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A PRELIMINARY CHECKLIST OF BUTTERFLY DIVERSITY IN THE WESTERN GHATS AT POINGUINIM, CANACONA, GOA

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Butterflies are the most beautiful insects. They are well adapted to the landscape and react quickly to any alteration in their habitat as a result of anthropogenic activities. Thus they act as bio- indicators. Presence of rich butterfly diversity in and around Poinguinim reflects the health of its environment; however, variations in butterfly population in different areas indicate impact of human activities. Documentation of butterfly composition should be updated regularly by researchers or NGOs as it help in estimating impact of anthropogenic activities on the habitat and also crucial to fill up any voids in the process of conservation of butterfly fauna. In the present investigation , the highest number of butterfly species was recorded from Dharwatem Forest Area (DFA) Sub site -3 (35 species , 160 individuals) and this might be due to presence of sufficient host plants and favorable climatic conditions like humidity and temperature for the growth and development, followed by Parshuram Temple (PT) Sub site-1 (27 species,132 individuals), Shradhanand High School (SHS) Sub site-2 (24 species, 117 individuals) with moderate human interference and least was in Tirwan Forest Area (TFA) Sub site - 4 (17 species and 45 individuals) with maximum human activities as the survey site was adjacent to the National highway.

Keywords: Anthropogenicity; biological indicators; lepidoptera; species diversity.

1. INTRODUCTION

Butterflies are one of the most astonishing and highly attractive elements of biodiversity. They play a vital role in the food chain components of predatory insects, spiders, reptiles and birds. They are highly sensitive creatures which react quickly to the environmental disturbances like temperature, light,

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other climate changes and the availability of host plants for oviposition and development.

For rapid development environmental protection must be a most vital aspect and should balance with economic growth. There is an alarming rise in industrial and automobile pollution due to urbanization. With the shrinking of greenery and increase in pollution, our wildlife is fast disappearing and many species are on the verge of extinction.

Butterflies make up a large group of Lepidoptera diverse in shape, size and color. They are cosmopolitan, found everywhere on the earth except the Polar Regions. They are considered as bio-indicators of a healthy ecosystem [1] and have an intimate relationship with plants. They enable sustenance of ecosystem services through their role in pollination and serving as important food chain components. They are the health and quality indicators of their host plants and habitats, thus investigation of butterfly fauna is very important in identifying and preserving potential habitats under threat.

Vast literature is available on the butterfly diversity documentation in India. Jeevan et al. [2] recorded "41 species of butterflies from Mandagadde Bird Sanctuary of Shivamogga, Karnataka". Prasanna Kumar et al. [3] recorded "84 species of butterflies from Seshachalam Biosphere Reserve, Andhra Pradesh". Santhosh and Basavarajappa [4] recorded "95 species of butterflies from Agro-horticultural ecosystems of Mysore, India". Irungbam and Meenakshi [5] studied "butterfly diversity from Mendralgang of Bhutan and recorded 125 species of butterflies". Dwari & Mondal [6] recorded "29 species of butterflies from Agricultural fields of Howrah district in West Bengal". Sayeswara [7] documented butterfly diversity at Gandhi park, Shivamogga City, Karnataka and recorded 36 species.

Western Ghats is one of the most biologically diversified areas in the country with a wide variety of butterfly species. 1501 butterfly species are recorded from India. 334 species of butterflies are reported from the Western Ghats [8] and 150 from the Eastern Ghats [9]. "Butterfly diversity in India varies from place to place". According to Gaonkar [10] "the butterfly diversity decreases from south to north along the Western Ghats and the butterfly species reported from the States are Gujarat (158 species), Maharashtra (208 species), Goa (249 species),Kerala (314 species), Karnataka (316 species) and Tamil Nadu (316 species)".

Species inventory of butterflies in Bondla wildlife sanctuary was compiled by Borkar and Komarpant [11]. 91 species of 66 genera and 14 sub families were reported during the one year study period, of which 20 were habitat specialists and 71 were generalists. Sharma and Borkar [12] reported 251 butterflies from the state of Goa. Three new species Black-vein Sergeant (*Athyma ranga (*Moore) White- banded Awl (*Hasora taminatus* (Hübner)) Coon (*Psolos fuligo* (Mabille) were added to the list by Rangnekar and Dharwadkar[13]. Bowalkar et al. [14] conducted a survey at the Taleigao plateau, and reported 98 species of butterflies under 72 genera and five families which accounts for about 39% of the reported butterfly fauna in Goa.

Butterflies react quickly to any variations in their habitat due to anthropogenic activities such as agricultural practices [15]. Climatic change amplifies the habitat modifications and severely influences butterfly diversity [16]. Expansion of a species range may often be in response to human activities such as afforestation of host specific plants, diversion of traffic from least impact zones of the habitat, development of butterfly parks etc. favoring these species. Thus, butterflies play a crucial role in co-evolutionary relationships between flora and fauna [16]. Hence, the present study was aimed to assess impact of habitat variations on the relative abundance of butterfly species and to prepare a checklist of the butterflies in different areas of diversified habitats of Poinguinim village , Canacona, Goa.

