



GOVERNMENT OF KARNATAKA

MONITORING BUTTERFLY FAUNA OF COASTAL KARNATAKA

By
Dr. A.K.CHAKRAVARTHY
UNIVERSITY OF AGRICULTURAL SCIENCES
DEPARTMENT OF AGRICULTURAL ENTOMOLOGY
BANGALORE-560065
KARNATAKA



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Foreword

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INTRODUCTION

a. PURPOSE OF RESEARCH

Naturalists are attracted to the beauty of butterflies, their color, form and flight. Butterflies are depicted as symbols in art since the times immemorial. They are among the most fascinating and beautiful animals. Butterflies undoubtedly are the most attractive among all insects. Vivid colors, shapes, sizes and patterns have fascinated man from Bronze Age. Most butterflies are diurnal and hence, easy to observe. Butterflies are the subject for the study for both biologists and the layman. Butterflies are primary consumers and so are important in any ecosystem. The life cycle of butterflies are closely related to plants. Relationship between any species of plants and butterfly is very specific. Plants and butterflies have co-evolved together. Butterflies are sensitive to environmental changes and are indicators.

The earliest is the cretaceous period. There are as estimated 10% of worlds butterfly species in India. The richness of butterfly fauna is due to the tropical (evergreen & deciduous) forests and vegetation which provide varieties of grasses and flowers-the natural habitat of butterflies. According to varshney (1986) there are nearly two thousand species of butterflies in India that are rare. The Malabar Banded Swallowtail, *Papilio liomedon* and the Nilgiri Tit, *Hypolycaena nigirica* have also become rare. The current work pertains to the surveys conducted during 2008-2009.

b. IMPORTANTANCE AND RELEVANCE OF RESEARCH TOPIC

The order Lepidoptera is the second largest diverse group of insects. So far, 1,40,000 species have been described. Of them 17,200 species are butterflies (Rhaopalocera). Lepidopterans have scales all over the body. Butterflies fly during the day, moths during night. Butterflies at rest hold the wings vertically over the back. Moths, in contrast may either hold the wings tent like over the back or wrap them around the body or extend them to the sides. Virtually all butterflies have knob like clubs at the tip of the antennae. Moths lack antennal clubs. The caterpillar has three pairs of walking legs and five pairs of prolegs.

The Western Ghats have a range of vegetation which includes the Mountains Wet Temperate forest type, including the shoal forests that occur amongst the high mountain grasslands in the valleys surrounded by ridges and higher slope; evergreen and semi-evergreen forests; riparian forests that grow along the riversides; dry and moist deciduous forests; and scrub forest and grasslands. This vegetation is suitable for the butterflies which are nature lovers. Western Ghats and Himalayas hold maximum species of butterflies and only Costal Karnataka holds about 350 species of butterflies in which some of the species are rare and restricted to these places only. The largest Indian butterfly is the common bird wing (19 cm at wing span) and smallest is the grass jewel (1.5 cm at wing span). *Colias hyale* Cramer and *Appias hippo* Boisduval (?) are endangered butterfly species. The Western Ghats are the hotspots for some of the endemic butterflies.

With the growing human population in India, today there are more people in and around protected areas. Their demands, even for mere substances, have increased. On the commercial side, the need to produce food, fiber and wood is much greater than even before. This has led to large tracts of forests being cleared and other natural areas giving way to urbanization, pollution, overgrazing or intensive agriculture. Loss of prime habitat is the major threat to all wildlife including butterflies. So there is an urgent need to monitor and develop the conservation methods to protect these beautiful flying jewels.

c. ORIGIN OF THE RESEARCH PROBLEM

It is unfortunate that many species of butterflies are declining due to deterioration in their habitat. It is reported that in India until 1957 about 520 species were already put in the threatened list. Since then the situation has further worsened. Even in Western Ghats, it is now difficult to come across a large-winged *Troides* or *kallima*, which are common earlier.

The primary cause of depletion in butterfly numbers is the degradation of habitat or deforestation. Factors like pollution, urbanization, development etc., have drastically affected the forest cover and vegetation. Since butterflies need plants for food, shelter and egg/pupal site, they directly affected.

Another factor for causing reduction in butterfly numbers is their commercial exploitation. There is a big demand for butterfly specimens, both alive and dead. Traders collect alive adults (and also pupae for breeding), kill them and sell.

How much is the effect of bird and other animal's predation on butterflies? It is known that birds feed primary on grains and seeds. But they do feed on insects: Butterflies are not so much preferred as the caterpillars. Sparrows, crows, mynas and other insectivorous birds devour a staggering number of caterpillars everyday.

The most important factor for the steep decrease in butterfly populations is use of insecticides, herbicides, biopesticides and other chemicals in order to increase yield in agriculture and horticulture. It is known that *Bacillus thuringensis* a pathogen recommended for insect pest is specific to kill caterpillars of butterflies and moths. Many other chemicals, of which the use is increasing day by day, take toll of greater number of insects in gardens and orchards.

Yet another cause is the collection of butterflies for natural history and other scientific studies. Since the number of such clubs, societies, museums and colleges have increased, their requirement of butterfly specimens has increased. Amateur collectors soon get fed up with commoner forms and try to net rare

ones. On the other hand, taxonomic specialists too insist on a large series of specimens for their studies. It is ironical

Butterflies are amongst the weakest defenseless creatures. They can do nothing better than unsuccessfully fly away from their enemies, like birds, lizards, frogs, spiders, etc. the first effort to conserve butterflies thus, come from nature itself. Some species exhibit mimicry for self protection. The best example of it is *Kallima*, the underside of which looks like oak leaf. Some species, like *Hypolimnas* females, mimic wing coloration of some other repelling species.

At present there is a total ban on the international trade of Indian species of butterflies. Such restrictive laws are needed in all countries since their supply is not inexhaustible. Presently there are about 350 species included in the Red Data Book and other such records, listed as endangered from this region. Further detailed studies and thorough surveys are required and it is feared that up to 1000 species may be presently vulnerable.

To protect and increase populations, some organizations like the Zoological Survey of India are proposing to establish the Butterfly farms. In these places, rare species would be bred in caged condition on their natural food-plants. Undoubtedly, these Farms would be useful places, to make scientific observations. The excess alive specimens could be regularly released in suitable areas. Those species, which can be multiplied in these Farms in large numbers, could be permitted to be sold to the traders cited above, while keeping the ban on other species. The enclosures of butterflies in the Farm will attract visitors also. After successful trails, such enclosures with common species can be opened in local zoo, botanical gardens and children parks.

The present trend of increasing use of harmful chemicals in agriculture ought to be discouraged. The control of pests like insects and mites is alright, but they need be brought under manageable limits. And what about the beneficial insect? The insecticide is not differentiating between harmful and useful insects. Butterflies are highly beneficial group of insects for their role in pollination. The value of pollinators is underscored in present day agri-horticulture. Such a study will help in sorting crop-wise pollinators. Even otherwise, the natural food plants of large number of butterfly species are not

known adequately. This information is required primarily for breeding purposes. However, it is known that none of the Indian butterflies is a serious pest of any major crop, Citrus butterfly, *papilio demoleus* is a pest on crops belonging to citrus family of plants.

As already stated there is need for the detailed study of butterfly fauna occurring in reserves like National Parks and Sanctuaries. This will help in estimating the abundance of a species and list the truly threatened species. Nowadays development is being concentrated along the coasts this should not jeopardize the butterfly fauna.

As an urgent action, the education on the subject is required. There is need to publish illustrated account of all threatened species of the region to extend awareness. The younger members of the nature clubs and societies, and the students of science should be target for imparting the knowledge on value of butterflies and the danger of their depletion. Lectures, slide show, films and article in magazines etc., could serve the purpose. To draw attention on the Indian butterflies, the government of India issued a set of multicolored 4 stamps, with an appropriate first day cover and special cancellation, on the 20th October, 1981. Exhibitions of display boxes with glass top, having dead specimens, can be arranged to educate and advise in classifying butterflies and how to properly preserve and label them. It is hoped that when people are told the importance of protecting butterflies, they may not destroy their natural surroundings and also that when come across a rare species, will desist from collecting it.

d. FOCUS OF RESEARCH

The objective of this study was

1. To document butterfly species in Coastal Karnataka with respect to location, status, abundance, seasonality, sightings and habitat preference.
2. To monitor butterfly species in Coastal Karnataka.
3. To identify the threats to butterfly populations and reasons of the reduction in butterfly fauna in Coastal Karnataka
4. To develop a baseline data on different species , their habitats and taxonomy, endemic species etc.
5. To identify the endemic butterfly species and to identify the hotspots for conservation
6. To suggest measures for monitoring and conservation of butterfly fauna in Coastal Karnataka.

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RESEARCH DESIGN

Documentation of butterfly species in Coastal Karnataka was made by formulating the research design based on the location, status, abundance, seasonally, sightings and habitat preference of the Butterfly fauna etc., which is obtained by monitoring butterfly species in different locations of Coastal Karnataka. Butterflies are easily approachable and as commonly found as birds. The best time of the year for watching butterflies is from just after the rains (Middle of August) to Early November. During this season, the host plants of butterflies grow abundantly all over vacant lots. This is the time when butterfly activity is at its peak. As there are plenty of food plants for the caterpillars to feed on, egg-laying too is at its peak. The second butterfly season is around March to May, when several tree and shrubs flower and grow new leaves. During this period the butterflies are attracted by using some baiting substances such as overripe, rotting fruits, animal dung, dead crabs etc. to monitor them closely and clearly. The Butterflies are monitored by using 8x40 binoculars from a distance of 2-3m. Some butterflies like skippers and Blue are smaller and similar looking which are the most difficult to watch and identify. Such butterfly species are identified by close-focusing.

Data from line and band transects were analysed using various standard indices, correlation and regression, ANOVA analysis and non-parametric analysis to deduce logical inferences. Based on the analysis of data the conservation measures for the assistance of butterfly species were advocated. In some patches the butterflies were visually observed and in some other patches of coastal Karnataka the insect hand net was deployed. Smaller specimens were stupefied with either formalin or ethanol for recording morphological features under microscope.

ORGANIZATION AND DESCRIPTION OF DATA

Karnataka has a Coastal line of about 320 Kms. An investigation was carried out to know the butterfly fauna in Coastal Karnataka from October 2005 to September 2006. To this the results of the surveys conducted during 2008-2009 have been added. Sixteen locations *viz.*, Ullal (12.20° 49' N, 74.9° 50'E, 26m AMSL), Kankanady (12.10° 49' N, 74.9° 50'E, 30m AMSL), Mangalore (12.10° 49' N, 74.9° 50'E, 30m AMSL), Karkala (13.20° 35' N 74.9° 34'E, 43m AMSL), Udupi (13.9° 35' N, 77.5° 34'E, 45m AMSL), Dharmasthala (33.6°35' N, 77.6°34'E), Uppinangadi (12° 49' N 74°

50'E, 89m AMSL), Bantwala (12.4° 49' N, 74.5° 50'E, 62m AMSL), Gundy (13°35' N, 76°32' E), Kalyanpura (13° 35' N 77° 34' E, 64m AMSL), Hebri (13.5° 35' N 77.4° 34' E, 79m AMSL), Bolanje (13.2° 35' N, 77.6° 34' E, 38m AMSL), Kundapura (13.8° 20' N, 70.4° 15' E), Kumta (14.8° 22' N, 74.2° 24' E), Karwar (14.6° 50' N, 74.7° 09' E, 39m AMSL) and Ankola (13.6° 20' N, 70.8° 15' E) were selected to document species richness and frequency of butterfly sightings. Few individuals were also collected through insect nets and released after recording their features for identification. Few individuals were stupefied with Chloroform. Linear transects of about 1 to 1.5 Km were run at each locality embracing different habitat patches. The descriptions of habitat patches are detailed below. During 2008-2009 four spots were selected along the sea coast from Mangalore to Karwar at about 25 km distance.

