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## THE BUTTERFLY (INSECTA: LEPIDOPTERA) DIVERSITY OF FOUR SACRED GROVES OF GOA, INDIA

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**Abstract:** The butterfly diversity of four sacred groves in Goa, viz., Nirankarachi Rai, Alvatiniichi Rai, Mharinginichi Rai and Azobhachi Rai was selected for study purposes. A total of 33 species belonging to 31 genera were observed which accounts for about 13% of the species recorded from Goa. The Family Nymphalidae dominated with a high number of species with maximum diversity in Mharinginichi Rai. It is concluded that further studies on groves from different habitats will significantly increase this number.

**Keywords:** Butterflies, Goa, species richness, sacred grove.

In ancient India, many communities practiced different forms of worshiping mother nature (Gadgil & Vartak 1974). One of the traditions is to protect forest patches designating them as sacred groves, dedicated to deities or ancestral spirits (Yadav et al. 2010). Over 13,720 sacred groves have been enlisted from India (Malhotra et al. 2001). Goa, a small state with an area of 3,702km<sup>2</sup> is covered by 1424.38km<sup>2</sup> of forests. Goa is estimated to harbour about 100 sacred groves (Rajendra Kerkar pers. comm. 2013) each reflecting unique micro climatic conditions with diverse flora and fauna.

Butterflies of Goa are fairly well documented

(Rangnekar & Dharwadkar 2009). Sharma & Borkar (2008) enumerated 251 species, while Rangnekar & Dharwadkar (2009) added three more species to the state, which takes the tally to 254 species. Documentation on butterflies of the state is mostly from national parks and wildlife sanctuaries and very few attempts have been made to enlist the richness and diversity of butterflies within the sacred groves of Goa. In this study, an attempt has been made to study the butterfly fauna of four patches of sacred groves in Goa.

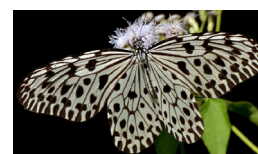
### MATERIALS AND METHODS

**Study Area:** Four sacred groves, viz.: Nirankarachi Rai (NR), Alvatiniichi Rai (AR), Azobachi Rai (AzoR) and Mharinginichi Rai (MR) have been studied (Fig. 1).

1. Nirankarachi Rai: The grove is located at Nanoda Village in Sattari Taluka (15°35'09"N & 74°11'24"E, 125m). This grove is dedicated to the holy spirit known as "Nirankari". It is essentially a Myristica swamp and covers an area <1ha. The vegetation is dominated by tree species such as *Gymnacranthera canarica*, *Holigarna*



*Idea malabarica*



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*grahamii*, *Polyalthia fragrans* and *Lophopetalum wightianum*.

2. Alvatiniichi Rai: The grove devoted to goddess “Alvatin” is located near Netravali Wildlife Sanctuary at Savari Village (15°04’03”N & 74°13’30”E, 122.3m), and covers an area <1 ha. The grove is bounded by agricultural land and thick evergreen forest. Like Nirancharachi Rai, this grove has unique *Myristica* swamp forests and is dominated by trees belonging to Myristicaceae as well as *Hydnocarpus pentandra* - an endemic tree species.

3. Mharinginichi Rai: It is located in Pissurlem Village of Sattari Taluka (15°31’40”N & 74°04’02”E, 46.7m), devoted to Dev Mharingan and managed by villagers. It covers about a 2ha area with elements of semi-evergreen forest. The grove is surrounded by a coconut plantation, grassland and degraded forest on lateritic plateau. The vegetation is dominated by trees such as *Hydnocarpus pentandra*, *Garcinia indica*, *Holigarna arnottiana*, *Ficus benghalensis*, *F. religiosa*, *F. exasperata* and *F. arnottiana* and *Persea macrantha*. However, the area was more or less degraded with *Chromolaena odorata* occupying

most of the degraded areas. In addition, shrubs such as *Carissa carandas*, *Ziziphus rugosa*, *Ziziphus oenopolia*, *Clerodendrum infortunatum* and *Ixora coccinea* are common.