2. MATERIALS AND METHODS

Present Study was conducted at four sub sites of Poinguinim village based on their strategic location and on the basis of human interference intensity of the local environment of the village such as educational activities, religious ceremonies, and highway traffic.

Sub site: 1) Parshuram Temple (PT): - The temple is located 1.4 km away from Cotigao wildlife sanctuary, amidst the quiet of the surrounding deep heavy woods in Poinguinim Village in Canacona Taluka (14.9740° N, 74.0957° E.).

Sub site: 2) Shradhanand High School (SHS): - It is located in Poinguinim, Rural Canacona South Goa district with a playground and a garden dominated by many shrubs such as *Carissa carandas, Ziziphus rugosa, Ziziphus oenoplia , Clerodendrum infortunatum , Ixora coccinea* are common in this study area.. (15.002219.N, 74.047876 E).

Sub site: 3) Dharwatem Forest Area (DFA): -It is located in Poinguinim Village of Canacona taluka (14.9774697°N,74.0905932°E). The place is surrounded by the forest, mountains and several water bodies and also human Settlements, with rich

vegetation such as *Gymnacranthera canarica, Holigarna grahami, Polyalthia fragrans, Lophopetalum wightianum* etc.

Sub site: 4) Tirwan Forest Area (TFA): - It is located on the border of Poinguinim village of Canacona taluka and is close to the state of Karnataka and National Highway. (14.9652686°N, 74.0850152°E).

Field surveys were carried out on every Sunday for a period of six months from Mid-September 2021 to Mid March 2022 from 7.00 a.m. to 12.00 noon. Photographs were taken using a Canon EOS 600D camera with 18-250mm lens and Redmi Note 10, Pro Max phone.

Key characters used in identification of butterflies were color pattern, mode of flight, color , size, shape and wing venation. The butterflies were identified by using Photographic guide to butterflies of Goa by [18] Rangnekar (2007), Winged jewels by Udaya Kumar k,Bharath S ,Nagaraj Shastri [19], A guide to the butterflies of Western Ghats (India) by Bhakare, M. and Ogale, H [20] and the website www.ifoundbutterflies.org [21].

Relative abundance of butterfly species in the four selected sites was calculated using the formula.

> Species relative abundance = (Total Number of Individual species (Isi) / Total Number of Species Population (∑Nsi)) X 100

3. RESULTS

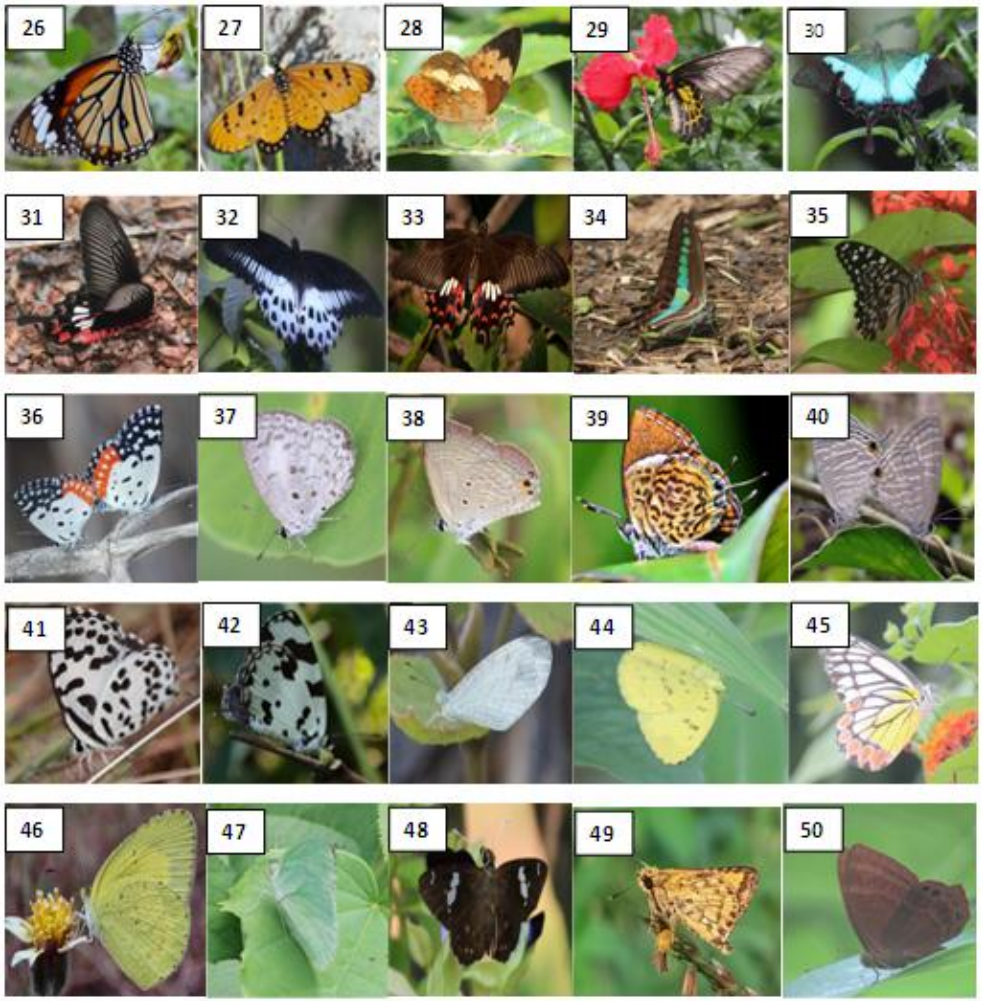
Altogether 50 species of butterflies belonging to six families were observed during morning hours around selected sites of Poinguinim village over the period of 6 months. (Fig.1). The checklist of the species of butterfly observed in the study area is presented in (Tables 1,2). Family Nymphalidae was represented by highest 28 species (56%) followed by family Papilionidae with 7 species (14%), Lycaenidae with 7 species (14%), Pieridae with 5 species (10%), Hesperiidae with 2 species (4%) and Riodinidae with only 1 species (2%). The percentage occurrence of the six families indicates that Nymphalidae is the most common family around Poinguinim village representing 56% of the total butterfly species whereas Riodinidae was the family with the lowest percentage occurrence of 2% (Fig. 2).