Gundya: A transect was selected at the junction of four roads. Along the east was a forest stretch with planted teak, along west was also forest stretch, towards was an areca plantation and towards north was a cluster of helmets with garden around. **Kankanady:** The transect comprised of built-up patches, gardens, low laying paddy fields. **Karkala:** The stretch about 3 Km from town towards south-east contained indigenous, lofty, old trees with well spread canopy interspersed with open spaces with no vegetation. **Mangalore:** A stretch of 6 Km along Cochin-Mumbai national highway in the city represented built up environment with intense human activity. **Ullal:** A stretch of 1.5 Kms across Cashew and coconut plantations was selected. **Udupi:** A stretch of 2.0 km across a garden and road with avenue trees was selected for monitoring butterfly. **Dharmasthala:** A stretch of open land along Nethravathi river stream with sparse vegetation was selected for monitoring purpose. **Uppinangadi :** A stretch of about 1.5 Kms with indigenous old trees and built up environment about 3.0 Km from town was selected adjacent to mango and banana planted area. **Kalyanpura:** A stretch of about 2.0 Kms in the rural Kalyanpura village with paddy and vegetable cultivated area with lush weed growth around. **Hebri:** A stretch of about 1.0 Kms having well cultivated rice and vegetable fields about 2.0 Kms from town. **Bolanje:** This stretch consisted of flowering plants specially jasmine across cultivated area north of Hebri. **Bantwala:** A stretch of about 2.0 Kms along Nethravathi river stream bordered with coconut and banana cultivated patches. In **Kundapura** a stretch of two kilometers along the coast with sparse vegetation was selected for documenting and monitoring butterflies. The vegetation consisted of woody shrubs with sandy soils. In **Kumta** and **Karwar** also stretches of 2 kilometers about 6 kilometers from coast were selected for documenting and monitoring butterflies. The stretches consisted of vacant land with gardens (flowering herbs and shrubs) and few avenue trees. At **Ankola** a stretch of 2 kilometers along the highway consisting of well grown avenue trees and gardens were selected for documenting and monitoring butterflies. The transects were run at monthly intervals. The vegetation

comprised of tropical wet evergreen, semi evergreen, mixed dry deciduous, tropical dry shrubs and rugged slope land scapes mostly with lateritic soils. The butterfly specimens were identified following Wynter-Blyth (1957) and Kunte (2000).

The Coastal Karnataka during study period experienced warm humid, tropical climate with intermittent showers. Both southwest and Northeast monsoons were active. February to April experienced generally warm dry weather with good sunshine hours. Southwest monsoons began May end. But torrential rains were received after June 13th 2006. From June 18th to June 30th about 1030 mm rains were received in and around Mangalore. The rains continued with cloudy overcast and high humidity during July to September 2006. The ground sampling with respect to line transects and sample sites have been included in the database. In addition, visual sightings were also considered for interpretation.

A review of literature on butterflies of Coastal Karnataka was also attempted. The major difficulty in collating the data and interpretation is that mention of specific localities is not indicated. Most scientific names of butterflies have changed. This makes application of GPS and comparisons difficult.

ANALYSIS OF DATA

There were two sets of data collected. One set referred to butterflies in a restricted space (Transects). Another set collected through roving surveys in four-drive vehicle covering a large area and through opportunistic recordings but in a short time.

Following parameters were considered for recording the data:

Species richness:

Species richness is a direct measure of diversity. It counts the number of species available in any locality.

Diversity indices:

Shannon-weiner index was computed as,

$$H' = - \sum P_i \log P_i$$

Where, P_i = Proportion of individuals in the I^{th} species and is given by

$$P_i = \frac{n_i}{N}$$

Where, n_i = Number of individuals of the I^{th} species and N = Total number of individuals of all species collected at that locality.

Simson's index was computed as

$$D = \frac{N_i (n_i - 1)}{N (N-1)}$$

Where, n_i = Number of individuals of the I^{th} species and N = Total number of individuals of all species collected at that locality. Values of 'D' range from 0 to 1; increase in D value shows a decline in diversity. Therefore reciprocal form of Simson's index ($1/D$) is adopted.

Abundance:

Refers to the total number of individuals of all insect species, which appeared at the observation time in each locality on each observation day.

Niche breadth:

As niche breadth is a quantitative measure of resource specialization of one species compared to another, it was calculated to study the extent of specialization of selected species identified using the geographic representation pattern observed during the course of study. The abundance data gathered at each locality were used as base data. It was calculated by using Shannon-weenier diversity index (Colwell and Futuyma, 1971).

$$H' = -\sum P_i \log p_i$$

Where, P_i = Proportion of individuals found at I^{th} sampling site relative to total number of specimens collected from all sampling sites; H = Shannon-weenier measure of niche breadth.

Niche overlap:

How the butterfly species in the study area are co-existing? It would be pertinent to understand how these species or pairs are segregating or partitioning the resources according to geographic parameters. So Niche overlap analysis was conducted between species pairs, where 1 indicates complete overlap between species and 0 indicates no overlap. Using simplified Morisita index (Horn, 1966).

$$C_H = \frac{2 P_{ij} P_{ik}}{P_{ij}^2 + P_{ik}^2}$$

Where,

C_H = Index of overlap between species 'j' and 'K'; and

P_{ij} = Proportion of individuals of j^{th} species occurring at the i^{th} compared to the total number of specimens collected from all sampling sights.

P_{ik} = Proportion of individuals of k^{th} species occurring at the i^{th} compared to the total number of specimens collected from all sampling sights.

Attributes and characteristics:

Nine attributes of adult and five attributes of larva, viz., size, color, flight, flight height, habitat, habit, activity, antennae and frequency of sightings for adult and color, pattern of colors, appendage, size and host plants for larva were recorded for a butterfly species for adult. In each attribute, three to eleven and for larva, two to six characteristics were categorized to document variations in each attribute. These attributes and characteristics were utilized to identify and distinguish species. (Table 1).

VALIDATION AND VERIFICATION OF FINDINGS

Species identified:

One hundred and twelve species of butterflies were recorded in coastal Karnataka during 12 months (Table. 2). These species belonged to 5 families and 70 genera. (Pai, 2002, identified 48 species in Goa). All butterflies were identified without killing them. Fourteen species needs to be identified. Monitoring is required in mangroves, reverine ecosystem, estuarie regions of Coastal Karnataka.

The features of the species identified are summarized. The features, attributes and characteristics together formed the basis, for identifying the specimens. Maximum number of species belonged to Nymphalidae. Papilionidae, Pieridae and Hesperidae. All the species of butterflies identified in Coastal Karnataka are tabulated in table 2. Along with the common species of butterflies some of the uncommon species were also identified. Both the caterpillars and adult require specific plant and habitat. If either the plant or habitat is remained, the butterfly is vulnerable to the changes. In Coastal Karnataka, land development is occurring rapidly. This will have definite adverse effects on the butterfly fauna. But the authorities can do well to preserve habitats and plants of butterflies and other fauna in designated stretches of land. In this report, larval and adult host plants of butterflies species are not indicated as they have been listed by earlier workers (Table 13). Further plants associated with butterflies recorded during the current survey in coastal region, is already reported. The data bases originating from these preliminary surveys are indicated in table 12.

Frequency of sightings:

The commonness of butterfly species was determined by the frequency of sightings. For instance, from Hassan to Sakleshpur, pierids were sighted 35 times in spots of 8' x 6' x 8' (1 x 6 x 4) dimensions in 35 km) (Table 3). Similarly, the frequency of butterfly sightings from Shakleshpur to Gundya, Gundya to Dharmastala, Dharmastala to Karkala, Karkala to Mangalore and Mangalore to Uppinangadi, Kundapura to Kumta, Kumta to Ankola, Ankola to Karwar is indicated in Table 3. Besides, the vegetation, phenophase of plants and GPS, the time factor, i.e. morning, noon or evening may also influence

butterfly detectability. The frequency of butterfly sightings at five locations in coastal Karnataka is indicated in Table 5. Maximum number (24) of sightings were recorded in Gundya because of a mosaic of habitat that, included garden, forest, open space and cultivated ecosystems. This mosaic includes plants and habitat patches of both larvae and adults. Edges of several habitats offer a mixed combination of plants and patches that meet requirements of several species.

Habitat preference:

The Littoral and Swamp vegetation is common in the Coastal region of Karnataka which includes river estuaries, creeks, inlets, islands and mangroves are seen in saline swamps. Vegetation of coastal sand dunes includes plants like *Crotalaria verrucosa*, *Launaea pinnatifida*, mangrove beanstalk (*Derristrifoliata*) and shrubs like screw pine (*Pandanus sp.*) etc. This vegetation attracts many species of butterflies, which is the most preferred habitat for most of the species.

A sample of data relating to habitat preference in butterflies *sighted* in Coastal Karnataka during the study period is given in Table 4. Of the 14 habitats, open space vegetation was the most preferred followed by mangroves and river estuaries. Garden and roadside vegetation were the next most preferred. Most sightings occurred in open space with sparse vegetation, followed by mangroves, river estuaries, gardens and roadside vegetation. These habitat patches met all requirements of the butterflies in terms of oviposition, larval diet and adult shelter and food.

Detectability:

Number of sightings of butterflies during October 2005 and March 2006 at Hourly intervals at Karkala is depicted in Figure 1. Sightings were made within 0.5 km². The first butterfly sighting was made at about 7.00 am in the morning with a peak between 1.00 pm to 2.00 p.m. The detectability was almost nil after 3.30 pm. So it is best to document the butterflies during noon hours in coastal Karnataka between October to March. Between April to September the butterfly detectability decreased in general due to rainfall and cloudy overcast. Obviously detectability trials have to be run for every month or season to get a reliable estimate of population or activity of the butterflies.

Species richness in agro ecosystems and sampling sites

Agro ecosystems in coastal Karnataka generally held few butterfly species (Figure 2). Paddy fields attracted five species while rubber plantations attracted only one species. Species richness of butterflies at seven locations is depicted in Fig.3. The number of species varied from 12 to 42. Hassan recorded a maximum of 42 species and the least number of species (11) were recorded in Mangalore. Mangalore recorded the least number in view of the built-up environment, Urbanization, sparse vegetation and pollution. Thus butterflies provide good indication of environmental quality. Species richness of butterflies at five locations species, genera and family-wise is also indicated in Table 6. the least number of species in rubber plantations may be due to uniform plant structure and architecture with little or no ground vegetation. As we progress transitional to coastal region, the species richness in butterfly decreases. The vegetation vis-à-vis habitat types also decrease.

Seasonality:

The number of butterfly species recorded from October 2005 to September 2006 is indicated in Figure 4. The number of butterfly species declined as the months advanced from October to April. In October- November 25 butterfly species were recorded. In March – April only 14 species were recorded. In June - July and in August - September the butterfly species decreased slightly. Field observations indicated that flowering of plants and availability of larval host plants play a major role in the seasonal occurrence of butterflies, besides the climatic factors. Usually high temperature, higher humidity levels or dry conditions with high wind velocity may be inimical to the butterflies.

Database:

In order to render the data accessible and comparable with respect to GPS and species information, data collected on butterfly species is being furnished in a format (Table. 7). Broadly the data addresses species information, its breeding and IUCN status. Database from secondary sources is also created and furnished in Table 8. As seen from the data, scientific names of few butterfly species have changed. Few species additions have been affected. Information on biology and larval host plants of the butterflies have also been added. While few butterfly species have expanded generally the generalist/common, abundantly present species.