4. Azobachi Rai: Azobachi Rai (15°36’27”N & 74°04’44”E, 247.8m) is conserved in the name of Azoba at Keri Village, Sattari Taluka and covers about 11ha area which is surrounded by the Sahyadri mountain ranges. The vegetation is dominated by tress such as *Ficus arnottiana*, *F. callosa*, *F. carica* and *F. nervosa*, *Terminalia paniculata* including endemic species such as *Aglaia elaeagnoidea*, *Holigarna grahamii*, *Polyalthia fragrans* and *Nothopegia castaneifolia*. Shrubs such as *Allophylus cobbe*, *Clerodendrum infortunatum*, *Flemingia strobilifera*, *Ixora coccinea* and *Lea indica* are common. Lianas and stragglers form an important component and they include *Calamus thwaitesii*, *Diploclisia glaucescens*, *Gnetum ula*, *Calycopteris floribunda*, *Callicarpa tomentosa*, etc.

The butterflies covered in this study were identified in the field visually with the help of the photographic guides of Rangnekar (2007) and Kunte (2000). The Identity of some of the taxa was confirmed by Mr. Parag Rangnekar. Photographs were taken using a Nikon D5100 (Image 1a–h).

**RESULTS AND DISCUSSION**

The four studied sacred groves constitute about 15 ha area. A total of 33 species belonging to 31 genera were observed which constitutes 13% of the butterfly diversity (Table 1) of the state. This included 18 species of Nymphalidae and five species each from Papilionidae, Pieridae and Lycaenidae. The faunal elements were of interest in that it contained two endemic species, viz., Southern Birdwing *Troides minos* and Malabar Tree Nymph *Idea malabarica*. The former is protected under Schedule-I of the Wildlife (Protection) Act, 1972, while the latter is near threatened (Lepidoptera Specialist Group 1996). This indicates the importance of sacred groves. The family Nymphalidae was dominant in all the four sacred groves (Fig. 2), as it is the largest family of butterflies. One of the reasons for its dominance might be the availability of their larval food plants which was also reviewed by Murugesan et al. (2013). A similar pattern of dominance was observed by different authors (Kunte 1997, Kunte et al. 1999; Arun 2000; Devi & Devidar 2001; Eswaran & Pramod 2005; Kumar et al. 2007; Dolia et al. 2008; Krishnakumar et al. 2008; Ramesh et al. 2010; Gogoi 2012; Murugesan et al. 2013).

With regard to the number of species recorded from the various patches of sacred groves, 22 were



Figure 1. Study sites in Goa

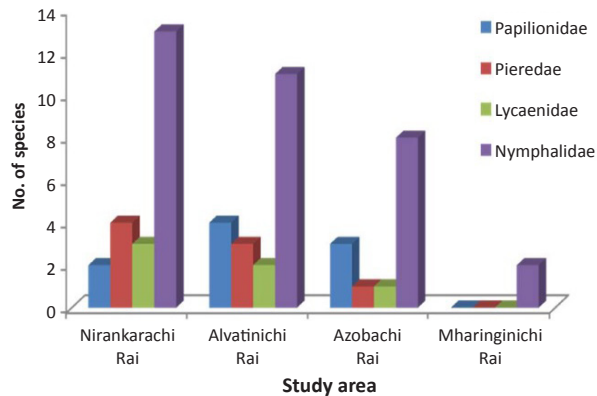
Table 1. Checklist of butterflies with their scientific names and their occurrence in different groves

