families, Libelluiidae, Coenagrionidae, Lestidae, Protoneuridae, Aeshnidae, and Calopterygidae. Das et al. (2010) investigated 58 species of Odonata, the Zygoptera suborder included 23 species, whereas the Anisoptera suborder contained 35 species. Libellulidae was the most diverse family, with 31 species in the Baripada forest division. Agrawal (1957) discovered 15 species in Pilani, Rajasthan. Bose and Mitra (1975) found 13 species split into two suborders, four families, and twelve genera in Rajasthan. Prasad and Thakur (1981) identified 16 species in Rajasthan.

The sensitivity of Odonata to environmental change exhibits variation, with certain species serving as potential indicators of change. However, it is advisable to interpret alterations in the overall composition of odonate assemblages as indicators of environmental disturbance.

Water bodies are required for the life cycle of Odonates and Banswara has several water bodies with rich flora surrounding them. Consequently, the availability of flora and water in the survey zone causes the increased fauna of dragonflies and damselflies in the Kagdi Pickup area.

**Conclusion**

The study found that three species *Ceriagrion cerinorubellum*, followed by *Enallagma exsulans* and *Orthetrum luzonicum*. predominated throughout the Kagdi pickup area of Banswara district, Rajasthan. Odonates are common throughout the year, but notably during the monsoon. Further study is necessary to obtain complete details of their life cycle in the study area. We found that Kagdi Pickup area has good odonate diversity, and its climatic conditions are suitable for Odonates.

**References**


1. Agrawal, J.P. 1957 Contributions towards the Odonata fauna of Pilani. *Proceedings of the 44th Indian Science Congress, Calcutta*. Part 3. Abstract no. 28: 309.
2. Bose, G. and Mitra, T.R. 1975 The Odonata fauna of Rajasthan. *Records of the Zoological Survey of India*, 71: 1–11.
3. Das, S. K., Sahu, H. K. and Rout, S. D. 2010 Odonates of Baripada Division of Similipal Biosphere Reserve, including North Orissa University Campus, Orissa, India. *Tigerpaper*, 37: 13-15.
4. Das, S.K., P.K. Sahoo, N. Dash, S. Marathe, S. Mahato, A. Dashahare, P.S. Mishra, A. Prasad, and R. Rana. 2013 Odonates of three selected tiger reserves of Madhya Pradesh, Central India. *Check List*, 9: 528–532.
5. Dijkstra, K-D. B., Bechly, G., Bybee, S.M., Dow, R.A., Dumont, H.J., Fleck, G., Garrison, R.W., Hämäläinen, M., Kalkman, V.J., Karube, H., May, M.L., Orr, A.G., Paulson, D.R., Rehn, A.C., Theischinger, G., Trueman, J.W.H., Van Tol, J., Von Ellenrieder, N. and Ware, J. 2013 The classification and diversity of dragonflies and damselflies (Odonata). *Zootaxa,* 3703(1): 36-45.
6. Emiliyamma, K.G. and Radhakrishnan, C. 2000 Odonata (Insecta) of Parambikulam Wildlife Sanctuary, Kerala, India. *Records of Zoological Survey of India*, 98(1): 157–167.
7. Fraser, F.C. 1933 *The Fauna of British India including Ceylon and Burma, Odonata. Vol. I.* Taylor and Francis Ltd., London, 436 pp.
8. Fraser, F.C. 1934 *The Fauna of British India including Ceylon and Burma, Odonata. Vol. II.* Taylor and Francis Ltd., London, 442 pp.
9. Fraser, F.C. 1936 *The Fauna of British India including Ceylon and Burma, Odonata. Vol. III.* Taylor and Francis Ltd., London, 461 pp.
10. Hammer, Ø., Harper, D.A.T. and Ryan, P.D. 2001 PAST: Paleontological Statistics software package for education and data analysis. Palaeontologia Electronica 4(1): 9.
11. Husain, A., and Sharma, G. 2012 Odonates of Arabian and Indian deserts and their conservation status. *Biological Forum*, 4: 74–91.
12. IUCN. 2021 The IUCN Red List of Threatened Species. Version 2022-2. https://www.iucnredlist.org. Accessed on [November 2021].
13. Kulshrestha, A.K. and Kulshrestha, A.K. 1990 On a collection of damselflies (Coenagrionidae; Odonata) from district Bharatpur (Rajasthan). *Records of the Zoological Survey of India,* 87(1): 11–14.
14. Kumar, A., and Mitra, A. 1998 Odonata diversity at Sahastradhara (Sulphur springs), Dehra Dun, India, with notes on their habitat ecology. *Fraseria (NS),* 5: 37–45.