Species richness in Seasons

Maximum numbers of butterfly species were recorded during August-September (91) compared to 81 species in May-July and 60 in October-December. The least number of butterfly species were recorded during January to April. These variations are in accordance with the climatic factors and in turn to the blooming and flowering of plants herbs, shrubs and trees. Each locality exhibited minimal changes in the number of butterfly species recorded (Table 7).

Abundance

Abundance is another ecological parameter that helps in understanding conservation needs of butterflies. Common jay was the maximum number recorded (481). It was recorded from all the locations (Table 8) surveyed. The numbers varied from 31 to 132 per location. The butterfly was the most abundant in Gundy and the least at Bolanje, South Canara. Common Emigrant was the next most abundant species (Table 8). Pioneer (Arid) was the least abundant with 170 numbers. Data on abundance would help in restoring populations of the least abundant butterfly species.

Diversity

Simpson and Shanon-Weiner indices were calculated to determine abundance of species. Again Gundy recorded the maximum (3.70 by Simpson and 2.85 by Shanon-Weiner) number of species diversity. Both Mangalore and Ankola represent built-up environments. Further, time and location-specific observations are required to get reliable estimates of the species richness or diversity of butterflies.

Niche breadth and niche overlap

Niche breadth is a quantitative attribute of the resources utilized or specialized by one species compared to another. The niche breadth values were calculated for 15 species of butterflies using the number of locations or area in which the species occurred. The niche breadth values for common Jay were higher (4.78) during the first season (October-December) compared to the other three seasons. Similarly the Indian Skipper (4.92) recorded higher niche breadth during October-December compared to other three seasons and species of butterflies. Higher niche breadth values for common Emigrant suggested that the species has specialized in utilizing various resources (Table 10).

Niche overlap values indicate how the species of butterflies are portioning the resources. The niche overlap values were calculated for 15 species-pairs where overlap value of 1 indicated complete overlap between the species while, zero indicates no overlap. *Danus chrysippus* and *Danus genutia* and *Eurema hecabe* and *Eurema lecabe* recorded higher values of niche overlap (Table 11).

Credibility of findings

The specimens were identified using various books like Kunte 2000, Gunathilagaraj *et al* 1998, Wynter-Blyth 1957 and papers published on butterflies in Journal of Bombay Natural History Society.

CONCLUSION

a. Basic findings

- When one can watch butterflies almost anywhere in India, one of the hotspots for butterfly watching is the Western Ghats that rise along the west coast from southern Gujarat all the way to Coastal Karnataka and Kerala. The butterfly diversity increases markedly from South India where Karnataka tops the list with over 330 species including several endemic species such as Southern Birdwing and the Malbar Banded peacock, which are found nowhere else in the world.
- One hundred and twelve species of butterflies were recorded during this project period (2008-2009) in different locations of Coastal Karnataka. These species belong to 8 families and 70 genera. Most of the species identified are commonly available: Common joy, Common jizeble, Common grass yellow, Yellow pansy, Common tiger, Indian skipper, Common Indian crow, Grass demon etc.
- Some uncommon species of butterflies were also identified which are rarely found: Orange Tail Owl (*Bibasis sena*), Tamil Spotted Flat (*Celaenorrhinus nficernis*), Spotted Angle (*Caproma agama*),

Contiguous swift (*Polytremis lubricans*), Large Banded Swift (*Pelopididas subochracea*), Wax dart (*Cupitna purrea*), Tree flitter (*Hyarotis adrustus*), Tamil oakblue (*Arhopala bazaloides*) Southern Birdwing (*Troides minos*), Malbar Banded peacock (*Papilio crino*) etc.

- Habitat preferences of butterfly fauna were recorded and the vegetation of Coastal Karnataka was observed. The vegetation in Coastal Karnataka plays an important role in the diversity of butterfly species and their habitat preference.
- The Wet-Evergreen vegetation which includes evergreen forests with tall straight trees. Trees in this vegetation are festooned with mosses, ferns and orchids. Canes, screw pines, tree ferns and woody climbers (lianas). The Semi-Evergreen vegetation occurs between tropical and moist deciduous and therefore combines both these types. This vegetation is seen on the eastern slopes of the Western Ghats.
- The littoral and Swamp vegetation which occurs in the Coastal Karnataka along the river estuaries, creeks, inlets and islands which include the mangroves and coastal sand dunes which include plants like *Crotalaria verrucosa*, *Launaea pinnatifida*, mangrove beanstalk etc., play an important role in the diversified butterfly fauna of Coastal Karnataka.
- Hot spots for some of the rare and endemic butterflies were identified and recommended for conservation. Some of the endemic species which occur typically in Coastal Karnataka are; Southern Bird wing, Malbar Rose, Malbar banded Swallowtail, Malnbar Raven, Malbar Banded Peacock, Malabar Tree Nymph, Nilgiri Tiger, Red-spotted Duke, Tamil Lacewing, Nilgiri Clouded Yellow etc.

b. Implication of basic findings

The natural vegetation of Coastal Karnataka provides the habitat requirements of many butterfly species. The present study on monitoring butterfly fauna in Coastal Karnataka clearly indicates that the butterfly species are well diversified and many endemic species are also present in the Coastal Karnataka. These species are to be monitored and species diversity has to be maintained.

The Western Ghats have a range of vegetation which includes the Mountains wet Temperate forest type, including the shoal forests that occur amongst the high grasslands, in the valleys surrounded by ridges and higher slope; evergreen and semi-evergreen forests; riparian forests that grow along the riversides; dry and moist deciduous forests; and scrub forest and grasslands which play an important role in the species richness and diversity. This vegetation has to be protected and conserved.

The natural vegetation of Coastal Karnataka is under threat due to growing human populations in and around the protected areas. With more and more land coming under cultivation, it is all the more important to first assess the impacts of agricultural practices on butterfly populations, as well as on other wildlife.

This problem can be solved by encouraging the farmers to adopt eco-friendly practices, like integrated pest management, organic farming, maintaining hedgerows, and finally suggesting a plan whereby farmlands can support butterfly populations by farming in a wildlife-friendly way.

Most Indian Butterflies are now protected under the Wildlife Protection Act 1972, which implies that catching and killing of certain species is illegal, unless permitted under a license. However, laws on paper are not likely to save wildlife unless sufficient measures are taken simultaneously to protect their habitats, generate public awareness, and make local people partners in conserving butterfly habitats.

RECOMMENDATIONS

- For successful conservation of butterflies, both proximate and ultimate causes of environmental degradation and species loss must be considered. The best way to protect biological diversity is to protect the habitats of butterflies.
- Conserving butterflies will improve our whole environment for wildlife and enrich the lives of people now and in the future. Butterflies can only effectively be conserved in their natural habitat. Butterflies are sensitive to the habitat changes, they are habitat specialists. They can disappear rapidly if management changes. The intensification of the practices such as farming and forestry has had a profound effect on the management of semi-natural habitats. The restoration of habitat and sustainable management regimes is vital for the conservation of butterflies.
- In Indian sub-continent, there is very little conservation activity directed towards butterflies. Butterflies are treated as non-target species in the conservation and management of wildlife. Butterflies serve as important plant pollinators in the local environment, and help in pollinating more than 50 economically important plant crops.
- An action plan should be developed to conserve these butterflies and their natural habitats.
- Hot spots for conservation of butterflies are the public parks (eg. Tagore park in Mangalore), open areas surrounding public offices, open areas surrounding educational institutions(eg. Mangalagangothri) and along the coast some patches (eg. Muradeshwara, karwar, Brahmawara) of flowering plants can be maintained to attract butterflies and bees.
- Frequent monitoring is required in these habitats to study the impact of development on the biodiversity.
- Common flowering shrubs (*Largestromia lanceolata*, *Barrintonia raecemosa*, *Hibiscus sinensis*, *Oleander sp*, *jacaranda sp.*, *Cassia javanica*, *Neerium sp.* and *Ixora sp.* etc) and trees like *Tabubia avalanidia*, *Spathodea companulata*, *Terminalia ballerica*, *Terminalia arjuna*, *Butea monosperma* etc. which are attractive to butterflies, bees and some birds can be grown in

open areas, gardens, backyards of houses and islands which will help in conserving the biological diversity. Along the stretch of Coastal Karnataka there are open areas like gardens, backyards houses and huge open spaces where these trees and shrubs can be grown. In coastal Karnataka there are large number of educational institutions and universities and buildings with sprawling open areas where some of these shrubs and trees can be planted.

- Identify the common butterfly species present in a radius of 5 Km around this hotspots and plant caterpillar food plants in the garden accordingly. Butterflies will visit for a longer period if they find plants to lay their eggs. Flowering plants have to be planted in large groups which flower at the same time. The group of plants attracts butterflies than a single plant with a few flowers. Wild flowers like Coat Button, Coat pink, Lantana will attract more butterflies. Plants like Rattlepod and Indian Turnsole(*Heliotropium*) attract male butterflies like Tigers and crows which help in prolong butterfly stay's in the gardens.
- Cultivation practices in the protected areas should be avoided and cultivation near the protected areas has to be monitored. Pesticides kill butterflies, caterpillars and other useful insects, so measures has to be taken in avoid using of insecticides and herbicides in this hot spots.
- People should be educated by conducting awareness programs on butterfly conservation, because effective conservation of butterflies is achieved through awareness and participation of people. Biological resources need protection against inappropriate uses and overexploitation by humans so there is a need for awareness regarding problem facing butterfly conservation amongst the public.
- Netrani Island or Netragudo commonly called as Pigeon Island, is situated 19 km of Muradeshwara coast is located at 14⁰1'07.0"N and 71⁰19'43.7" E in Uttara Kannada district in the Arabian Sea. Deep blue sea around the Island is crystal clear with a visibility of up to 30 meters during normal sunny day, exposes vast sea bed full of scattered fringing coral beds with supporting incredible fish life. The island is small, pretty with diverse plant population, most of them with Western Ghat representation. A survey was conducted in 2008-09 and butterflies were not recorded hence flowering shrubs and trees can attracted the butterflies.

- Tourism and development activity along the coastal region should be restricted.
- Some of the endangered species of butterflies can be reared under cage condition and can be released.

Table 1. Butterfly Fauna of Coastal Karnataka

Attribute	Characteristics	Quantification
I. Adult		
Size	Large (75 mm wing span and above); tailed Large (75 mm wing span and above); tailless Medium (45 – 75 mm wingspan); tailed Medium (45 – 75 mm wingspan); tailless Small (upto 45 mm wingspan); tailed Small (upto 45 mm wingspan); tailless	
Color	Black or shades of black or black dominant Brown/shades of Brown or Brown dominant Blue/shades of Blue or Blue dominant Red/shades of Red or Red dominant Green/shades of Green or Green dominant Yellow /shades of Yellow or Yellow dominant	
Flight	Fast – wing beats rapid Moderate – wing beats leisurely Slow – wing beats slowly	
Flight height	Just above the ground – 0-2 m Low - >2m- 4m Medium - >4m – 6m High - >6m	
Habitat	Wooded areas – covered with vegetation Open areas – not covered with vegetation Garden – sparse cover of vegetation especially flowering Sea Beach – The bed of sand adjacent to sea water for about 0.25- 0.50 km Shrubs – Sparse cover of medium trees/small trees and bushes Forest – covered with forest trees Dry areas – patch without much water and vegetation Water streams – water channels or flowing water streams Wet surface – just surface cover of water Grasslands – covered with grasses In and around cultivated tracts – planted area	

Habit	Diurnal – Active daytime Nocturnal – Active nighttime Crepuscular – Active in twilight hours
Activity	Pollinating – interacting with flowers Basking – wings spread under sun Resting underside leaves Resting under shade Hovering around flowers Wandering, random flights
Antennae	Lengthy – More than length of body Medium – As long as length of body Short – lesser than length of body
Frequency of sightings	Common- < 75 – 100% of sightings Uncommon - >50 – 75% of sightings Occasional - >25 – 50% of sightings Rare – 0-25% of sightings
II. Larva	
Color	Black or shades of black or black dominant Brown/shades of Brown or Brown dominant Blue/shades of Blue or Blue dominant Red/shades of Red or Red dominant Green/shades of Green or Green dominant Yellow /shades of Yellow or Yellow dominant
Pattern of color	With spots With streaks With prominent marks Smooth
Appendage	With Appendage Without Appendage
Size	Minute (0-5 mm) Small (>5-10 mm) Medium (>10-20 mm) Large (>20 mm)
Host plants	Herb, Shrub, Flowering shrub, Creepers, Small tree Medium tree, Tall tree

Table 2. List of butterflies identified in coastal Karnataka.