As per the frequency of occurrence of the butterfly species, 3 species namely Common grass yellow (*Eurema hecabe* Linnaeus,1758), Glassy tiger (*Parantica aglea* Stoll, 1782) and Common tiger (*Danaus genutia* Cramer, 1779) were found to be abundant with *E. hecabe* being the most widespread species.

Ten species rated as very Common include Plain tiger (*Danaus chrysippus*),Chocolate pansy (*Junonia iphita*), Glassy tiger (*Parantica aglea*), Common crow (*Euploea core*), Grey pansy (*Junonia atlites*), Common tiger (*Danaus genutia*), Common birdwing (*Troides helena)*, Common mormon (*Papilio demoleus*), Common grass yellow (*Eurema hecabe*), Common jezebel (*Delias eucharis*). Nine species rated as common, eleven species were not rare whereas seven species found to be rare and Thirteen species found were very rare which include Blue oakleaf (*Kallima horsfieldii)*, The tamil yeoman (*Cirrochroa thais*), The clipper (*Parthenos sylvia*), Lemon pansy (*Junonia lemonias*), Common lascar (*Pantoporia hordonia*), Red spot duke (*Dophla evelina*), Common baron (*Euthalia aconthea*), The rustic (*Cupha erymanthis*), Malabar banded peacock (*Papilio crino*), Common blue bottle (*Graphium sarpedon*), Gram blue (*Euchrysops cnejus*), Angled pierrot (*Caleta decidia*), and Wandering psyche (*Leptosia nina*).

The four sites which were chosen for study showed variation in distribution of different species of butterflies and also number of individuals. Where, highest butterfly diversity was recorded in Site-3 (total species count of 35) followed by Site-1 (total species count of 27), Site-2 (total species count of 24) and Least was in Site-4 (total species count of 17), Whereas the total number of individuals recorded in these site is different. In this, the highest number of individuals were recorded on site-1 (160 individuals) followed by site-2 (132 individuals), site-3 (117 individuals) and least was recorded on site-4(45 individuals). At site 1 Common grass yellow (*Eurema hecabe*)was found at maximum (25.0). Angled castor (*Ariadne ariadne*), Angled pierrot (*Caleta decidia*)and Plum judy (*Abisara echerius*) were minimum(0.62). At site 2.Glassy tiger (*Parantica aglea*) were maximum (12.87), Long brand bush brown (*Mycalesis visala*), Grey pansy (*Junonia atlites*), Common hedge blue (*Acytolepis puspa*) and Mimosa yellow *(Pyrisitia nise*) were minimum (0.75), at site 3 Chocolate pansy (*Junonia iphita*) with (7.69) was maximum Glassy tiger(*Parantica aglea*), Blue oak leaf (*Kallima horsfieldii*) ,Red spot duke (*Dophla evelina*), Common tiger (*Danaus genutia*), were minimum. The rustic (*Cupha erymanthis*) , Common emigrant (*Catopsilia pyranthe*), Blue oak leaf (*Kallima horsfieldii*) .were minimum.(0.85) . At site 4 Common crow(*Euploea core*)were maximum 15.55 Chocolate pansy (*Junonia iphita*),Common palmfly(*Elymnias hypermnestra*) The clipper (*Parthenos Sylvia*), Common lascar (*Pantoporia hordonia*). Common birdwing (*Troides Helena*)

1) Danaus chrysippus 2) Ariadne ariadne 3) Mycalesis visala 4) Mycalesis perseus 5) Junonia iphita 6) Elymnias hypermnestra 7) Parantica aglea 8) Ypthima huebneri 9) Euploea core 10) Tanaecia lepidea 11) Melanitis leda 12) Kallima horsfieldii 13) Cirrochroa thais 14) Hypolimnas bolina 15) Junonia atlites 16) Parthenos sylvia 17) Neptis hylas 18)Ariadne merione 19) Orsotrioena medus 20) Junonia lemonias 21) Melanitis phedima 22) Pantoporia hordonia 23) Dophla evelina 24) Euthalia aconthea 25) Doleschallia bisaltide