15. Kumar, A. and Prasad, M. 1981 Field ecology, zoogeography and taxonomy of the Odanata of Western Himalaya, India. *Records of the Zoological Survey of India*, 20: 1–118.
16. Lahiri, A.R. 1979 Odonata (Insecta) from different states of North Eastern India. *Oriental Insects*, 13: 119–132.
17. Mitra, T.R. 2002 Geographical distribution of Odonata (*Insecta*) of Eastern India. *Memoirs of the Zoological Survey of India,* 19: 1–208.
18. Mitra, T.R. 2006 *Handbook on common Indian dragonflies (Insect:Odonata)*. Kolkata: Zoological Survey of India.
19. Nair, M.V. 2011 *Dragonflies & damselflies of Orissa and Eastern India*. Wildlife Organisation, Forest & Environment Department, Government of Orissa.
20. Palot, M.J., and Soniya, V.P. 2000 Odonata of Keoladeo National Park, Bharathpur, Rajasthan, India. *Zoos' Print Journal*, 15: 317–320.
21. Paulson, D., and Schorr, M. 2021 World Odonata list. Retrieved May 2021, from https://www.pugetsound.Edu/academics/academic-resources/slater-museum/biodiversity-resources/dragonflies/world-odonata-list2. Accessed on [October 2021]
22. Prasad, M. and Thakur, R.K. 1981 Further additions to the Odonata fauna of Rajasthan. *Jantu,* 1: 26–29.
23. Prasad, M., and Varshney, R.K. 1995 A checklist of the Odonata of India including data on larval studies. *Oriental Insects*, 29: 385–428.
24. Sethy, P.G.S and Siddiqui, S.Z. 2007 Observations on Odonates in Simlipal Biosphere Reserve, Orissa. *Zoos' Print Journal,* 22(11): 2893–2894.
25. Sharma, G. 2014 Studies on Odonata and Lepidoptera fauna of foothills of Aravalli Range, Rajasthan. *Records of Zoological Survey of India*, Occasional Paper No. 353: 1–104.
26. Sharma, G. 2015 *Pictorial Handbook on Damselflies and Dragonflies (Odonata: Insecta) of Rajasthan.* Zoological Survey of India, Kolkata, 266pp.
27. Sharma, G., and Joshi, P.C. 2007 Diversity of Odonata (Insecta) from Dholbaha Dam (Distt. Hoshiarpur) in Punjab Shivalik, India. *Journal of Asia-Pacific Entomology*, 10: 177–180.
28. Subramanian, K.A. and Babu, R. 2017 *Checklist of Odonata (Insecta) of India. Version 3.0.* Zoological Survey of India, Kolkata, 51 pp.
29. Subramanian, K.A. and Babu, R. 2020 *Dragonflies and Damselflies (Insecta: Odonata) of India*, pp. 29–45. In: Ramani, S., P. Mohanraj & H.M. Yeshwanth (eds.). *Indian Insects: Diversity and Science*. CRC Press, Taylor & Francis Group, London, 450 pp.
30. Subramanian, K.A. 2014 *A Checklist of Odonata of India.* Zoological Survey of India, Kolkata, 31pp.
31. Subramanian, K.A. 2005 Damselflies and dragonflies of peninsular India-A field guide. I.I.S. Bangalore, India. http://ias.ac.in/initiat;sci_ed/lifescape/odonates.html.
32. Subramanian, K.A. 2009 *Dragonflies of India: a field guide*. India: Vigyan Prasar.
33. Thakur, B.K. 1985 Field notes on the Odonata around lake Kailana, Jodhpur (Rajasthan). *Bulletin of Zoological Survey of India,* 7(1): 143–149.
34. Tiple, A.D., Kulkarni, N. and Joshi, K.C. 2011 Diversity of Odanata in Kanha National Park, Madhya Pradesh, India. *Indian Journal of Forestry*, 34: 329–332.

*Trithemis arteriosa* (Male)

*Orthetrum sabina*

*Brachythemis contaminata* (Male)

*Ceriagrion coromandelianum*

*Orthetrum luzonicum*

*Trithemis annulata*

*Enallagma exsulans*

*Trithemis aurora*

*Trithemis arteriosa* (Female)

*Brachythemis contaminata* (Female)

*Enallagma exsulans* (Male&Female)

*Diplacodes trivialis*

# Social calls and behaviour in a flock of Black Drongo *(Dicrurus macrocercus)* in Gandhinagar, Gujarat

**Raj Odedra*, Kavan Shukla**
(*Ph.D. Scholar; Department of Zoology, School of Science, Gujarat university, Ahmedabad, Gujarat 380009, India, Department of Botany, M.D. Science College, Porbandar, Gujarat 360575, India
Mail: rajayodedra@gmail.com)

**Citation:** Odedra Raj and Shukla Kavan. Social calls and behaviour in a flock of Black Drongo (*Dicrurus macrocercus*) in Gandhinagar, Gujarat.
*Ela Journal of Forestry and Wildlife*
11(3): 1303-1310

**Date of Publication:** 30 September 2022

ISSN 2319-4361



**Keywords**
Black Drongo, social call, flock behaviour, spectrogram, phrases, notes, calls.

**Abstract**
The Black drongo *Dicrurus macrocercus* is a small passerine bird in the dicruridae family, it is a black bird with distinct forked tail found mainly in South and Southeast Asia. The study was carried out in city of Gandhinagar, Gujarat and nine parameters including time duration of the call, frequency, rhythm and tone, rate of delivery, phrases, notes pattern, amplitude, flow of call, body movement/ physical activity associated with the call, were chosen to study social interaction behaviour and its associated vocals.

## Introduction

Communication has been part of life right from its existence on earth. It has played an important role in evolution of life, giving it the diversity and complexity, we see around the world (Kulcyzcki 2014). Birds show a complex and diversified form of vocal communication which is only next to humans and has various dialects, types and differences unique to each species, they even show the much-desired vocal learning which is not even seen in various mammals closely related to humans, thus playing a very important role in studying human vocalization through birds and solving the mysteries in both the organisms (Baker 2008). Songbirds (Order: Passeriformes, Suborder: Passerine) are the largest group of the birds; they cover about 4000 out of 9000 total number of bird species (Catchpole and Slater, 1995). Songbirds and the syrinx of songbirds are most extensively studied among all birds.