SL. NO.	BUTTERFLY	SPECIES
FAMILY PAPILIONIDAE		
1	Southern birdwing	<i>Troides minos</i> Cramer
2	Common jay	<i>Graphium doson</i> Feeder
3	Tailed jay	<i>Graphium</i> □ <i>gamemnon</i> Linn.
4	Lime butterfly	<i>Papilio demoleus</i> Linn.
5	Common mormon	<i>Papilio polymnestor</i> Linn.
6	Common mormon	<i>Papilio polytes romulus</i>
7	Common mormon	<i>Papilio polytes stichius</i>
8	Common rose	<i>Pachiliopta aristolochiae</i> Fab
9	Common mime	<i>Papilio clytia</i> L
10	Red helen	<i>Papilio helenus</i> L
11	Blue marmon	<i>Papilio polymenester</i> Cramer
12	Crimson rose	<i>Pachiliopta hector</i> L
13	Spotted swordtail	<i>Pathysa nomius nomius</i> Es
14	Common Bluebottle	<i>Graphium sarpedon</i>
15	Paris peacock	<i>Papilo paris</i>
16	Malabar banded peacock	<i>Papilio Buddha</i>
17	Common banded peacock	<i>Papilio crino</i>
18	Malabar rose	<i>Papchliopta pandiyana</i>
19.	Malabar Banded Swallowtail	<i>Papilio liomedon</i>
FAMILY PIERIDAE		
20	Common emigrant	<i>Catopsilia Domona</i> Cramer
21	Common jizebel	<i>Delias eucharis</i> Drury
22	Common wanderer	<i>Pareronia valeria</i> Fabricius
23	Common grass yellow	<i>Eurema hecabe</i> Moore
24	Small grass yellow	<i>Eurema lecabe</i> Linn.
25	Mottled emigrant	<i>Catopsilla pyraithes</i> Linn.
26	Great orange tip	<i>Hebomoia glaucippe</i> L
27	Pioneer	<i>Anaphaeis aurota</i> Fab.
28	Common gull	<i>Cepora</i> sps.
29	Albatross	<i>Appias albina</i>
30	White orange tip	<i>Ixias</i> sp.
31	Plain orange tip	<i>Colotis eucharis</i>
32	Psyche	<i>Leptosia nina</i>
33	Nilgiri Clouded Yellow	<i>Colias nilagiriensis</i>
FAMILY NYMPHALIDAE		
34	Common leopard	<i>Phalanta phalantha</i> Drury
35	Common sailor	<i>Neptis hylas</i> Moore
36	Yellow pansy	<i>Junonia hierta</i> Fabricius
37	Common castor	<i>Ariadne merione</i> Cramer
38	Plain tiger	<i>Danaus chrysippus</i> Linn.
39	Common tiger	<i>Danus genutia</i> Cramer
40	Common Indian crow	<i>Euploea core</i> Cramer

41	Danaid egg fly	<i>Hypolimnas misippus L</i>
42	Great egg fly	<i>Hypolimnas bolina jacintha</i>
43	Rustic	<i>Cupha erimanthus D</i>
44	Common baron	<i>Euthalia aconthea C</i>
45	Baronet	<i>Euthalia nais F</i>
46	Grey count	<i>Tanaceia lepida B</i>
47	Chocolate pansy	<i>Precis iphita C</i>
48	Peacock pansy	<i>Junonia hierta F</i>
49	Lemon pansy	<i>Junonia lemonias L</i>
50	Clipper	<i>Parthenos Sylvia L</i>
51	Angled castor	<i>Ariadne ariadne</i>
52	Baron	<i>Euthalia garuda</i>
53	Blue admiral	<i>Nanesia canace</i>
54	Blue pansy	<i>Précis orithya</i>
55	Black rajah	<i>Charaxex fabius</i>
56	Commander	<i>Linenitis procris</i>
57	Common nawab	<i>Eriboea athomas</i>
58	Common sargent	<i>Pantoporia perius</i>
59	Joker	<i>Byblia ilithya</i>
60	Lacewing	<i>Cethosia nietneri</i>
61	Yeomen	<i>Cirrochroa thais</i>
62	Grey pansy	<i>Précis atlites</i>
63	Red admiral	<i>Venessa indica</i>
FAMILY SATYRIDAE		
64	Common evening brown	<i>Melanitis leda leda D.</i>
65	Common brush brown	<i>Mycalesis perseus F</i>
66	Common four ring	<i>Ypthima hubneri K</i>
67	Common five ring	<i>Ypthima balbus Fab</i>
FAMILY LYCAENIDAE		
68	Lesser grass blue	<i>Zizina otis Fab.</i>
69	Common pierrot	<i>Castalius rosimen Fab.</i>
70	Common silverline	<i>Spindaris vulcanus Fab.</i>
71	Tiny grass blue	<i>Zizula hylax F</i>
72	Gram blue	<i>Euchrysops cnejus F</i>
73	Pale grass blue	<i>Pseudozizeeria maha K</i>
74	Rounded pierrot	<i>Tarucus nara K</i>
75	Zebra blue	<i>Leptotes plinius</i>
76	Hedge blue	<i>Actolepis puspa</i>
77	Line blue	<i>Chilades laius</i>
78	Pea blue	<i>Lampides boeticus</i>
79	Red pierrot	<i>Talicerca nyseus</i>
80	Peacock royal	<i>Tajuria cippus</i>
FAMILY DANIINAE		
81	Striped tiger	<i>Danus genutia C</i>
82	Dark blue tiger	<i>Danus Melissa C</i>
83	Common Indian crow	<i>Euploea core C</i>

FAMILY ACRAEIIDAE		
84	Tawny coster	<i>Acraea violae F</i>
FAMILY HESPERIIDAE		
85	Indian skipper	<i>Spiallia galba Fabricius</i>
86	Grass demon	<i>Udaspes folus Cramer</i>
87	White banded awl	<i>Hasora taminatus H</i>
88	Common banded awl	<i>Hasora badra M</i>
89	Brown awl	<i>Badamia exclamationis</i>
90	Common spotted flat	<i>Celaenorthinus leucocera K</i>
91	Rice swift	<i>Borbo cinnara W</i>
92	Indian palm bob	<i>Suastus greminus</i>
93	Giant red eye	<i>Gangara thyris</i>
94	Tamil grass dart	<i>Taractrocera ceramus</i>
95	Dark palm dart	<i>Telicota ancilla</i>
96	Water Snow flat	<i>Teagiades litigiosa</i>
97	Pied flat	<i>Pseudocoladinia dan</i>
98	Restricted Demon	<i>Notocrypta curvifascia</i>

IMPORTANT FEATURES OF BUTTERFLIES IDENTIFIED IN COASTAL KARNATAKA

1. PAPILIONIDAE: (Swallow tails)

SOUTHERN BIRDWING- Large, tailless; flight leisurely; black and golden yellow; common; flies high; diverse habitats-forests, agricultural tract; diurnal; human habitations; larva with prominent abdominal outgrowths.

COMMON JAY – Large, tailless; flight fast; light blue; common; flies high; evergreen forests or moist deciduous forests; larva – dark brown or green with spines.

TAILED JAY- Large, tailed; flight very fast; bright green with small spots; flowering plants, gardens; upto 5m; larva light green

LIME BUTTERFLY- Large, tailless; flight fast; yellow spots with band on wings; common; human habitations; upto 5 m flight; sun basking; pale green with pale brown and cream bands

COMMON MORMON – Large, tailed; flight fast; cream colored spots on wings; common; flies low; gardens; human habitations; velvety dark green with black transverse band with appendage

COMMON ROSE- Large, tailed, body red with red spots on hind wing; flight slow; common in gardens ; prefers flowers

2. FAMILY : PIERIDAE (Yellows And Whites)

COMMON EMIGRANT- large, tailless; pale yellow wings, narrow borders; flight fast; garden flowers; diverse habitats except wet evergreen; common; caterpillars leafy green with a black longitudinal line with a white line on either sides too.

COMMON JEZEBEL- large, tailless, black-yellow with red spots; flight slow; diverse habitats; city gardens; common; 20-25 m above ground – flight; larva live and feed together

COMMON WANDERER- Medium, mainly with shades of brown; flight fast; in forested areas; it has characteristic wandering flight; rests on upper side of leaves for a long time; larva completely dark green matches color of leaves.

COMMON GRASS YELLOW-Small; bright yellow, borders of wings black; flight is weak but rapid; upto 6-8 m above ground; open areas around human habitation; pale green with yellow and pink lines on sides.

SMALL GRASS YELLOW – Small, bright yellow, borders of wings black, undersides of the wing with black dots; flight low, weak, frequent grass and garden patches

MOTTLED EMIGRANT- Large, yellowish or greenish with their borders, flight zig-zag, fast, 10-15m above ground, frequents different types of habits

3. FAMILY: NYMPHALIDAE (Brush footed butterflies)

COMMON LEOPARD- medium, orange with small black dots on both wings; flight fast; in wooded areas; moderate heights; fond of flowering herbs and shrubs; gardens; larva cylindrical and reddish brown with well marked segments.

COMMON TIGER- Brown-red- black with white patches on both wings with black streaks along veins; moderate size; flight slow at moderate height; wooded areas

COMMON CASTOR- Medium, mainly rusty brown with black wavy markings, reddish brown with black lines across wings; slow-sailing flight; castor dotted patches; caterpillar is green with a longitudinal dorsal brown head; it is horned and spined.

4. FAMILY : DANIIINAE

COMMON INDIAN CROW- large, tailless; black with two rows of marginal white spots; flight is slow; scrub, near human habitations; moderate heights, common; extraordinary sailing flight; matured larva are shiny and gaudy, orange reddish with four pairs of tentacles.

5. FAMILY : HESPERIIDAE (Skippers)

INDIAN SKIPPER- Small, black and white wing patterns, diverse habitats, from grasslands to forested habitats; prefers openings with abundant sunlight; flies close to ground; fond of flowers, larva feeds during night; during day hides in a cell.

6. FAMILY : LYCAENIDAE (Blues)

LESSER GRASS BLUE- Medium, blue upper side of wings, flight is weak; found in grassy areas; underside of wings grayish with small brown spots; flight just above ground; short bouts; flowering herbs in open areas or gardens; larva green with longitudinal stripes/lines; dark stiff hairs in parts of the body.

7. FAMILY : SATYRINAE (Dark brown)

COMMON EVENING BROWN: Large, forewing, which may be, produced at the tip with a black eye spot, hind wing may be toothed. Found among the leaf litter, under shade, under bamboos, flight is jerky. The colors of underside of the wings vary with the seasonal forms. In all 11 species of brown are similar. This group of butterflies is widely distributed inhabiting deciduous, semi evergreen and evergreen forests.