26) *Danaus genutia* 27) Acraea terpsicore 28) *Cupha erymanthis* 29) *Troides Helena* 30) *Papilio crino* 31) *Pachliopta aristolochiae* 32) *Papilio polymnestor* 33)*Papilio polytes* 34) *Graphium sarpedon* 35) *Papilio demoleus* 36) *Talicada nyseus* 37) *Acytolepis puspa* 38) *Euchrysops cnejus* 39) *Jamides celeno* 40) *Castalius rosimon* 41) *Rathinda amor* 42) *Caleta decidia* 43) *Leptosia nina* 44) *Eurema hecabe* 45) *Delias eucharis* 46) *Pyrisitia nise* 47) *Catopsilia pyranthe* 48) *Celaenorrhinus putra* 49) *Potanthus Omaha 50) Abisara echerius*

Fig. 1. Butterfly species diversity from poinguinim during the study period

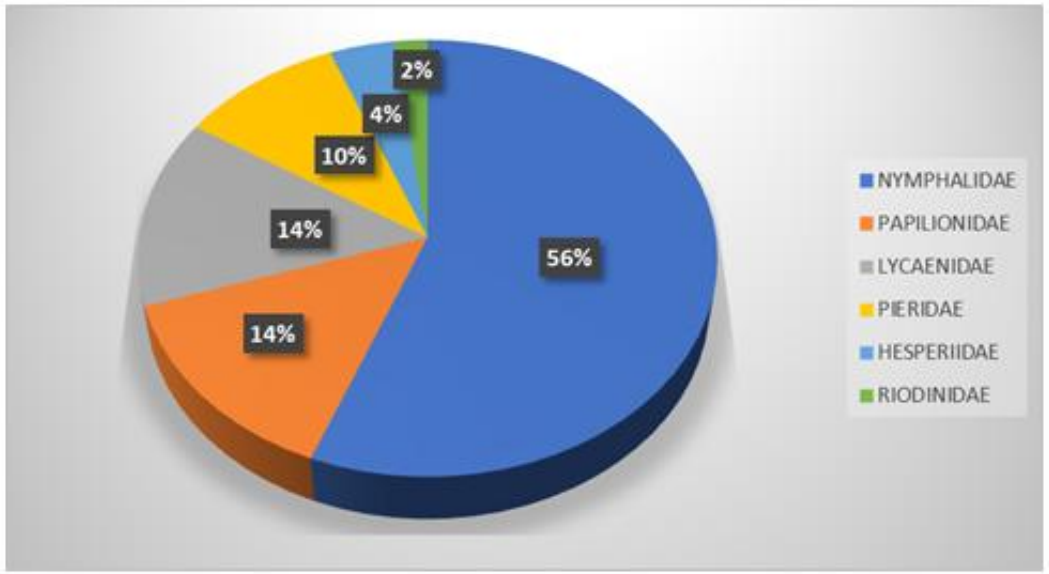


Fig. 2. Family wise composition of butterfly species

Table 1. Preliminary checklist of butterfly diversity in Poinguinim

Sr. No.	Family	Scientific name	Common name	Numerical abundance	Relative abundance Status
01	Nymphalidae	*Danaus chrysippus* (Linnaeus, 1758)	Plain tiger	16	VC
02		*Ariadne ariadne* (Linnaeus, 1763)	Angled castor	6	NR
03		*Mycalesis visala* (Moore, 1858)	Long brand bush brown	11	C
04		*Mycalesis perseus* (Fabricius, 1775)	Common bush brown	8	NR
05		*Junonia iphita* (Cramer, 1779)	Chocolate pansy	17	VC
06		*Elymnias hypermnestr* (Linnaeus, 1763)	Common palm fly	3	R

Sr. No.	Family	Scientific name	Common name	Numerical abundance	Relative abundance Status
07		*Parantica aglea* (Stoll, 1782)	Glassy tiger	29	VC
08		*Ypthima huebneri* (Kirby, 1871)	Common four ring	11	C
09		*Euploea core* (Cramer, 1780)	Common crow	18	VC
10		*Tanacia lepidea* (Butler, 1868)	The grey count	6	NR
11		*Melanitis leda* (Linnaeus, 1758)	Common evening brown	11	C
12		*Kallima horsfieldii* (Kollar, 1844)	Blue oak leaf	1	VR
13		*Cirrochroa thais* (Fabricius, 1787)	The Tamil yeoman	2	VR
14		*Hypolimnas bolina* (Linnaeus, 1758)	Common egg fly	8	NR
15		*Junonia atlites* (Linnaeus, 1763)	Grey pansy	16	VC
16		*Parthenos sylvia* (Cramer, 1776)	The clipper	1	VR
17		*Neptis hylas* (Linnaeus, 1758)	Common sailor	3	R
18		*Ariadne merione* (Cramer, 1777)	Common castor	14	C
19		*Orsotrioena medus* (Fabricius, 1775)	The nigger	7	NR
20		*Junonia lemonias* (Linnaeus, 1758)	Lemon pansy	2	VR
21		*Melanitis phedima* (Cramer, 1780)	Dark evening brown	9	NR
22		*Pantoporia hordonia* (Stoll, 1790)	Common lascar	1	VR
23		*Dophla evelina* (Stoll, 1790)	Red spot duke	1	VR
24		*Euthalia aconthea* (Cramer, 1777)	Common baron	2	VR
25		*Doleschallia bisaltide* (Cramer, 1777)	Autumn leaf	6	NR
26		*Danaus genutia* (Cramer, 1779)	Common tiger	24	VC
27		*Acraea terpsicore* (Linnaeus, 1758)	Tawny coaster	11	C