Bird calls are usually short and simple, but they can also be complex and long when repeated notes are arranged and delivered in different arrangements. Calls typically occur in specific context and carry some


**Fig. 1: Satellite image of Punit van from google maps.**

function and they are produced by both sexes through the whole year. Calls have a large functionality and at least 10 different call categories (e.g., alarm, flight and feeding call etc.) can be found (Fagerlund 2014) Furthermore, some birds have more than one call for one category and some use very similar calls for different meaning. Call sounds are important for songbirds also and generally they have greater repertoire of call sounds than non-songbirds (Brainard et al. 2000)

Structure of bird song has large diversity. Typical song may contain components which are pure sinusoidal, harmonic, non-harmonic, broadband and noisy in structure (Nowicki et al. 2005). Sound is often modulated in amplitude or frequency or even both together i.e., coupled modulation (Owings 1998). A well-established way to divide song into four hierarchical levels is: elements or notes, syllables, phrases and song (Catchpole et al.1995). Notes can be regarded as elementary building units in bird song (Gaunt et al. 1998) whereas phrases and songs often contain individual and regional variation. Duration of one syllable ranges from few to few hundred milliseconds. A bird's song can be as diverse as the number of birds there are in this world with each having its unique set of phrases, syllables, tones, notes etc. combined with dialects and personal variations and touch to it (Baker 2008). We intended to study the social interaction calls and associated behaviour in a flock of black drongo using spectrogram and evaluate it for nine different parameters including the time duration of the call, frequency range, rhythm and tone, rate of delivery, phrases, notes pattern, amplitude, flow of call and physical activity associated with the call in natural habitat.

**Materials and Methodology**

Following equipment, instruments, software and materials were used during the course of study: Zoom H1n Handy recorder version 1.19, a pair of Nikon Action (8×40) binoculars, i-ball Decibel BT 5.0 headphones, Conan EOS 1300d camera, for Spectrogram and call/ song editing: Audacity software version 3.1.3, birdNet software, for GPS location: One plus 7pro, camouflage

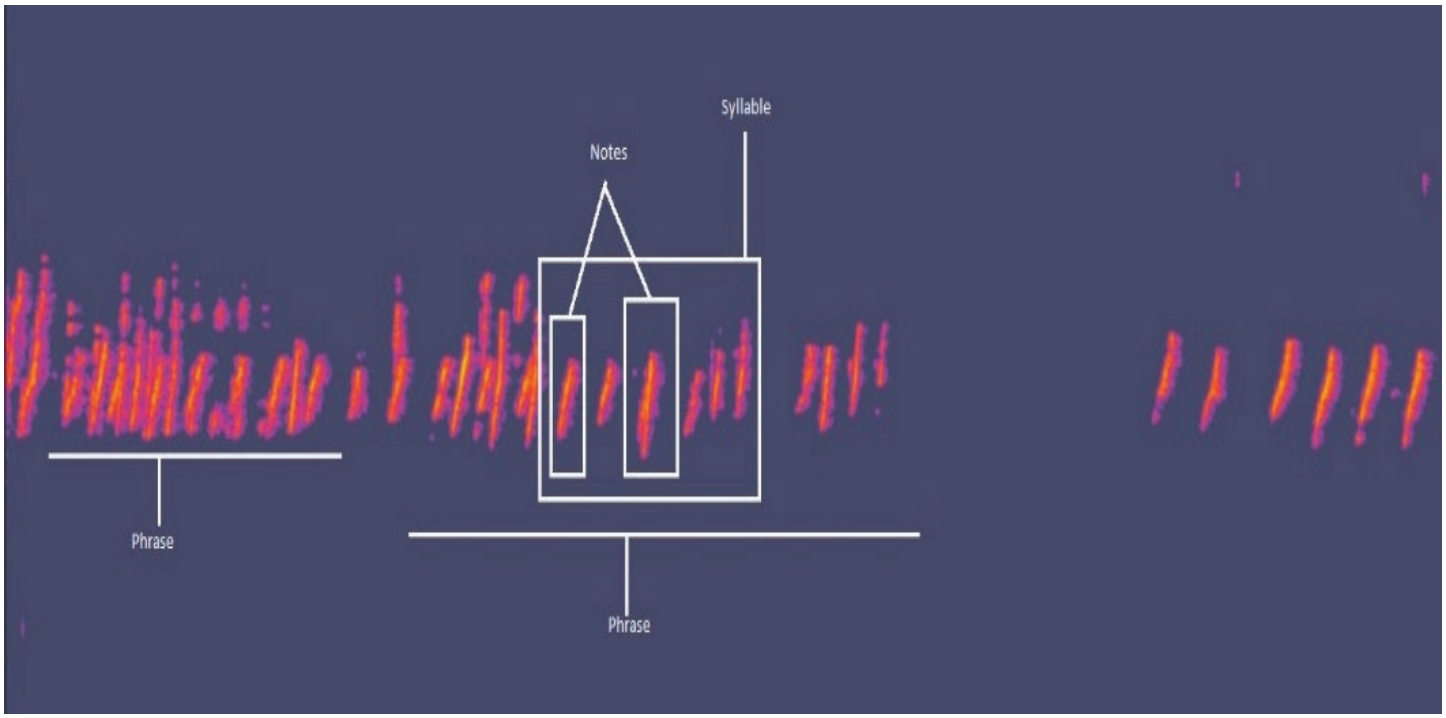



Fig.2: Components of bird call/song spectrogram.

cloth.

**Location and time duration**

The study was conducted from 4th December 2021 to 15th March 2022 at Punit van in the city of Gandhinagar (23.2175° N, 72.6672° E). Three time slots were selected for the study i.e., morning (6.30 am to 10 am), afternoon (1pm to 4 pm) and evening (5.30 pm to 7.30 pm). In a day, study was carried out in any of the 2 time slots such that equal time was allotted in each slot, evening was the prominent time of their gathering as a flock.