	Family/Common Names	Scientific Names	MR	AR	AzoR	NR
Paillionidae						
1	Blue Mormon	<i>Papilio polymnestar</i> (Cramer)		+	+	
2	Common Rose	<i>Pachliopta aristolochiae</i> Fabricius	+	+	+	
3	Common Mormon	<i>Papilio polytes</i> Linnaeus	+	+		
4	Southern Birdwing	<i>Troides minos</i> Cramer		+		
5	Tailed Jay	<i>Graphium agamemnon</i> Linnaeus			+	
Pieridae						
6	Common Grass Yellow	<i>Eurema hecabe</i> Moore	+	+	+	
7	Common Wanderer	<i>Pareronia valeria hippia</i> Cramer	+	+		
8	Pioneer	<i>Anaphaeis aurota</i> (Fabricius)		+		
9	Common Jezebel	<i>Delias eucharis</i> Drury	+			
10	Common Emigrant	<i>Catopsilia crocale</i> Fabricius	+			
Lycaenidae						
11	Lesser Grass Blue	<i>Zizina otis indica</i> Murray	+			
12	Pale Grass Blue	<i>Zizeeria maha ossa</i> (Swinhoe)		+		
13	Common Pierrot	<i>Castalius rosimon rosimon</i> Fabricius	+			
14	Suffused Double-banded Judy	<i>Abisara bifasciata suffusa</i> Moore	+			
15	Malayan	<i>Megisba malaya</i> (Horsfield)		+		
Nymphalidae						
16	Common crow	<i>Euploea core core</i> (Cramer)	+	+	+	
17	Rustic	<i>Cupha erymanthis</i> Frushstorfer	+	+	+	+
18	Striped Tiger	<i>Danaus genutia</i> (Cramer)			+	
19	Common Evening Brown	<i>Melanitis leda</i> (Drury)	+		+	
20	Chocolate Pansy	<i>Precis iphita</i> (Cramer)		+	+	
21	Common Sailer	<i>Neptis hylas</i> (Moore)	+	+	+	
22	Glassy Tiger	<i>Parantica aglea</i> Stoll	+		+	
23	Grey Pansy	<i>Precis atlites</i> (L.)	+	+		
24	Grey Count	<i>Tanaecia lepidea</i> Frushstorfer	+			
25	Common Four Ring	<i>Ypthima huebneri</i> (Kirby)	+			
26	Common Sergeant	<i>Athyma perius</i> (Linnaeus)	+			
27	Malabar Tree Nymph	<i>Idea malabarica</i> (Moore)	+	+		+
28	Plain Tiger	<i>Danaus chrysippus</i> (Linnaeus)	+	+		
29	White Four-ring	<i>Ypthima ceylonica</i> (Hewitson)		+		
30	Common Bush Brown	<i>Mycalesis perseus typhlus</i> Frushstorfer		+		
31	Tamil Yeoman	<i>Cirrochroa thais thais</i> (Fabricius)	+	+	+	
32	Nigger	<i>Orsotriaena medus</i> (Fabricius)	+			
33	Blue Tiger	<i>Tirumala limniace exoticus</i> Gmelin		+		

MR - Mharinginichi Rai; AR - Alvatinihi Rai; AZOR - Aazobachi Rai; NR - Nirancharachai Rai

from MR, 20 species from AR, 12 species from Azor and two species from NR. The species composition of the various patches of sacred groves was also interesting. A total of nine species, viz., the Common Jezebel *Delias eucharis*, Common Emigrant *Catopsilia crocale*, Lesser Grass Blue *Zizina otis indica*, Common Pierrot *Castalius rosimon rosimon*, Suffused Double-banded Judy *Abisara bifasciata suffusa*, Grey Count *Tanaecia lepidea*, Common Four Ring *Ypthima huebneri*, Common Sergeant *Athyma perius* and Nigger *Orsotriaena medus* were seen only in

Mharinginichi Rai. The Common Bush Brown *Mycalesis perseus typhlus*, White Four-ring *Ypthima ceylonica*, Malayan *Megisba malaya*, Pale Grass Blue *Zizeeria maha ossa*, Pioneer *Anaphaeis aurota* and Southern Birdwing *Troides minos* were sighted only in Alvatinihi Rai. The latter is an endemic species to Peninsular India and was sighted twice on subsequent days during the morning hours in January 2014 and was found visiting this grove from the nearby evergreen forest. The Tailed Jay *Graphium agamemnon* and Striped Tiger *Danaus*



**Figure 2.** Family wise distribution of butterfly species in four sacred groves of Goa

*genutia* were sighted exclusively in Azobachi Rai. Rustic *Cupha erymanthis* is the only species which has been recorded from all the four groves. Bray-Curtis analysis was used to analyse the similarity between the four sites (Table 2) based on the presence and absence of butterfly species. Maximum similarity was observed between MR and AR (52.38%) and the least was observed between AzoR and NR (14.29%).