Sr. No.	Family	Scientific name	Common name	Numerical abundance	Relative abundance Status
28		*Cupha erymanthis* (Drury, 1773)	The rustic	1	VR
29	Papilionidae	*Troides helena* (Linnaeus , 1758)	Common birdwing	19	VC
30		*Papilio crino* (Fabricius, 1792)	Malabar banded peacock	2	VR
31		*Pachliopta aristolochiae* (Fabricius, 1775)	Common rose	9	NR
32		*Papilio polymnestor* (Cramer, 1775)	The blue Mormon	8	NR
33		*Papilio polytes* (Linnaeus, 1758)	Common Mormon	20	VC
34		*Graphium sarpedon* (Linnaeus, 1758)	Common blue bottle	1	VR
35		*Papilio demoleus* (Linnaeus, 1758)	Lime butterfly	4	R
36	Lycaenidae	*Talicada nyseus* (Guerin, 1843)	Red Perrot	7	NR
37		*Acytolepis puspa* (Horsfield, 1828)	Common hedge blue	7	NR
38		*Euchrysops cnejus* (Fabricius 1798)	Gram blue	2	VR
39		*Jamides celeno* (Cramer, 1775)	Common cerulean	14	C
40		*Castalius rosimon* (Fabricius, 1775)	Common Pierrrot	11	C
41		*Rathinda amor* (Fabricius, 1775)	Monkey puzzle	4	R
42		*Caleta decidia* (Hewitson, 1876)	Angled Pierrot	2	VR
43	Pieridae	*Leptosia nina* (Fabricius, 1793)	Wandering psyche	2	VR
44		*Eurema hecabe* (Linnaeus, 1758)	Common grass yellow	40	VC
45		*Delias eucharis* (Drury, 1773)	Common jezebel	21	VC
46		*Pyrisitia nise* (Cramer, 1775)	Mimosa yellow	12	C
47		*Catopsilia pyranthe* (Linnaeus, 1758)	Common emigrant	4	R
48	Hesperiidae	*Celaenorrhinus putra* (Moore, 1866)	Common spotted flat	5	R

Sr. No.	Family	Scientific name	Common name	Numerical abundance	Relative abundance Status
49		*Potanthus omaha* (H. Edwards, 1863)	The lesser dart	10	C
50	Riodinidae	*Abisara echerius* (Stoll, 1790)	Plum Judy	5	R

Table 2. Numerical count of butterfly diversity during the study period in Poinguinim

Sr no	Species	Months																											Total
		September		October					November				December				January						February			March			
		3rd sun	4th sun	1st sun	2nd sun	3rd sun	4th sun	5th sun	1st sun	2nd sun	3rd sun	4th sun	1st sun	2nd sun	3rd sun	4th sun	1st sun	2nd sun	3rd sun	4th sun	5th sun	1st sun	2nd sun	3rd sun	4th sun	1st sun	2nd sun	
1	Plain tiger		1			2	2		1			1	1	1				3	1		1			1			1	16
2	Common birdwing	1	1		2	2		1		1	1		3		1	1	1			1		1			1		1	19
3	Malabar banded peacock						1							1														2
4	Common spotted flat				1					2									1					1				5
5	Angled castor			1			2			1					1											1		6
6	Red pierrot				2			1					1				1						1				1	7
7	Common hedge blue													1						1		1		3		1		7
8	The wandering psyche					1												1										2
9	Long brand bushbrown	1			1		3		1				2						2					1				11
10	Common rose					2				2			1			1							2				1	9
11	Common bushbrown		1					2				1			1	1									2			8
12	Chocolate pansy	1		4			1				3		1		1		1			1	2			1		1		17
13	Blue mormon				1				1					2						2				2				8
14	Common palmfly			1															1				1					3