**Methodology**

First the sites were identified where frequent sightings of the black drongo was observed. Later the H1n recorder was placed there wrapped in a Camouflage cloth such that the birds or any other organism would not see it. Observations were taken by sitting at a place away from the area where recording was taken and even the photo and video graphic evidence were taken, these were later used for observing minute physical and vocal observations associated to a behaviour and connecting different aspects to the recorded calls. Camouflaged clothing was worn throughout the study and places with no or minimum human hinderance were selected.

A total of 30 observations and recordings were made for the social interaction call and its associated behaviour in black drongo. Each recording was taken at 48k 24bit audio and auto level setting was used with lo cut and limiter being off. Call recordings were edited and listened carefully using i-ball Decibel BT 5.0 headphones for detailed vocals. Audacity version 3.1.3 was used to study the spectrogram and edit the background noises and get the best sample of bird call possible. Linear scale with default colour scheme was used to convert the call into visual form and study of detailed pattern of notes, phrases and syllables was carried out. These are components of any sound which can be represented in a visual form like spectrogram. In the present study the sound is the black drongo's social interaction call, notes are the basic building blocks of a bird song/call which forms syllables, a syllable is a group of notes which repeatedly occurs together as complex both representing a sound, grouping of notes and syllables represent a group of sounds known as a phrase, further many such phrases together forms a repertoire of a call or a song having same or different sounds to it (Baker 2008, Barrington 1773, Thompson et al. 1994). Notes, syllables and phrases are shown in figure 2. Another important parameter during evaluation was the frequency of the sound which defines whether the call and its components were low pitched or high pitched, pitch is the sound form of

frequency, for a bird call a particular note representing a sound has a minimum and maximum frequency. Amplitude is another important parameter which is the maximum vibration or loudness when sound is produced (Thompson et al. 1994, Owings et al. 1998)

## Results

### (A) Behaviour

Social interaction was prominently observed in a flock of 10 plus individuals in evening at Punit van lake where they would gather mostly on daily basis, their number varied between 12 to 15 individuals at a time, during the day time they would forage individually and not be in a large flock. It was a unique finding as black drongo mostly are solitary due to their aggressive and territorial nature but here no signs of aggression were seen in most observations, exception being when sometimes they would chase away the other bird species, but no internal aggression was seen within the flock and in fact they were seen harmoniously giving calls, flying in patterns and even interacting with each other.

Black drongo were seen performing manoeuvres in circular path mid-air, another type of circular motion was also done in which they would start a short flight and then immediately return back to the starting point on the branch from where they took off, they would also perform other flips and tricks too like they would start the flight by flapping their wings many times and then return with a gliding motion, while sitting on the branch they raised and lowered their tail while giving the call and would continuously move their heads analysing their surrounding and observing each other's movements, they were also seen matching each other's flight pattern and manoeuvres, having friendly chases in a non-aggressive playful manner. Drongo despite being territorial and aggressive birds were calm and interactive with each other and no sign of aggression was seen within the flock, however at times they would often chase out birds of other species from their territory, not a single instance of sharing or fighting over food was observed amongst the flock indicating they still had an individualistic approach towards food and it was in plenty in their territory which might be one of the reasons for peaceful coexistence amongst a flock of 10 to 15 drongo at the same place.

### (B) Types of call

Three different types of sounds were observed during the flock interaction. Rhythm and tone of the call was chattering, having a continuous and loud rate of delivery during the social interaction. Tweeting sounds were observed in the spectrogram where double comma like notes were seen, single whistling sounds were represented by backslash like notes and lastly screech sounds were represented by long segmented rod-shaped notes. Tweeting, whistles and loud screech sounds were distinctly identifying features of the call heard in different combinations.

### (C) Call analysis

A total of 30 call samples were analysed for the social interaction call in the flock. The time duration of call samples ranged between 10 to 20 minutes, having a mean value of 15.006 minutes, mode of 12 minutes and a standard deviation of 3.2898 minutes (graph 1). Three types of basic notes are observed in the spectrogram of all 30 call samples analysed one such spectrogram in two parts can be seen in figure 3, one note is long segmented or unsegmented rod shaped, the other note is small double comma shaped and lastly backslash shaped note is seen. Phrases when heard sounded like a single continuous phrase of a call, but it can be divided into four phrases as shown in the spectrogram, first phrase includes all three types of notes, syllables here consist of double comma note followed by rod shaped notes in between and ending with backslash shaped notes. Phrase two consisted of a greater number of rod-shaped notes representing more shriek calls and a cluster of few double comma shaped notes and backslash shaped notes in the end. Phrase three consisted of an equal number of rods shaped and double comma shaped notes, with a few backslashes shaped notes. Last and the fourth phrase consisted of rod-shaped notes which were shorter representing the decrease in the intensity and loudness of the screech calls, also a greater number of tweeting notes along with some whistling sounds were observed in the end and these above-mentioned details can be observed in figure 3. Frequency range (can be observed in spectrograms of figure 3) for double comma shaped note (tweeting sound) was between 2000 to 4000 hertz, for backslash shaped note (whistling sound) frequency range was 2000 to 6000 hertz and for rod shaped notes frequency range was 2000 to 18000 hertz in all 30 call