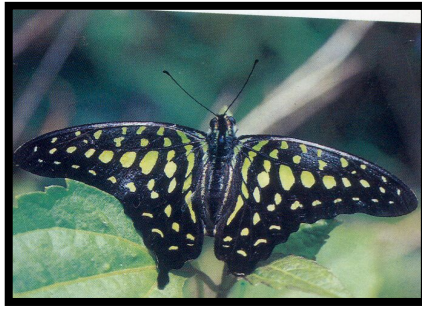
8. FAMILY: ACRAEINAE (Tawny coster)

TAWNY COSTER: small sized with bright tawny-red coloration. The forewings are long but broad and rounded at the apex. The hind wings are round. Both wings are with black border. The butterfly avoids shade and dense vegetation, prefers open vegetation types. Common in gardens. Larval hosts are the Passionflower plants.

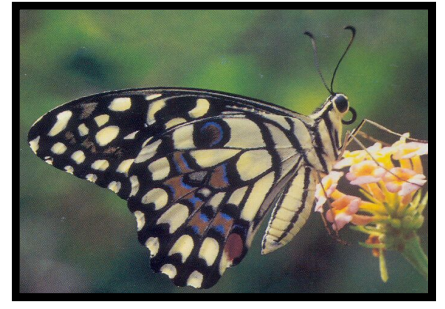
PAPILIONIDAE



Common Jay



Tailed Jay



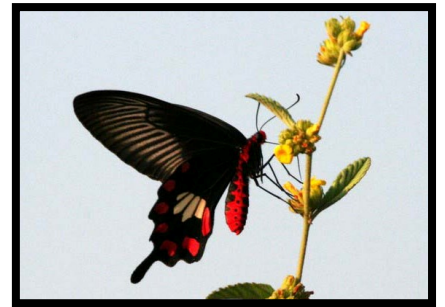
Lime Butterfly



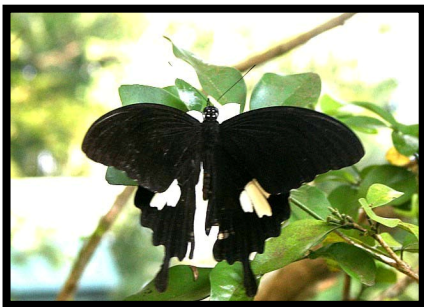
Southern Birdwing



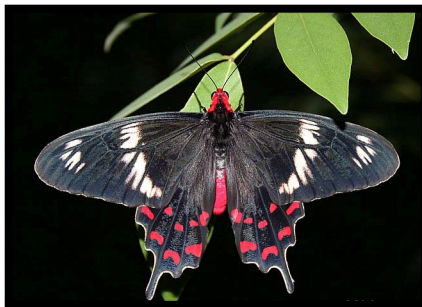
Common Marmon



Common Rose



Red Helen
swordtail



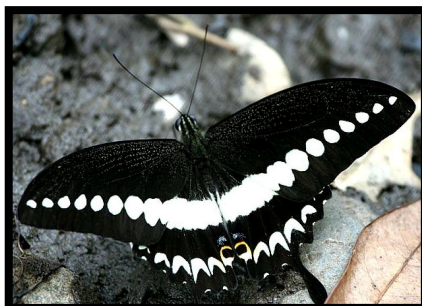
Crimson Rose



Spotted



Common Banded Peacock
Bluebottle



Malbar banded Swallowtail



Common

NYMPHALIDAE



Common Leopard



Common Sailor



Lemon Pansy



Common Castor
Crow



Plain Tiger



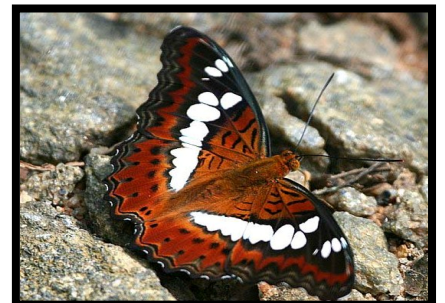
Common Indian



Danaid eggfly



Baranet



Commander



Chocolate Pansy



Peacock Pansy



Blue pansy

PIERIDAE



Common Emigrant



Common Jezbal



Common Wanderer



Common Grass Yellow
Tip



Small grass Yellow



Great Orange



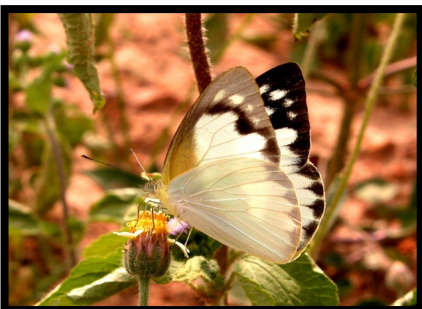
Pioneer



Common Gull



White Orange Tip



Albatross
Emigrant



Psyche



Mottled

HISPERHDAE



Indian Skipper
Awl



Grass Demon



Common Banded



Rice Swift



Restricted Demon



Water Snow Flat



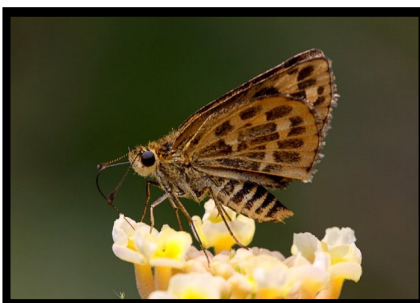
Pied flat



Great Red Eye



Indian Palm Bob



Tamil Grass Dart



White Banded Awl



Brown Awl

LYCAENIDAE



Lesser Grass Blue
Pierrot



Common Silverline



Common



Tiny Grass Blue



Zebra Blue



Line Blue



Gram Blue
Blue



Hedge Blue



Pale grass



Pea Blue



Red Pierrot



Rounded Pierrot



Crotalaria verrucosa



Launaea pinnatifida



Derristrifoliata



Screw pine

Table 3. Number of butterfly sightings at different locations with details in coastal Karnataka (roving survey)

Location	Vegetation	Area covered (Km)	Dominant group/ no. of sightings*
Hassan to Sakhleshpur	<i>Pongamia pinnata</i> , <i>Delonex regia</i> <i>Samania saman</i>	35	80 sightings
Sakhleshpur to Gundya	<i>Terminalia</i> , <i>Dipterocarpus</i> Wild Cinnamon, <i>Sapindus</i> , <i>Bombax</i> , Grasses, Bare, Bamboos	40	42 sightings
Gundya to Dharmasthala	No flowering trees, shrubs, creepers mixed species vegetation	30	5 sightings
Dharmasthala to Karkala	Mixed species vegetation	70	8 sightings
Karkala to Mangalore	Mixed species vegetation	50	6 sightings
Mangalore to Uppinagadi	Mixed species vegetation	50	10 sightings
Kundapura to kumta	Mixed species vegetation	115	23 sightings
Kumta to ankola	Mixed species vegetation	38	12 sightings
Ankola to karwar	Mixed species vegetation	30	10 sightings
Mangalore- Karwar, Sea beach, sand bed	Few xenophytic plants	70 km	14 sightings

* Average number of sightings/day (n=7)

Table 4. Habitat preference exhibited in general by Butterflies of Coastal Karnataka

Sl.No	Habitat	Preference
1	Garden	+++
2	Evergreen forest	--
3	Beaches	--
4	Back water	--
5	Plantations	--
6	Bare land	--
7	Roadside vegetation	++
8	Open space with sparse vegetation	+++
9	Ground vegetation and grass cover	+
10	Field crop ecosystem	+
11	Urbanized patch	+/-
12	Fresh water pond/Stream	+
13	Mangroves	++
14	River Estuaries	++

+ = Preferred

+++ = Most preferred

++ = Much preferred

-- = Absent

Table 5. Butterfly sightings at fifteen locations in Coastal Karnataka *

Location	Species details	No. of sightings
Karkala	Large Pieris=9, Common crow=4, Common rose=4, Plain tiger=3, Striped tiger=2, Small Pieris=2	28
Ullal	Large Pieris=5, Common crow=3, Small grass yellow=4, Striped tiger=2	20
Mangalore	Pierids=5, Common crow=3	18
Gundy	Dark blue tiger=2, Common crow=9, Large Pieris=4, Common grass yellow=4, Small grass yellow=5	30
Kankanady	Evening brown=3, Lycaenids=2, Common crow=1	16
Bantwala	Large Pieris=13, Common crow=4, Satyrids=4, Araeidae=3, Skippers=7, Small Pieris=6, Lycaenids=5	48
Udupi	Small Pieris=7, Papilionids=9, Satyrids=7, Araeidae=3, Danidae=8, Large Pieris=6, Lycaenids=11	51
Brahmavara	Large Pieris=9, Hesperids=16, Satyrids=6, Araeidae=5, Small Pieris=4, Lycaenids=11	35
Hebri	Lycaenids=10, Large Pieris=9, Common crow=14, Satyrids=7, Nymphalids=4, Skippers=4, Danidae=6	46
Bolanje	Pieris=8, Common crow=4, Satyrids=6, Papilionidae=10, Skippers=6, Lycaenids=5, Danidae=9	48
Kundapura	Large Pieris=11, Common crow=3, Plain tiger=3, Striped tiger=2, Small Pieris=2	32
Kumta	Large Pieris=10, Common crow=4, Common rose=4, Plain tiger=3, Small Pieris=3	28
Ankola	Large Pieris=8, Common crow=5, Plain tiger=3, Striped tiger=2, Small Pieris=5	39
Karwar	Large Pieris=9, Common crow=5, Common rose=3, Plain tiger=5, Striped tiger=3, Small Pieris=4	35
Sea beaches and sand bed	Grey pansy = 6, Map butterfly =5, Danaid egg fly =7, Great egg fly = 6, Common palm fly = 7 White branded royal = 8	24

* Pooled data of counts in roving survey and transects

Table 6. Species richness of butterflies at 17 locations, Coastal Karnataka

Location	Number of butterfly		
	Species	Genera	Family
Karkala	22	16	5
Ullal	14	9	4
Mangalore	18	14	5
Gundy	24	19	5
Kankanady	16	10	4
Bantwala	12	6	4
Udupi	18	12	5
Brahmavara	12	6	4
Hebri	14	8	5
Bolanje	14	9	6
Uppinagadi	18	12	5
Dharmasthala	16	11	5
Kundapura	15	8	4
Kumta	16	8	5
Ankola	14	6	4
Karwar	13	6	5
Sea Beach, Sand bed	11	10	3

- Mean of 6 observations at each location

Table 7. Species richness of butterflies at different locations in different Seasons

Location	No. of butterfly species in study periods			
	I (Oct-Dec)	II (Jan-Apr)	III (May-Jul)	IV (Aug-Sep)
Darmasthala	12	10	12	10
Bantwala	8	6	10	10
Mangalore	10	8	11	8
Brahmavara	11	9	14	12
Hebri	9	8	16	15
Karkala	10	7	18	14
Kumta	-	-	-	10
Karwar	-	-	-	12
Sea beach, sand bed	-	-	8	11

Table 8. Abundance of selected butterflies sighted at 6 different locations in Coastal Karnataka

Butterfly	Numbers/Location on all 6 dates						Total
	G	M	U	K	B	H	
Bird wing	62	18	34	46	28	22	210
Common. Jay	132	54	105	106	31	43	481
Tailed jay	83	26	34	59	18	27	247
Lime butterfly	84	49	29	45	22	30	259
Common marmon	110	38	56	62	36	42	344
Common rose	83	17	47	55	28	36	266
Common Emigrant	165	48	69	78	19	26	405
Common jezebel	106	22	72	81	24	38	343
Common grass yellow	88	16	43	56	34	26	263
Rustic (Malnad)	56	15	32	28	26	40	197
Pioneer (Arid)	37	21	25	31	24	32	170
Common Pierrot (Forest)	46	17	35	28	26	22	174
Total							3359

G= Gundya; M=Mangalore; U=Udupi; K=Karkala; B=Bolanje; H=Hebri; The data represents pooled sightings from all method overall observation dates. All species were not recorded from every location in Coastal Karnataka; n=6 but, for last 2 location n=3.