MR shows a maximum butterfly species richness (22 species) and the reasons might be high plant diversity which provides host and food plants for butterflies. This grove is infested with *Chromolena odorata* which is known for high nectar production (Laxmi & Solomon Raju 2011). This may be one of the reasons for the high number of butterfly species as it provides abundant nectar. This grove is also surrounded by a lateritic plateau and grassy plains which provide additional suitable habitats for butterflies and creates wide scope for food plants. Butterflies from adjacent areas may be visiting and contributing to the butterfly diversity. AR is a swamp forest dominated by Myristicaceae members and is surrounded by agricultural fields and evergreen forest. Evergreen forest provides good habitat for butterflies hence the AR has more diverse butterfly species (20 species) compared to AzoR and NR. AzoR is a thick forested area dominated by liana species. This grove is not infested with weeds while the adjacent areas of AzoR is surrounded by cashew plantation and were completely infested with the weed *C. odorata*. Butterfly diversity has been observed to be more towards the boundaries of the groves as compared to interior with more native species. AzoR has less number of butterfly species (12 species) as compared to MR and AR. Light is an important factor for butterfly assemblage (Hill et al. 2001) and it is associated with increased butterfly diversity (Sparrow et al. 1994). This could be the reason

**Table 2.** Similarity Matrix of distribution of butterfly species in four sacred groves.

Similarity Matrix				
	MR	AR	AzoR	NR
MR	*	52.381	47.0588	16.6667
AR	*	*	50	18.1818
AzoR	*	*	*	14.2857
NR	*	*	*	*

MR - Mharinginichi Rai; AR - Alvatinichi Rai; AZOR - Aazobachi Rai; NR - Nirancharachi Rai

for less butterfly diversity as AzoR is a thick forested area and its surroundings provide a well lighted environment and nectar source through invasive plant species. Similar views regarding the importance of invasive species for butterfly species richness was also expressed by Raju & Reddy (1995) and Borkar & Komarpant (2004). NR is the smallest among all four sacred groves. Like AR this grove has less plant diversity, but characteristically dominated by family Myristicaceae and has the least butterfly species (2 species). The Malabar tree nymph *Idea malabarica* is found to be the commonest species at NR. Plant families such as Rutaceae, Aristolochaceae, Fabaceae, Poaceae, Rhamnaceae, Apocynaceae, Moraceae, Capparidaceae which provide a large number of host species (Kunte 2000) are not observed in NR. NR is surrounded by agricultural fields and rubber plantations which do not provide any suitable habitat for butterflies. A small area, less plant diversity and adjacent paddy fields may be the major factors for less number of butterfly species observed here. Similarity among the sites, based on the butterfly species distribution, varies from 14.29– 52.38 %. This shows that the distribution of butterfly species also depends on the vegetation type apart from other factors.

## CONCLUSION

From the study it is concluded that generally sacred groves with high plant diversity hold a high number of butterflies. Presence of endemic and Near Threatened species, viz., Southern Birdwing *Troides minos* and Malabar Tree Nymph *Idea malabarica* indicates the importance of these groves for the butterflies and their conservation. In spite of the high anthropogenic activities in Mharinginichi Rai, good diversity of flora and fauna, such groves become ecological harbours. Research efforts to gather basic information on faunal diversity, especially butterflies are needed for future effective management programmes as butterflies are good indicators of environmental quality (Gunathilagaraj



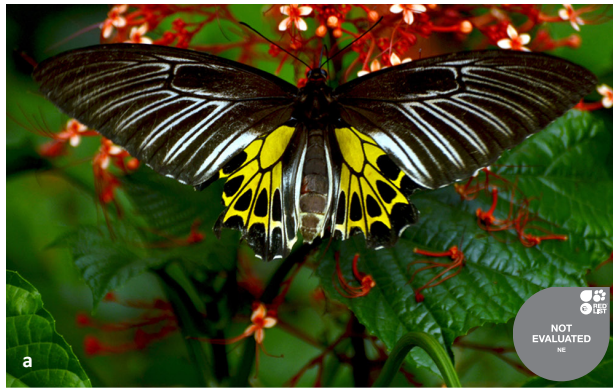


Image 1a–h. a - *Troides minos*; b - *Idea malabarica*; c - *Tirumala limniace exotica*; d - *Delias eucharis*; e - *Pareronia valeria hippia*; f - *Catopsilia crocale*; g - *Cupha erymanthis*; h - *Eurema hecabe*. © Authors

et al. 1998) and of ecological significance (Kanerla et al. 2013). It is concluded that year round work in the sacred groves of different habitats might throw some light with regard to butterfly diversity.

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