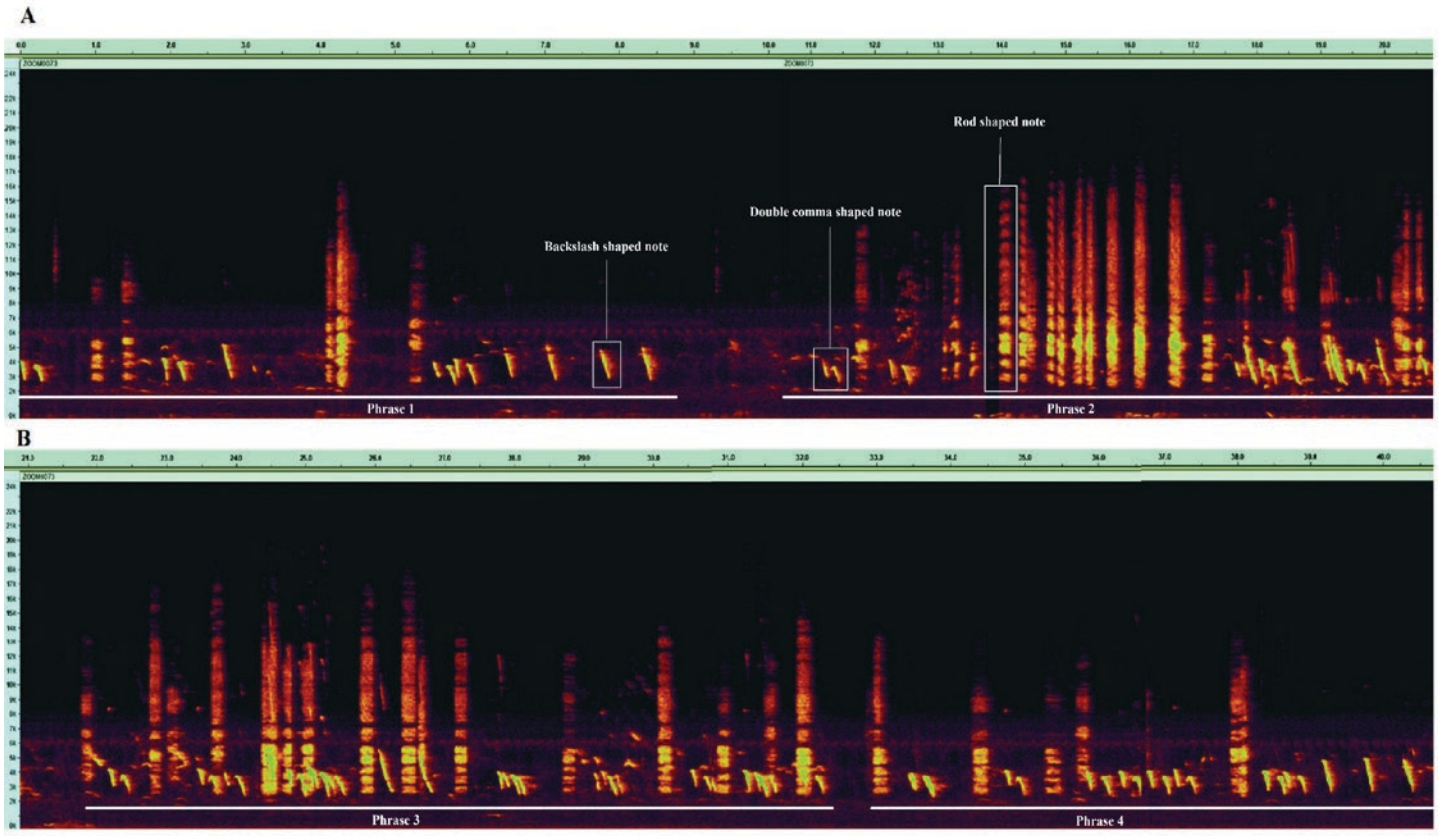
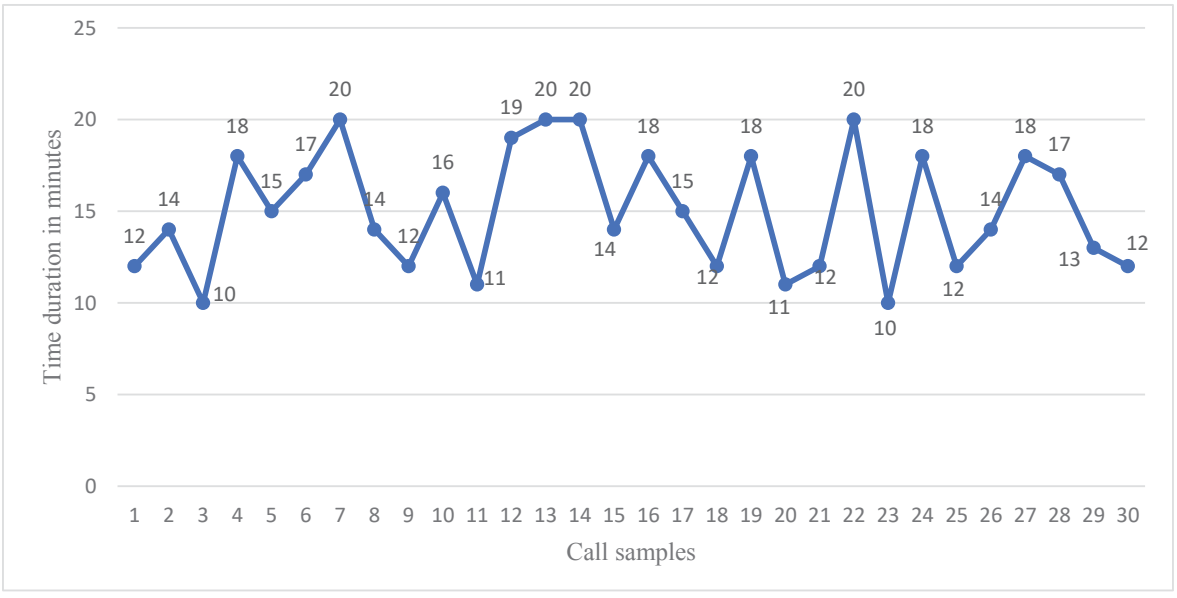
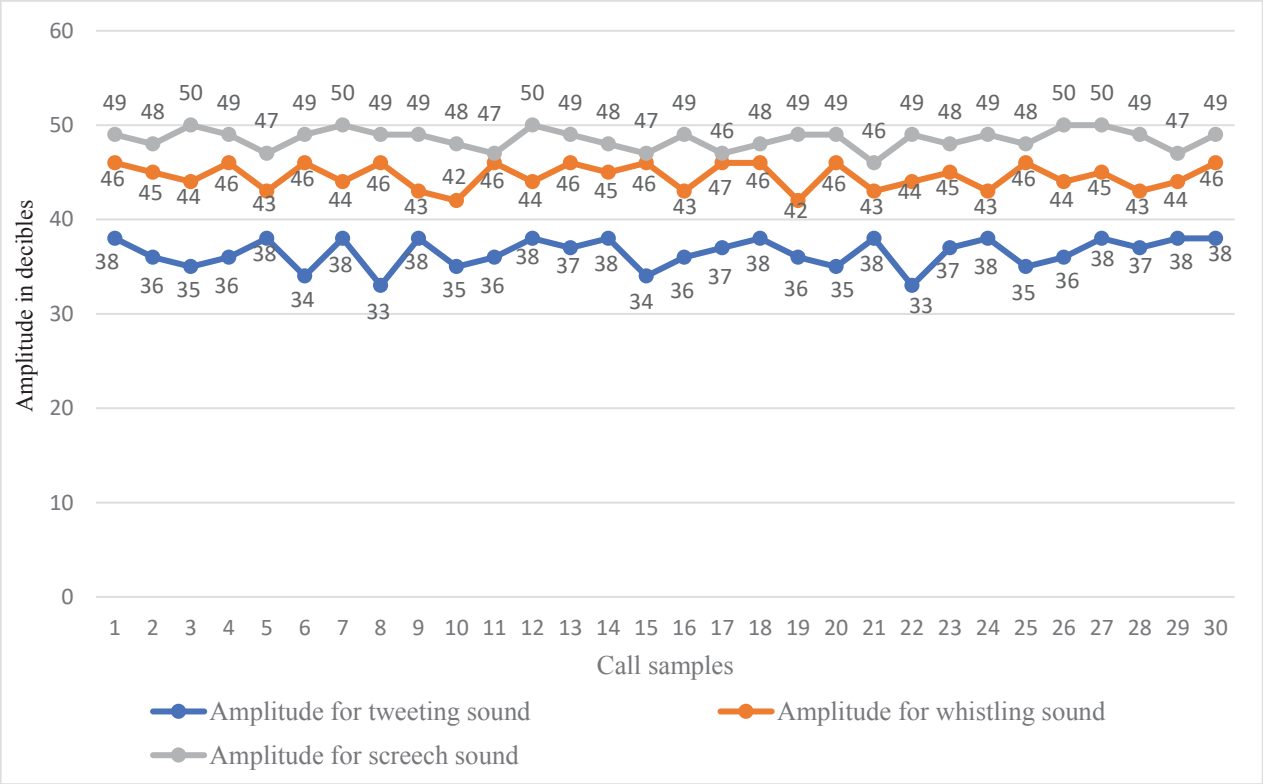