Table 9. Diversity of butterflies at 10 different locations in Coastal Karnataka

Locations	Butterfly diversity	
	Simpson index	Shannon-Weiner index
Gundya	3.70	2.85
Mangalore	1.08	0.83
Udupi	2.26	1.75
Karkala	1.87	1.60
Bolanje	0.656	0.531
Hebri	0.445	0.264
Kundapura	1.15	0.95
Kumta	1.75	0.80
Ankola	1.55	0.70
Karwar	1.80	0.85

Data pooled from all sampling methods on all dates of observations in each location. N=6 for first 4 location and n=3 for last 2 location

Table 10. Niche breadth values for selected butterfly species recorded in different study periods

Butterfly	Study periods			
	I	II	III	IV
Bird wing	2.15	1.80	1.65	-
Common. Jay	4.78	3.58	2.96	3.45
Tailed jay	3.15	3.00	1.90	2.80
Lime butterfly	2.85	2.20	1.50	2.50
Common marmon	3.55	2.76	2.01	3.20
Common rose	2.65	1.86	1.05	1.16
Common Emigrant	4.26	3.60	3.00	3.15
Common jezebel	1.18	0.76	0.35	0.78
Common grass yellow	1.65	1.08	0.95	0.88
Rustic (Malnad)	2.06	1.35	1.02	-
Blue admiral	1.98	3.06	0.94	0.97
Blue pansy	2.13	2.56	1.92	2.64
Tiny grass blue	3.01	1.47	2.01	1.98
Red pierrot	1.99	1.65	1.58	2.51
Indian Skipper	4.92	3.49	3.12	3.67
Common palm fly	-	-	2.20	2.58

Table 11. Niche overlap values of 6 pairs of butterfly in Coastal Karnataka

Sl. No	Species pair	Niche overlap
1	<i>Papilio polystes</i> and <i>P. clytia</i>	0.728
2	<i>Catapsilla crocle</i> and <i>C. pyranthe</i>	0.684
3	<i>Danus chrysippus</i> and <i>D. Melissa</i>	0.653
4	<i>Papilio polystes</i> and <i>Danus chrysippus</i>	0.356
5	<i>Papilio clythia</i> and <i>Cupa erimanthis</i>	0.026
6	<i>Papilio polystes</i> and <i>Anaphaeis aurata</i>	0.018
7	<i>Papilio paris</i> and <i>Papilio buddha</i>	0.594
8	<i>Ypthima hubneri</i> and <i>Ypthima balbus</i>	0.610
9	<i>Eurema hecabe</i> and <i>Eurema lecabe</i>	0.785
10	<i>Hypolimnas misippus</i> and <i>Hypolimnas bolina jacintha</i>	0.759
11	<i>Danaus chrysippus</i> and <i>Danus genutia</i>	0.812
12	<i>Hasora taminatus</i> and <i>Hasora badra</i>	0.701
13	<i>Talicauda nyseus</i> and <i>Tajuria cippus</i>	0.035
14	<i>Junonia hierta</i> and <i>Junonia lemonias</i>	0.871
15	<i>Papilio demoleus</i> and <i>Danaus chrysippus</i>	0.043

Overlap value of 1 indicates complete overlap between the species, 0= No overlap

Table 13: Some of the common shrubs and trees for habitat of butterflies

Tree type	Species
Shrubs	<i>Largentromia lanceolata</i>
	<i>Coliandra sp.</i>
	<i>Helectis isora</i>
	<i>Barrintonia raecemosa</i>
	<i>Hibiscus sp.</i>
	<i>Neerium</i>
	<i>Oleander</i>
	<i>Brusotia</i>
Trees	<i>Wrentia tinctoria</i>
	<i>Tasubia avalamidiae</i>
	<i>Tasubia rosea</i>
	<i>Jucaranda</i>
	<i>Spathodea conyanlata</i>
	<i>Cassia jaranica</i>
	<i>Terminalia arjuna</i>
	<i>Terminalia ballerica</i>
<i>phetophorum</i>	

Table 14: Hot spots of Costal Karnataka for Conservation of Butterflies

Sl.No	Hot Spot
1.	Mangalagangotri; Mangalore university campus
2.	Manipal Institute of Technology; An educational institute
3.	Tagore park; A public park
4.	Muradeshwara
5.	Brahmawara
6.	All Sea Beaches; Beaches from Mangalore to Karwar
7.	Temples; Famous temples in Costal Karnataka

Table 12 Butterfly fauna of Coastal Karnataka

Sl.no	Dist. /Taluk/village	* Lat. Long. Alt.	Common & Scientific name	Density	Sighting	Distribution	Seasonality	Habitat preference	IUCN status
1.	Udupi/Karkala/Mala	13° 35' N 77° 34' E	Southern birdwing <i>Triodes minos</i>	Occasional	5	U,K,M	J, D	Forest, cultivated lands	E
2.	Udupi/Udup/Udyavar	13° 35' N 77° 34' E	Common jay <i>Graphium doson</i>	Common	42	M,U,UP,K,D, G,H,S	O to M	Evergreen forest	LC
3.	DK/M'lore/Ullala	12° 49' N 74° 50' E	Tailed jay <i>Graphium agamemnon</i>	Uncommon	13	M, UL	O, D, J	Flowering plants, gardens	D
4	DK/M'lore/someshwara	12° 49' N 74° 50' E	Lime butterfly <i>Papilio demoleus</i>	Common	38	M,U,UP,K,D, G,H,S	O to M	Citrus orchards, human habitations etc	LC
5	DK/M'lore/kollur	12° 49' N 74° 50' E	Common mormon <i>Papilio polymnestor</i>	Common	43	M,U,UP,K,D, G,H,S	O to M	Gardens, human habitations	LC
6	DK/M'lore/pillikula	12° 49' N 74° 50' E	Common rose <i>Pachiliopta aristolochiae</i>	Common	34	M,U,UP,K,D, G,H,S	O to M	Flowering plants, gardens	DD
7	DK/M'lore/ullal beach	12° 49' N 74° 50' E	Common Imigrant <i>Catopsilia pomona</i>	Common	46	Sr,M,U,UP,K, D,G,H,S	O to M	Flowering plants, gardens	LC
8	UK/sirsi/Dharma reservoir	14° 43',N 74° 58' E	Common Jezebel <i>Delias eucharis</i>	Common	40	Sr,M,U,UP,K, D,G,H,S	O to M	City gardens	LC
9	UK/sirsi/Dasana gaddhe	14° 38',N 74° 50' E	Common Wandarer <i>Pareronia valeria</i>	Common	44	Sr,M,U,UP,K, D,G,H,S	O to M	Forests	LC
10	UK/sirsi/Hebre RF	14° 31', N 74° 36' E	Common grass yellow <i>Eurema hecabe</i>	Common	35	Sr,M,U,UP,K, D,G,H,S	O to M	Open area,	LC
11	Dk/Udupi/Anekere	13° 12'N 74°59'E	Small grass yellow <i>Eurema lecabe</i>	Uncommon	19	A,U	J, F	Gardens	D
12	UK/Kumta/Honnamavu	14° 24' N 74° 24' E	Mottled Emigrant <i>Catopsilla pyraithe</i>	Uncommon	16	H,Km,Sr	J, F	Gardens forests	D
13	UK/Kumta/vanalli betta	14° 25' N 74° 23' E	Common leopard <i>Phalanthium phalantha</i>	Common	41	M,U,UP,K,D, G,H,S	O to M	Wooded areas	LC
14	UK/Kumta/Vannalli	14° 25' N 74° 23' E	Common sailor <i>Neptis hylas</i>	Common	35	M,U,UP,K,D, G,H,S	O to M	Gardens	LC
15	UK/honnavar/Honnavar	14° 15' N 74° 25' E	Yellow pansy <i>Junonia hierta</i>	Uncommon	14	H.Km	J, F, M	Grasses and Gardens	D

16	UK/Honnavaara/sharavathi river	14° 16' N 74° 26' E	Common castor <i>Ariadne merione</i>	Common	37	M,U,UP,K,D, G,H,S	O to M	Castor plants	LC
17	UK/kumta/Dhadeshwar	14° 22' N 74° 24' E	Plain tiger, <i>Danaus chrysippus</i>	Common	43	M,U,UP,K,D, G,H,S	O to M	Wooded areas	LC
18	Hassan/Hassan/Alur	13° 12' N 76° 22' E	Common tiger <i>Danus genutia</i>	Common	40	M,U,UP,K,D, G,H,S	O to M	Wooded areas	LC
19	Hassan/Sakleshpur/hongrahalli	13° 30' N 76° 27' E	Common Indian crow <i>Euploea core</i>	Common	37	M,U,UP,K,D, G,H,S	O to M	Human habitat	LC
20	DK/Belthangady/Nalyadi	13° 35' N 77° 34' E	Lesser grass blue <i>Zizina otis</i>	Occasional	3	Bl, NI	F, M	Herbs, flowering herbs	E
21	Hassan/sakalehpur/Gundya	13° 35' N 76° 32' E	Common pierrot <i>Castalius rosimen</i>	Common	30	M,U,UP,K,D, G,H,S	O to M	Forest	LC
22	DK/M'lore/sampekhudru	12° 49' N 74° 50' E	Common silverline <i>Spindaris valcanus</i>	Commn	44	M,U,UP,K,D, G,H,S	O to F	Evergreen forest	LC
23	UK/Udupi/anekere	13° 35' N 77° 34' E	Indian skipper <i>Spiallia galba</i>	Common	40	M,U,UP,K,D, G,H,S	O to F	Paddy field, under shade	LC
24	DK/M'lore/ullal	12° 49' N 74° 50' E	Grass demon <i>Udaspes folus</i>	Uncommon	11	Ul, M, Sr	D to F	Open area	DD
25	DK/M'lore/Ullal	12°49' N, 74°50'E	Common mormon <i>Papilio polymmestor</i>	Common	14	M,UL,An,Kn	S,D,N	Garden plants	D
26	DK/M'lore/Ullal	12°49' N 74°50'E	Common mormon <i>Papilio polytes</i>	Common	10	A,U,K,D,H,G	A,S,D,N	Flowering plants	LC
27	DK/M'lore/Pillicula	12°49' N 74°50'E	Common mormon <i>Papilio polymestor</i>	common	21	UP,Kun,Kar,G H,	A,D,N	Garden	LC
28	Kar/Ankola	13°35' N 77°34' E	Common mime <i>Papilio clytia</i>	Uncommon	18	Kar,An,Kun,U P,	S,N	Open space	DD
29	Kar/Ankola	13°35' N 77°34' E	Red Helen <i>Papilio helemus</i>	Uncommon	20	Kar,An,UP,D G	S,O	Garden	DD
30	Kun/Kundapura	12°35' N 76°34' E	Blue marmon <i>Papilio polymenestor</i>	Uncommon	28	Kun,UP,G,H,S	A,S,O	Herbs	LC
31	UK/Kumta/Honnamavu	12°35' E 76°34' E	Crimson rose <i>Pachiliopta hector</i>	Common	32	G,H,S, UP,K,D	J,F,S,O	City Garden	D