15	The gram blue						1								1															2
16	Glassy tiger			6		1			3			3	1			5		1		1	2			3	1		2	29
17	Common fourring		1		2	1				2				1			1						2			1			11
18	Common crow	2	1		1		1				1	1				1		1	2		1	1	2	1	1		1	18
19	Common grass yellow	4	2	1	1	1		2	1	4	2	1			1	1	2	1		3	1	1	1	3	2		5	40
20	Common jezebel		2	1		3			2		1	1		1	1		1	1		2	1	1		2			1	21
21	Grey count			2			1							1					1						1			6
22	Common evening brown	1			1			1					1		1	1		1		1				2		1		11
23	Common cerulean			3	1		1				3			2							1		1	1			1	14
24	Common pierrot		2			1	1		1	1		1			2		1								1			11
25	Mimosa yellow							1					1		2		1	1	2	1		1		1		1		12
26	Blue oakleaf									1																		1
27	The tamil yeoman				1											1												2
28	Common eggfly		1		1				1				2				1		1				1					8
29	Common mormon	3		1	1	2		1			1	2		1	1	1		1		1		1		1		1	1	20
30	Grey pansy	2	1	1		1	1	1			1	1	1			1	1		1				1		1	1		16
31	The clipper									1																		1
32	Monkey puzzle			1				1							1						1							4
33	Common sailor											1											2					3
34	Common blue bottel																		1									1
35	Common castor	2				1						1	2			1		1	1		1	1		1		2		14
36	The nigger		1		1	1					1			1			1							1				7
37	The lemon pansy							1										1										2
38	Dark		1		1		1					1		1			1						1		1	1		9

	evening brown																												
39	Common lascar							1																					1
40	Common emigrant		1						1	1								1											4
41	Plum judy			1		1							1					1					1						5
42	Red spot duke														1														1
43	Common baron			1						1																			2
44	Angled pierrot						1	1																					2
45	Autumn leaf		1		1						1				1				1	1									6
46	Tawny coster			1		2			1	1		1				1	1				1				1	1			11
47	Common tiger	4	3		5		4	2			1		1	1		1				1				1					24
48	The rustic								1																				1
49	Lime butterfly				1							1				1					1								4
50	The lesser dart	1		1	1					1		1					1		1			1	1			1			10
																													454

Table 3. Monthly distribution of different families of butterfly species recorded during study period

Sr. No.	Family / Months	Nymphalidae	Papilionidae	Lycaenidae	Pieridae	Hesperiidae	Riodinidae	Total
1.	September	25	5	2	9	1	0	42
2.	October	65	15	15	11	3	2	111
3.	November	34	8	6	14	3	1	66
4.	December	38	15	8	7	1	0	69
5.	January	38	8	5	19	3	1	74
6.	February	33	8	8	12	4	1	66
7.	March	12	4	3	7	0	0	26

Table 4. Relative abundance of butterflies during the study period in various sites of Poinguinim

Sr. No.	Common Name	Scientific Name	Site-1	Relative Abundance	Site-2	Relative Abundance	Site-3	Relative Abundance	Site-4	Relative Abundance
1	Plain tiger	*Danaus chrysippus*	2	1.25	14	10.60	-	-	-	-
2	Angled castor	*Ariadne ariadne*	1	0.62	-	-	5	4.27	-	-
3	Long brand bush brown	*Mycalesis visala*	8	5.00	1	0.75	2	1.70	-	-
4	Common bush brown	*Mycalesis perseus*	5	3.12	3	2.27	-	-	-	-
5	Chocolate pansy	*Junonia iphita*	3	1.87	4	3.03	9	7.69	1	2.22
6	Common palmfly	*Elymnias hypermnestra*	-	-	-	-	2	1.70	1	2.22
7	Glassy tiger	*Parantica aglea*	11	6.87	17	12.87	1	0.85	-	-
8	Common fourring	*Ypthima huebneri*	7	4.37	-	-	4	3.41	-	-
9	Common crow	*Euploea core*	-	-	6	4.54	5	4.27	7	15.55
10	The grey count	*Tanaecia lepidea*	-	-	4	3.03	2	1.70	-	-
11	Common evening brown	*Melanitis leda*	2	1.25	-	-	3	2.56	6	13.33
12	Blue oak leaf	*Kallima horsfieldii*	-	-	-	-	1	0.85	-	-
13	The tamil yeoman	*Cirrochroa thais*	-	-	-	-	-	-	2	4.44
14	Common eggfly	*Hypolimnas bolina*	2	1.25	-	-	6	5.12	-	-
15	Grey pansy	*Junonia atlites*	4	2.50	1	0.75	8	6.83	3	6.66
16	The clipper	*Parthenos Sylvia*	-	-	-	-	-	-	1	2.22
17	Common sailor	*Neptis hylas*	-	-	-	-	3	2.56	-	-
18	Common castor	*Ariadne merione*	6	3.75	-	-	8	6.83	-	-
19	The nigger	*Orsotrioena medus*	-	-	-	-	4	3.41	3	6.66
20	Lemon pansy	*Junonia lemonias*	-	-	2	1.51	-	-	-	-
21	Dark evening brown	*Melanitis phedima*	-	-	-	=	6	5.12	3	6.66
22	Common lascar	*Pantoporia hordonia*	-	-	-	=	-	-	1	2.22