Fig.3: A and B spectrogram of Black drongo social interaction call showing four different phrases and three different notes. On the X axis of spectrograms, time is mentioned and on the Y axis frequency is mentioned.

samples taken. For the 30 call samples, amplitude of tweeting sound had a mean value of 36.466 decibels (db), having mode of 38 db and standard deviation of 1.6131db, amplitude of whistling sound had a mean value of 44.6 db, having mode of 46 db and standard deviation of 1.3796 db and lastly the amplitude for screech sound had a mean value of 48.5333 db, having mode of 49 db and standard deviation of 1.0742 db.




Graph 1: Time duration graph for social interaction amongst flock in black drongo. Range of time duration is between 10-20 minutes; mode value is 12 minutes with a standard deviation of 3.2898 minutes.




Graph 2: Amplitude graph for social interaction in a flock of black drongo. Amplitude of tweeting sound had a mean value of 36.466 db, mode value of 38 db and standard deviation of 1.6131db, amplitude of whistling sound had a mean value of 44.6 db, mode of 46 db and standard deviation of 1.3796 db and lastly the amplitude for screech sound had a mean value of 48.5333 db, mode of 49 db and standard deviation of 1.0742 db.

**Discussion**

A flock of 10 to 15 black drongo were observed in flock interacting with each other through calls, flights manoeuvres and friendly chases, here no signs of aggression were seen in most observations, exception being when sometimes they would chase away the other bird species, but no internal aggression was seen within the flock, such interaction shows a unique behaviour as usually black drongo are considered solitary and territorially aggressive birds know to having solitary foraging and territorial behaviour (Kaur et al. 2018, Narayan et al. 2014). Different flight patterns and manoeuvres performed by them during the interaction as mentioned in results were unique to these interactions as when foraging perching and straight path flights are only seen, while no such behaviour or calls or flights or manoeuvres were observed during mating interaction (Kaur et al. 2018, Muhammad et al. 2020). Having sufficient food in their territory being one of the main reasons for their peaceful coexistence in a flock is supported by comparison with various studies on foraging where they were seen tolerating other species birds up to an extent (Narayan et al. 2014). Such flock interactions and associated calls are hard to study in laboratory conditions and therefore needs to be studied in their natural habitat highlighting the importance of such study which in conducted as field work.