32	DK/Udupi/Anekere	14°12'N 74°59'E	Spotted sword tail <i>Pathysa nomius</i>	Uncommon	16	M,An,Kun,Kar	S,O,N	Open areas	LC
33	UK/Kumta	14°22'N 74°24'E	Common blue bottle <i>Graphium saspedon</i>	Common	12	Kum,Kun,Kar, M,An	O,N,S	Wooded areas	D
34	DK/Belthangandi/ Nalaydi	33°35'N 77°34'E	Paras peacock <i>Papilio paris</i>	Uncommon	24	M,UP,K,D,G, Ane	S,N	Open areas	DD
35	DK/Belthangadi/ Nalaydi	33°35'N 77°34'E	Malabar banded peacock <i>Papilio buddha</i>	Uncommon	17	M,UP,K,D,G, Ane	J,F	Wooded ares	DD
36	DK/M'lore/City	12°49'N 74°50'E	Malabar rose <i>Pachliopta padixana</i>	Occasionall y	18	UP,K,Kan,Kun ,An	A,S,O	Orchards	DD
37	Udupi/Karkala/Mala	13°35'N 77°34'E	Great orange tip <i>Hebomoia glaucippe</i>	Common	22	M,U,Ane,K,D, G	S,O,N	Wooded areas	LC
38	Udupi/Karkala/Mala	33°35'N 77°34'E	Pioneer <i>Anaphaeis auroti</i>	Uncommon	17	Ane,Kar,Kun, G,H	J,F,M	Open areas	LC
39	UK/Kumta/	14°22'N 74°24'E	Common gull <i>Cepora Spp</i>	Common	22	Kum,Kar,Ane, G,D,M	A,S,O,N	Garden	LC
40	UK/Kumta	14°22'N 74°24'E	Alba +ross <i>Appias albina</i>	Common	26	UP,K,D,G,H,S	J,F,M	Open area	DD
41	Udupi/Kar/Mala	13°35'N 77°34'E	White orange tip <i>Ixias Spp</i>	Uncommon	22	M,U,K,D,G,A ne	O,N,D	Garden	LC
42	Hassan/Sakaleshpur a	13°35'N 77°32'E	Plain orange tip <i>Colotis eucharis</i>	Common	26	Sr,M,U,Kar,K un	J,J,A	Open area	DD
43	DK/M'lore/City	12°49'N 74°50'E	Psyche <i>Leptosia nina</i>	Uncommon	11	U,M,S,Kun,Ku m	O,N	Human habitat	DD
44	DK/M'lore/Ullal	12°49'N 74°50'E	Danaid egg fly <i>Hypolimnas misippus</i>	Uncommon	10	M,U,UP,K,D, G	O,CO,M	Open areas	DD
45	DK/M'lore/Ullal	12°49'N 74°50'E	Great egg fly <i>Hypolimnus bolina</i>	Uncommon	18	H,S,G,K,Kum	J,A	Open areas	DD
46	Udupi/Udayavar	13°35'N 77°34'E	Rustic <i>Cupha erimanthis</i>	Uncommon	10	U,UP,K,D,G,S	Jun-Aug	Garden	LC
47	Udupi/Udayavar	13°35'N 77°34'E	Common baron <i>Euthalia aconthia</i>	Uncommon	8	Ane,Kar,Kum, S,G,K,t	J-m	Wooded areas	DD

48	Udupi/Udayavar	13°35' N 77°34' E	Baronet <i>Euthalia nais</i>	Common	27	K,P,G,S,U,Up, Ane	A-O	Sparse vegetation	LC
49	DK/M lore/Ullal	12°49' N 74°50' E	Grey count <i>Tanaceia lepida</i>	Common	34	M,U,UP,K,D, G,S	O-m	Garden	DD
50	DK/M lore/Ullal	12°49' N 74°50' E	Chocolate pansy <i>Precis eiphita</i>	Uncommon	30	M,U,UP,K,D, G,H,S	Jan-Jun	Open area	LC
51	Karvar	14°17' N 74°38' E	Peacock pansy <i>Junonia hierta</i>	Common	32	Kar,An,K,	M,A,May	Wooded area	DD
52	Kundapura	13°20' N 70°15' E	Lemon pansy <i>Junonia hierta</i>	Uncommon	14	M,U,P,k,D	June,July, S,O	Cultivated area,Forests	DD
53	DK/M lore/Ullal	12°49' N 74°50' E	Paris peacock <i>Papilio paris</i>	Common	30	M,U,UO,K,D, G,H	Jan-June	Wooded areas	DD
54	Ankola/Karawar	13°20' N 70°15' E	Common Sailor <i>Neptes hylas moore</i>	Uncommon	30	Kar,Ank	M,A,May	Open areas	LC
55	M lore/Ankola/Karvar	55°34' N 74°50' E	Baronet <i>Euthalia nais</i>	Common	34	M,U,UP,K,D	M,May	Garden areas	DD
56	DK/M lore/Ullal	56°49' N 34°70' E	Grey count <i>Tanaceia lepida</i>	Uncommon	32	Kar,Ank,	O -march	Cultivated areas	LC
57	Kundapura	13°20' E 70°15' E	Clipper <i>Parthenos sylvia</i>	Common	14	M,U,P,K,D	O,N	Human habitat	DD
58	Udupi/Udayavar	13°35' N 77°34' E	Angled castor <i>Ariadne ariadne</i>	Uncommon	11	M,U,P,KS,D	O,N	Garden	DD
59	DK/M lore/City	12°49' N 74°50' E	Southern Bird wing <i>Troides minos cramer</i>	Common	18	H,S,G,K,D	J,A	Wooded area	DD
60	Udupi/Udayavar	13°35' N 77°34' E	Common jay <i>Graphium doson</i>	Uncommon	15	H,D,G,Kar,Ka n	M,A	Uncultivated area	LC
61	Karvar	14°17' N 74°38' E	Tailed jay <i>Graphium gamemnon</i>	Common	14	M,UP,U,K,An e	O,N	Garden	LC
62	Kundapura	13°20' N 70°15' E	Lime butter fly <i>Papilio demoleus</i>	Common	20	H,S,G,Kun	J,A	Open area	DD
63	Udupi/karkalla/Mala	13°35' N 77°34' E	Morttiled emigrant <i>Catopisilla pyraithe</i>	Common	17	Ane,Kar,Kum	J,F,M	Garden	LC

64	Hassan? sakaleshpura	13°35' N 76°32' E	Common jezebel <i>Delias eucharis</i>	Uncommon	22	M,U,K,D,G	O,N,D	Cultivated area	DD
65	UK?kumta	14°22' N 74°24' E	Common leopard <i>Phalantu phalantha</i>	Common	18	UP,Kar,K,Ane	S,N	Wooded area	DD
66	M ^o lore/City	12°49' N 74°50' E	Plain tiger <i>Danaus Chrysippus</i>	Common	13	M,U,Ane,K,D G	S,O,N	Open area	LC
67	UK/Kumta	14°22' N 74°24' E	Common sailor <i>Neptis hylas</i>	Uncommon	17	S,R,M,U,Kar	J,J,A	Wooded area	LC
68	Ullal/M ^o lore	12°49' N 74°50' E	Lesser grass blue <i>Zizina otis</i>	Common	30	Kar,Ank,	J,F	Open area	DD
69	Udupi/Karkala/Mala	13°35' N 77°34' E	Common pierrot <i>Castalius rosimen</i>	Common	22	Kar,Kum,Ane	A,S,O	Garden area	DD
70	M ^o lore/City	12°49' N 74°50' E	Common Silver line <i>Spindalis vulcanus</i>	Uncommon	26	Ane,K,D,G,H	O,N,D	Cultivated area	LC
71	UK/Kumta	14°22' E 74°24' E	Indian skipper <i>Spiallia galba</i>	Common	17	UP,D,H,S	S,O,N	Wooded area	DD
72	DK/Udupi/Anekere	13°12' N 74°59' E	Grass demon <i>Udaspes folas</i>	Uncommon	26	D,G,H,U,P	M,S,	Open area	DD
73	Kumta	14°22' N 74°24' E	Rice swift <i>Borbo cinnara</i>	Common	23	M,U,Ane,K,D, G	M,J,N	Cultivated field	DD
74	Udupi/M ^o lore	12°35' N 40°77' E	Snow flat <i>Teagiades litigiosa</i>	Uncommon	22	UP,K,D,G,S	J,F,N	Open raea	LC
75	Karkala	12°35' N 35°79' E	Indian palm bob <i>Suastus greminus</i>	Common	10	U,M,K,Kar,an e	J,F,O	Garden	DD
76	Kundapura	13°35' N 70°15' E	Common banded owl <i>Hasora badra</i>	Common	14	K,M,G,H,	N,D,M	Wooded area	LC
77	Udupi	12°35' N 23°56' E	Dark blue tiger <i>Danus Melissa</i>	Uncommon	23	G,H,kar,Ane<	Mar,J	Open area	DD
78	Ullal/M ^o lore	12°35' N 35°50' E	Piad flat <i>Pseudocoladinia dan</i>	Common	11	H,S,G,K,D	J,A	Garden area	LC

79	Kumta?Kundapura	13 ⁰ 20'N 70 ⁰ 15'E	Red admiral <i>Vanessa indica</i>	Uncommon	32	Kar,Ank,	M,A,J	Open area	DD
80	Karkala	13 ⁰ 35'N 77 ⁰ 34'E	Joker <i>Byblia eilithya</i>	Common	12	Ane,G,H,K	M,J,F	Garden	DD
81	Udupi	12 ⁰ 35'N 35 ⁰ 60'E	Gram blue <i>Euchrysops cnejus</i>	Uncommon	14	H,K,Ane	March,D,J	Cultivated area	DD
82	M lorekarkla/ Udupui	12 ⁰ 35'N 49,77'E	Lace wing <i>Cethosia nietneri</i>	Common	23	G,H,K,Ane<kar	D,J,July	Open area	DD
83	Kundapura	12 ⁰ 35'N 77 ⁰ 59'E	Black rajah <i>Charaxex fabius</i>	Uncommon	12	G,H,Kar	A,S,N	Open area	LC
84	Kumta	14 ⁰ 22'N 74 ⁰ 24'E	Hedge blue <i>Actolepis puspa</i>	Common	19	H,K,Ane	A,N,D,O	Uncultivated area	DD
85	DK/M lore/City	12 ⁰ 49'N 74 ⁰ 50'E	Yeomen <i>Cirrochroa thais</i>	Uncommon	12	H,K,N,G,D	J,A M	Open area	LC
86	UK/Kumta	13 ⁰ 12'N 74 ⁰ 59'E	Commander <i>Linenitis procris</i>	Common	18	A,G,H D,H	M,D ,S	Cultivated area	DD
87	Belthangadi	14 ⁰ 35'N 75 ⁰ 34'E	Pea blue <i>Lampedes boeticus</i>	Unommon	22	A,G,D,H	A,M,J	Open area	LC
88	Nelyadi/ Uppinangadi	13 ⁰ 12'N 77 ⁰ 34'E	Red pierrot <i>Talicauda nyseus</i>	Common	20	G,H,Kar,Ane	J,O,M	Garden	DD
89	Honnavaara/Ullal	12 ⁰ 34'N 77O50'E	Gaint red eye <i>Gangara thyris</i>	Uncommon	23	G,H,kar,Ane	O,D,F	Cultivated area	LC
90	M lore/Kumta	23 ⁰ 35'N 77 ⁰ 57'E	Tamil grass drat <i>Taractrocera ceramaus</i>	Uncommon	12	A,G.H.K.D,	M,O,F,J	Uncultivated area	DD
91	Ullala/Karkala	12 ⁰ 49'N 74 ⁰ 50'E	Peacock royal <i>Tajuria cippus</i>	Common	22	H,A,K,Ane`	J,A,S,N	Uncultivated area	DD
92	DK/Ankola	23 ⁰ 45'N 77 ⁰ 58'E	Psyche <i>Leptosia nina</i>	Common	12	G,H,K,A,Kar	S,N,O J	Open area	LC

92	Kumta	12°50' N 77°56' E	Albastross <i>Apipias albina</i>	Uncommon	22	H,A,Km,u,D	F,July N,	Herbs	DD
93	Karkala	12°35' N 70°57' E	Common gall <i>Cepora Spp</i>	Common	12	K,D,G,UI	J,F,O	Garden	LC
94	UK/DK/M'lore	14°35' N 79°57' E	Line blue <i>Chlades laius</i>	Uncommon	22	D,K,H,G,Ui	S,OD,F	Garden	DD
95	Murudeshwar Beach, Murudeshwar	11°31' N 74°01'E	Malabar Banded swallow tail, <i>Papilio liomedon</i>	Uncommon	10			Xerophyte plants	
96	Gokarna beach, Gokarna,	14.55' N 74.31'E	Nilgiri clouded yellow, <i>Colias nilagiriensis</i>	Uncommon	12			Xerophyte plants	
97	Karwar Beach, Karwar	13° 55' N 74° 20" E	Brown awl, <i>Badamia exclamationis</i>	common	24			Shrubs and trees	
98	Magalore beach, Mangalore	12° 52' N, 74° 53' E	Restricted Demon, <i>Notocrypta curvifascia</i>	uncommon	13			Some shrubs	

Note:

Col 4: Average No. of sightings of the species/day.