Sr. No.	Common Name	Scientific Name	Site-1	Relative Abundance	Site-2	Relative Abundance	Site-3	Relative Abundance	Site-4	Relative Abundance
23	Red spot duke	*Dophla evelina*	-	-	-	=	1	0.85	-	
24	Common baron	*Euthalia aconthea*	-	-	-	=	2	1.70	-	
25	Autumn leaf	*Doleschallia bisaltide*	-	-	2	1.51	-	-	4	4.44
26	Common tiger	*Danaus genutia*	14	8.75	9	6.81	1	0.85	-	-
27	Tawny coaster	*Acraea terpsicore*	9	5.62	-	-	2	1.70	-	-
28	The rustic	*Cupha erymanthis*	-	-	-	-	1	0.85	-	-
29	Common birdwing	*Troides helena*	4	2.5	9	6.81	5	4.27	1	2.22
30	Malabar banded peacock	*Papilio crino*	-	-	-	-	-	-	2	4.44
31	Common rose	*Pachliopta aristolochiae*	-	-	5	3.78	4	3.41	-	-
32	The blue Mormon	*Papilio polymnestor*	2	1.25	4	3.03	2	1.70	-	-
33	Common Mormon	*Papilio polytes*	12	7.5	5	3.78	-	=	3	6.66
34	Common blue bottle	*Graphium sarpedon*	-	-	-		1	0.85	-	-
35	Lime butterfly	*Papilio demoleus*	2	1.25	-		2	1.70	-	-
36	Red pierrot	*Talicada nyseus*	-	-	5	3.78	2	1.70	-	-
37	Common hedge blue	*Acytolepis puspa*	6	3.75	1	0.75	-	-	-	-
38	Gram blue	*Euchrysops cnejus*	2	1.25	-		-	-	-	-
39	Common cerulean	*Jamides celeno*	11	6.87	2	1.51	-	-	1	2.22
40	Common pierrot	*Castalius rosimon*	-	-	8	6.06	3	2.56	-	-
41	Monkey puzzle	*Rathinda amor*	-	-	-	-	4	3.41	-	-
42	Angled pierrot	*Caleta decidia*	1	0.62	-	-	1	0.85	-	-
43	Wandering psyche	*Leptosia nina*	-	-	2	1.51	-		-	-
44	Common grass yellow	*Eurema hecabe*	24	25.0	8	6.06	6	5.12	2	4.44
45	Common jezebel	*Delias eucharis*	4	2.5	16	12.12	1	0.85	-	-
46	Mimosa yellow	*Pyrisitia nise*	7	4.37	1	0.75	-	-	4	8.88
47	Common emigrant	*Catopsilia pyranthe*	3	1.87	-	-	1	0.85	-	-
48	Common spotted flat	*Celaenorrhinus putra*	-	-	-	-	5	4.27	-	-
49	The lesser dart	*Potanthus omaha*	7	4.37	3	2.27	-	-	-	-
50	Plum Judy	*Abisara echerius*	1	0.62	-	-	4	3.41	-	-

Sr. No.	Common Name	Scientific Name	Site-1	Relative Abundance	Site-2	Relative Abundance	Site-3	Relative Abundance	Site-4	Relative Abundance
Total NO.OF INDIVIDUALS	160	-	132	-	117		45			
Total NO.OF SPECIES	27	-	24	-	35		17			

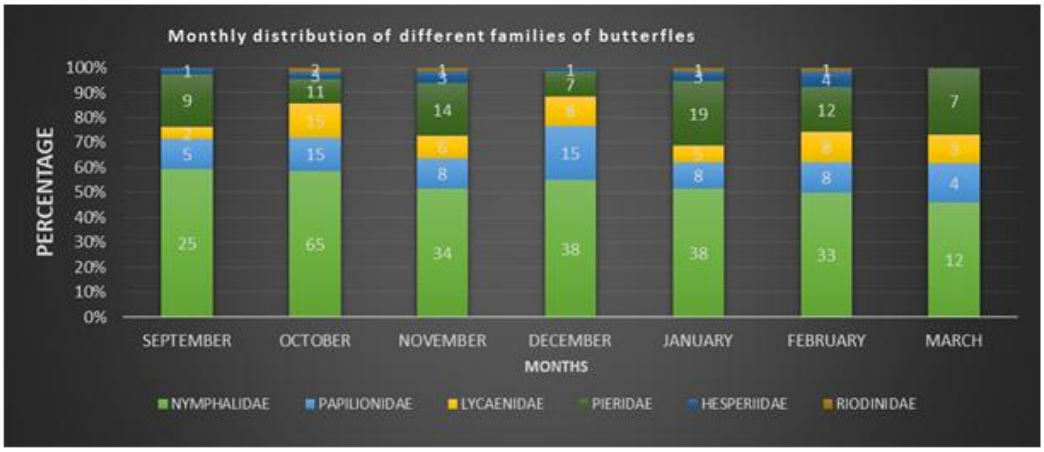


Fig. 3. Graphical representation showing monthly distribution of different families of butterfly species recorded during study period

Common cerulean (*Jamides celeno*) were minimum.(2.22).(Table 4). There were also some species which were seen on all 4 different sites. In total, 4 species were found to be common for all 4 sites which include Chocolate pansy (*Junonia iphita*), Grey pansy (*Junonia atlites)*, Common birdwing (*Troides helena*) and Common grass yellow (*Eurema hecabe*).

4. DISCUSSION

"Butterflies provide many vital economically important services within terrestrial ecosystems (such as nutrients recycling, soil formation, food Resources and Pollination. Climatic change influences the species diversity and intensifies the environmental impact on the ecosystems" [21] (Scott And Lemieux, 2005). During the survey a total of 50 species and 41 Genera belonging to six families i.e., Nymphalidae, Papilionidae, Lycaenidae, Pieridae, Hesperridae, and Riodinidae of order Lepidoptera were recorded.