Different aspects of calls and its associated behaviour on standardized parameters and through nine such parameters were compared for social interaction call in a flock of black drongos, such study was inspired by various studies which considered different parameters to study bird calls such as study done by Brainard et al. 2000, Cardoso et al. 2012, Fagerlund 2014 etc, but it lacked the elaborated criteria upon which different calls can be classified for different behaviours, the present study gives an insight into how these birds use calls as a medium for communication, complexity and more number of phrases in a call makes it easy to associate it with a specific behaviour and a species and to form an association between the three. Black drongo being a passerine bird having complex and loud prominent

calls, can be used as a model bird to diversify the study of calls and songs in passerine/song birds as most of these studies have species of finches and sparrows as their model birds (Petrinovich et al. 1984, Clayton et al. 1990, Beecher et al. 2000, Nordby 2000). More work needs to be done on studying and analysing different behaviours and their calls on spectrogram as done here to compare and understand different calls of a species.

Converting sounds and calls into spectrogram and other visual representations has been used by researchers to study bird songs and calls making it easy to understand and interpret (Greenwalt 1968, Baker 2008, Lankau 2015) similarly using applications like Audacity, birds calls and songs can be understood and interpreted by studying them with their associated behaviour and observing the notes, syllables and phrases to interpret how their vocals or bird language works. It is important to study together a behaviour along with its associated calls/songs as it gives a more holistic idea about the bird rather than studying just its behaviour alone, as sometimes just by listening to a call or a song we might be able to know the species of a bird and what is it doing (Barrington 1773, Wyles 1983, Murillo 2008). There is also a need to study more different calls/songs and its associated behaviour in black drongo as most of the studies on black drongo are done on its foraging and reproductive behaviour (Narayan et al. 2014, Kaur et al. 2018, Muhammad et al. 2020) with no reference to its associated calls.

**Acknowledgement**

This research was possible with the help and guidance of Dr. Kaid Johar SR and department of Zoology, Gujarat University. We would like to thank our friends, family and God for being there with us and helping at each step throughout this journey of our research.

**Bibliography**

1. Ali S. (ed). *The Book of Indian Birds*. Oxford University Press, Bombay, 2002, 1-402
2. Myron C. Baker 2008. Bird Song Research: The Past 100 Years, Biology Department, Colorado State University, Fort Collins, CO 80523.
3. Barrington D 1773. Experiments and observations on the singing of birds. *Philosophical Transactions of the Royal Society of London* 63, 249–291.
4. Beecher M. D., Campbell S. E., Burt J. M., Hill C. E. and Nordby J. C. 2000. Song type matching between neighbouring song sparrows. *Animal Behaviour*, 59, 21– 27.
5. Bensch S. and Hassel Quist D. 1992. Evidence for female choice in a polygynous warbler. *Animal Behaviour* 44, 301–311.
6. Brainard M. S. and Doupe A. J. 2000. What songbirds teach us about learning. *Nature* 417, 351–358.
7. Buchanan K. L. and Catchpole C. K. 1997. Female choice in the sedge warbler, *Acrocephalus schoenobaenus*: multiple cues from song and territory quality. *Proceedings of the Royal Society of London, Series B* 264, 521–526.
8. Nicole K. Barker 2008. Bird Song Structure and Transmission in the neotropics: trends, methods and future directions. Department of Biological Sciences, University of Windsor, 401 Sunset Avenue, Windsor, Ontario N9B 3P4, Canada.
9. Clayton N. S. 1990. Subspecies recognition and song learning in zebra finches. *Animal Behaviour* 40, 1009–1017.
10. Catchpole Clive and Slater P. J. B. 1995. *Bird song: biological themes and variations*. Cambridge [England]: New York, NY, USA: Cambridge University Press,
11. Cardoso G. C. and Atwell J. W. 2012. On amplitude and frequency in birdsong: a reply to Zollinger et al. *Animal behaviour*, *84*(4), e10–e15. https://doi.org/10.1016/j.anbehav.2012.08.012
12. Seppo Fagerlund 2014. Acoustics and physical models of bird sounds. HUT, Laboratory of Acoustics and Audio Signal Processing.
13. Goller F. and Larsen O. N. 1997. A new mechanism of sound generation in songbirds, in 'Proceedings of the National Academy of Sciences', Vol. 94, pp. 14787–14791.
14. Greenewalt C. H. 1968. *Bird Song: Acoustics and Physiology*, Smithsonian Institution Press, Washington D.C.
15. Gaunt A.S., Nowicki S. 1998. Sound Production in Birds: Acoustics and Physiology Revisited. In: Hopp S.L., Owren M.J., Evans C.S. (eds) *Animal Acoustic Communication*. Springer, Berlin, Heidelberg.
16. Kroodsma E. H. Miller (Eds.), *Acoustic communication in birds* (Vol. II, pp. 311– 337). New York: Academic Press.

17. Kulczycki Emanuel 2014. Communication History and Its Research Subject. *Analele Universitatii din Craiova, Seria Filosofie*. 33. 132-155.
18. Kaur G and Kler TK 2018. Breeding biology of Black Drongo (Dicrurus macrocercus) in relation to nest-site selection and habitat characterization in agricultural landscape. *Journal of Entomology and Zoology Studies* 6 (5): 2142-2147.
19. Kaur G and Kler TK 2018. Feeding behaviour and perching preferences of black drongo (Dicrurus macrocercus) in Ludhiana district (Punjab). *Journal of Entomology and Zoology Studies* 6 (4): 232-239.
20. Lankau H.E., MacPhail A., Knaggs M., Bayne E. 2015. Acoustic Recording Analysis Protocol. Bioacoustic Unit, University of Alberta and Alberta Biodiversity Monitoring Institute. Edmonton, Alberta.
21. Bilal Muhammad, Khalid Zeeshan, Mosvi Ali and Naseer Amir 2020. Feeding Ecology, Behaviour and Habitat Utilization of Black Drongo (*Dicrurus macrocercus*) in Pothwar Plateau, Pakistan. *Journal of Bioresource Management*. 7. 47-56. 10.35691/JBM.0202.0131.
22. Narayana Buddi, Vaidyula Vasudeva Rao and Reddy V. 2014. Foraging Behaviour of Black drongo (*Dicrurus macrocercus*) in Nalgonda district of Andhra Pradesh, India. *The Bioscan*. 9. 467-471.
23. Dina Lipkind and Ofer Tchernichovski 2011. Quantification of developmental birdsong learning from the sub syllabic scale to cultural evolution. Department of Psychology, Hunter College, City University of New York, NY 10065.
24. Antonio Celis-Murillo, Jill L. Deppe and Michael F. Allen 2008. Using soundscape recordings to estimate bird species abundance, richness, and composition Centre for Conservation Biology, University of California, Riverside, California 92521, USA.
25. Nordby J. C., Campbell S. E., Burt J. M. and Beecher M. D. 2000. Social influences during song development in the song sparrow: A laboratory experiment simulating field conditions. *Animal Behaviour* 59, 1187–1197.
26. Nowicki Stephen and Searcy William 2005. Song and Mate Choice in Birds: How the Development of Behaviour Helps us Understand Function. *Auk*. 122. 1-14. 10.1093/auk/122.1.1.
27. Owings D. H. and Morton E. S. 1998. *Animal vocal communication: A new approach*. Cambridge, UK: Cambridge University Press.
28. Peek F. W. 1972. An experimental study of the territorial function of vocal and visual display in the red-winged blackbird (*Agelaius phoeniceus*). *Animal Behaviour* 20, 112–118.
29. Petrinovich L. and Baptista L. F. 1984. Song dialects, mate selection, and breeding success in white-crowned sparrows. *Animal Behaviour* 32, 1078–1088.
30. David Rothenberg 2014, Investigation of musicality in birdsong. Department of Humanities, New Jersey Institute of Technology, University Heights, Newark, New Jersey 07102.
31. Read A. F. and Weary D. M. 1992. The evolution of bird song: Comparative analyses. *Philosophical Transactions of the Royal Society of London*, Series B: Biological Sciences, 338, 165–187.
32. Saunders, A. A. 1924. The study of bird sounds. *Condor* 26, 209–213.
33. Saunders, A. A. 1929. *Bird song* (Handbook 7). Albany, NY: New York State Museum.
34. Saunders, A. A. 1935. *A guide to bird songs*. New York: Appleton-Century.
35. Tchernichovski O., Nottebohm F., Ho C. E., Pesaran B. and Mitra P. P. 2000. A procedure for an automated measurement of song similarity. *Animal Behaviour* 59, 1167–1176.
36. Thompson N. S., LeDoux K. and K. Moody 1994. A system for describing bird song units. *Bioacoustics* 5, 267–279.
37. Wiley, R. H. and Richards D. G. 1982. Adaptations for acoustic communication in birds: Sound transmission and signal detection. In D. E. Kroodsma and E. H. Miller (Eds.), *Acoustic communication in birds (Vol. II, pp. 131–181). New York: Academic Press.*
38. Witchell C. A. 1896. The evolution of bird-song: With observations on the influence of heredity and imitation. London: Adam and Charles Black.
39. Wyles, J. S., Kunkel J. G. and Wilson 1983. Birds, behaviour, and anatomical evolution. *Proceedings of the National Academy of Sciences, USA, 80, 4394– 4397.*

| 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 Pune 411009 | +91-020-9822193707 | Pande.satish@gmail.com |
| 2 | **Jeet Singh**<br>IFS | 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 P. O. Box 272 Eilat 88106, ISRAEL | +972 53 7671290 | ryosef60@gmail.com |
| 4 | **Dr. N.R. Karmalkar**<br>Prof. & Ex-Vice Chancellor | Geology & Environmental Sciences | Savitribai Phule Pune University (formerly University of Pune), 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), Ganeshkhind 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), Ganeshkhind Pune-411007 | +91-020-25601436 | naraharipg@gmail.com |
| 7 | **Dr. Ramesh D. Gulati**<br>Emeritus Guest Scientist | Limnology Aquatic Ecology | Department of Aquatic Ecology, NIOO/Netherlands Institute of Ecology, 6708 PB Wageningen The Netherlands | +31.317473550 | R.Gulati@nioo.knaw.nl |
| 8 | **Dr. Aswini Pai**<br>Associate Professor andCo-Chair | Ethnobotanist and plant ecologist | Biology Johnson Hall of Science, Room 227 St. Lawrence University, 23 Romoda Drive, 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, Bioprospecting | 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 | 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 | 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, research, conservation and public health.
(EJFW was strated as a Newsletter in 2012)

# TABLE OF CONTENTS



Cover: Dr. Omkar Sumant and Back cover : Pramod Deshpande

**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**






ISSN 2319 - 2461

Journal for Private Circulation only