The family Nymphalidae, consisting of brightly colored butterflies, is the most ecologically diverse group and popularly known as the brush footed butterflies. It is the most dominant family in terms of distribution and number of species represented by 28 species, followed by Papilionidae with 7 species, Lycaenidae with 7 species , Pieridae with 5 species , Hesperiidae with 2species and Riodinidae with 1 species each.

Members of the family Nymphalidae were dominant because most of them are polyphagous in nature; consequently they were able to survive in all the habitats. Majority of the species belonging to this family are strong, active fliers facilitating them in searching for resources in large areas of 1 to 2 km radius. Richness of host plant such as *Carissa carandas, Ziziphus rugosa, Ziziphus oenoplia , Clerodendrum infortunatum , Ixora coccinea Gymnacranthera canarica, Holigarna grahami, Polyalthia fragrans, Lophopetalum wightianum* etc., may be one of the reasons for nymphalid domination in this area.

"Overall, in late monsoon and early post-monsoon seasons, both species diversity and abundance are increased exponentially. Several climatic factors such as humidity, temperature influence the activity of organisms and its abundance directly and through food resources indirectly" [22,23] (Shimadzu et al, 2013; Tiple and Arun, 2009). "In the Western Ghats, the late monsoon and post-monsoon period provide lush green vegetation due to heavy rains and it results in the overabundance of host plant resources to the majority of butterfly species" [24]. Similarly, seasonal dominance of larval hosts such as *Cassia and Senna* spp., is the prime reason for the *Catopsilia* spp. increase in May [25]. Many species depend on specialist needs such as specific phenology [26]](Navarro-Cano et al, 2015) or habitats [27]. "For example, *Graphium sarpedon* predominantly occurs in pre-monsoon, and *Kallima horsfieldii* in early monsoon season. Similarly, *Potanthus Omaha* occurs mostly in the monsoon season, possibly because it mainly depends on host plant *Oryza sativa*"[24] which is being cultivated in monsoon season. Most probably to avoid heavy rainfall some butterfly species restrict to few numbers during heavy monsoon rainfall [28], whereas to escape from southwest monsoon some others such as *Euploea spp*. migrate to plains [25]. "Large sized butterflies are known to show stronger seasonality, thus establishing the fact that extent of seasonality might also depend on the species traits" [29].

Based on the results obtained from the study on butterfly diversity at different sites in the study area we can conclude that the Nymphalidae family was found maximum in number and percentage of the species of butterfly among all six families. A total of 50 species of butterflies belonging to six families were recorded from different sites of Poinguinim village. The different flowering plants and growth of natural trees are main causes of species richness and diversity of butterflies. From our observations, significant variations of butterfly communities among different habitats are established. Main reason for this may be availability of larva and host specific vegetation.

Highest number of individuals were recorded on site-1 (160 individuals) followed by site-2 (132 individuals), site-3 (117 individuals) and least was recorded on site-4 (45 individuals) (Table 4). It clearlyindicates the impact of human interference on biodiversity. Site 4 though present in the forest area ,as it is next to the highway , vehicular pollution, noise pollution has great impact on diversity of both flora and fauna, which is evident from the recording of least number of butterflies both in terms of species diversity and numerical abundance. Four species were found to be common for all four sites which includes Chocolate pansy (*Junonia iphita*), Grey pansy (*Junonia atlites*), Common birdwing (*Troides helena*) and Common grass yellow (*Eurema hecabe*) indicating they are highly adapted to the changing habitat conditions.

"Butterflies are considered as crucial indicators, as species of order lepidoptera are strongly sensitive to environmental factors such as temperature, humidity, rainfall and velocity of wind" [30], thus affecting their distribution in different habitats. "This is in total accordance with the present investigation. Therefore, the conservation of butterfly diversity is achievable by enhancement of vegetation in habitats specially preferred by butterflies" [31].

However, in the study area, few variations were observed for the monthly fluctuations in the diversity, which support the bimodal pattern of increase and decrease in the butterfly species abundance of the study area. Maximum butterfly species observed in the month of November 2021 and least in February 2022. This may be due to rich growth of different plant species and grasses with the completion of monsoon period which provide diverse habitat, food and breeding sites for butterflies. All the values obtained from the diversity indices establish the richness of butterfly abundance. The study conducted helped in assessment of butterflies during the study period of six months and to obtain a preliminary checklist of butterfly diversity from Poinguinim village of Canacona taluka (Table 3) (Fig.3). It also aided in creation of digital database for Poinguinim village as butterflies were captured photographically. The data collected from present survey can serve as a reference for similar future studies.

5. CONCLUSION

The present study reveals that the study area provides favorable ecological conditions and habitat for butterflies. It is necessary to identify the rare butterfly species and conserve them by creating awareness among the public. Establishment of butterfly parks will help to maximize butterfly diversity and abundance, also in conserving species that might otherwise become rare or even disappear.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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