Col 5: Common- $>25/\text{Km}^2$; Uncommon- $10-25/\text{Km}^2$; Occasional- $<10/\text{Km}^2$; **Col 6:** Frequency of detecting the species in a patch; **Col 7:** An- Ankola, M-Mangalore, U- udupi, Up- Uppinangadi, K-Karkala, D- Dharmastala, H-Honnavaara, G-Gundya, UI-Ullal, A- Anekere, Km-Kumta, Bl-Belthangady, NI-Nelyadi, Kar- Karwar, Kun- Kundapur; **Col 8:** D- O-October; N-November; December; J- January; F-February; M-March; **Col 10:** E-Endangered; LC-Least concern; D-Declining; DD-Data deficient;

* GPS, details of each locality are furnished under materials and methods while describing the habitats

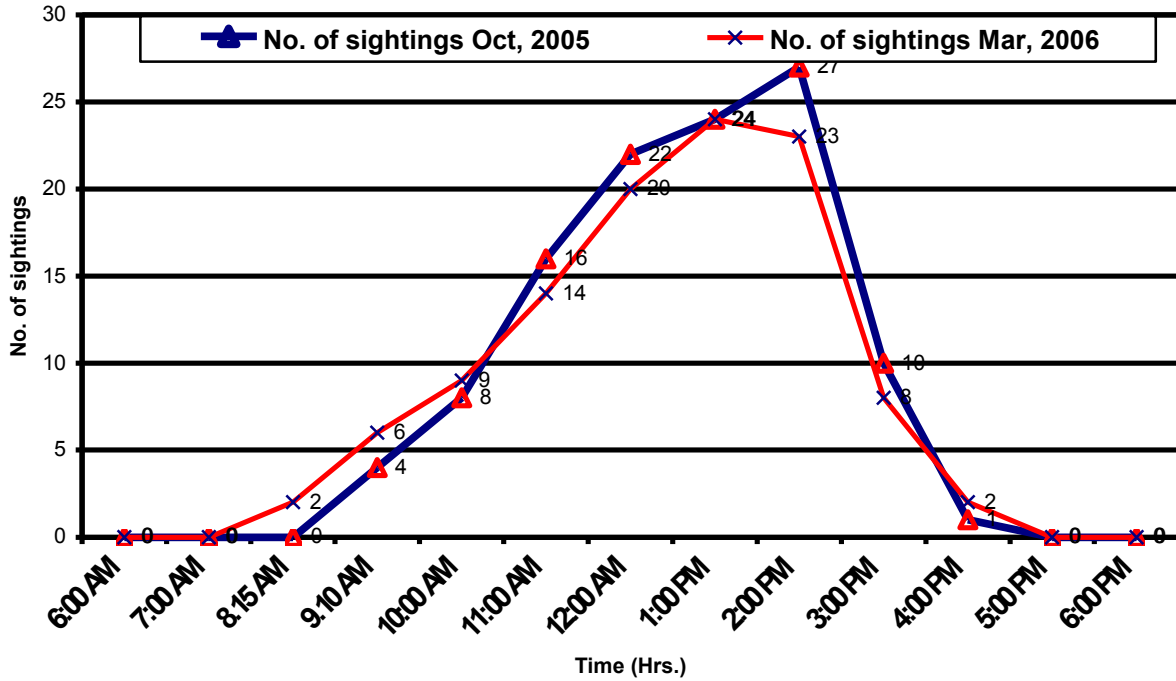


Fig. 1. Diurnal detectability/day of Butterflies of Coastal Karnataka (n=6)

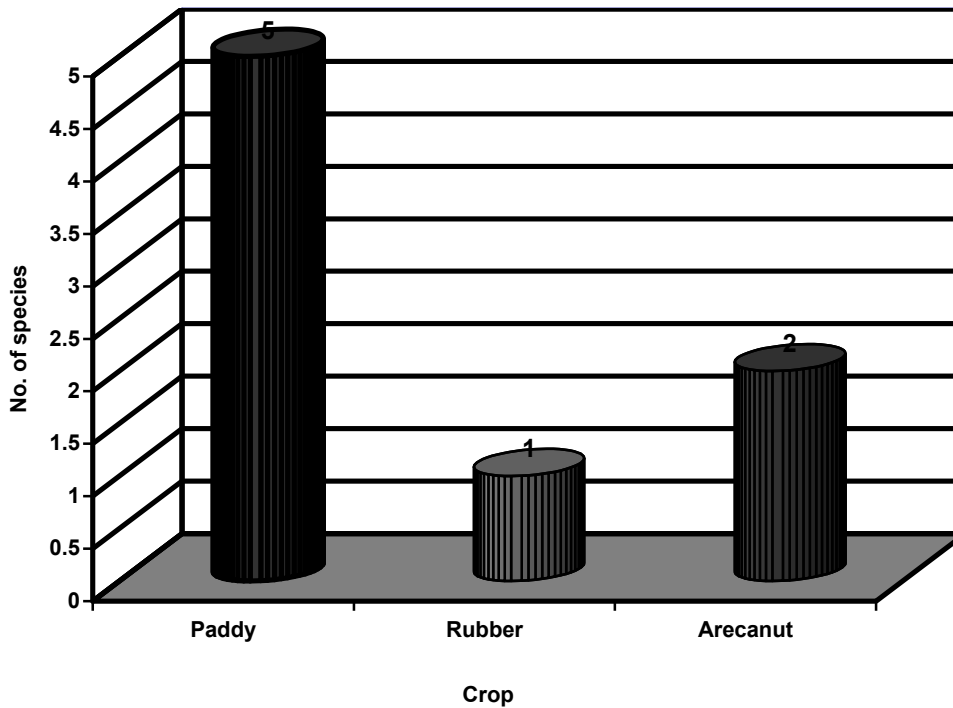


Fig. 2. Average number of butterfly Species of butterflies in different crop ecosystems (monitoring in transects, n=6)

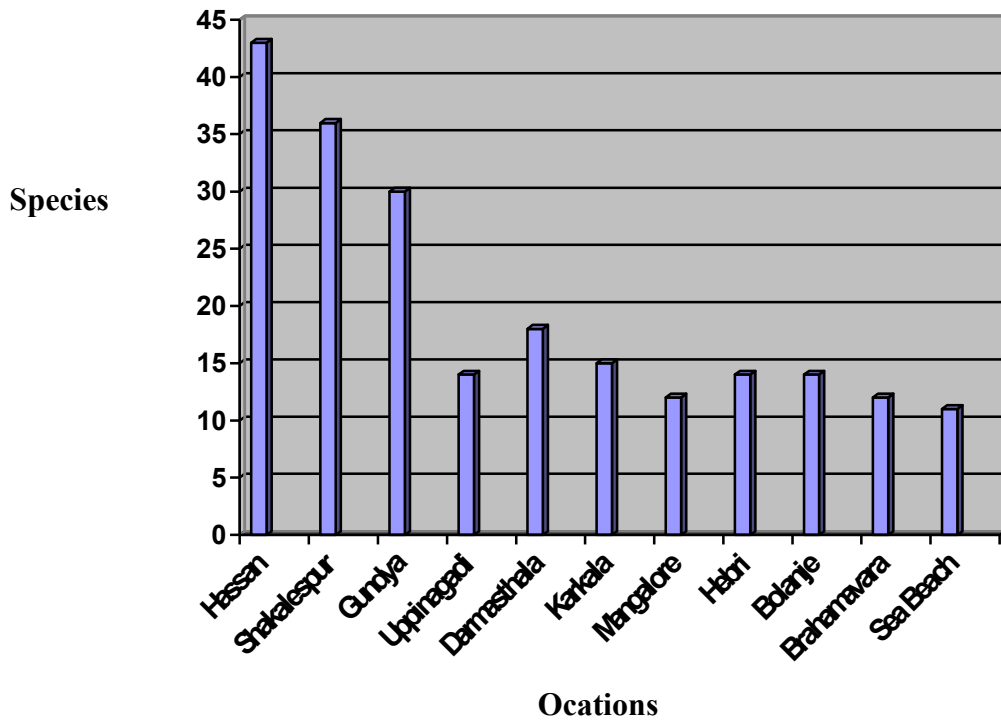


Fig.3: Butterfly species in different locations in costal Karnataka

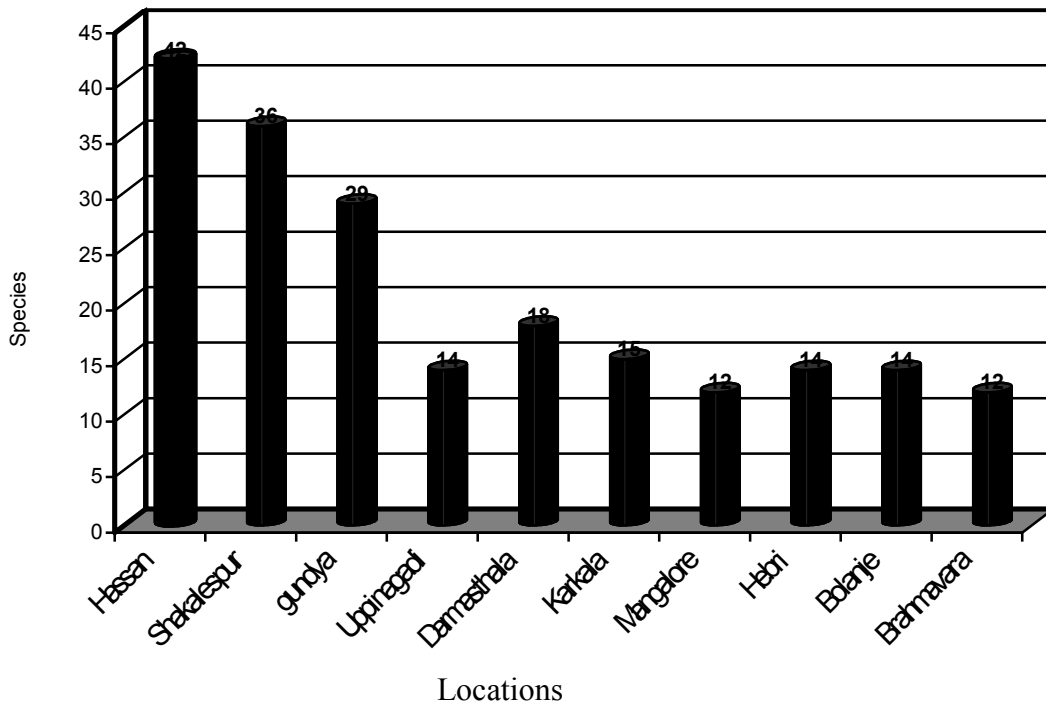


Fig. 3. Butterfly species in different locations in Coastal Karnataka

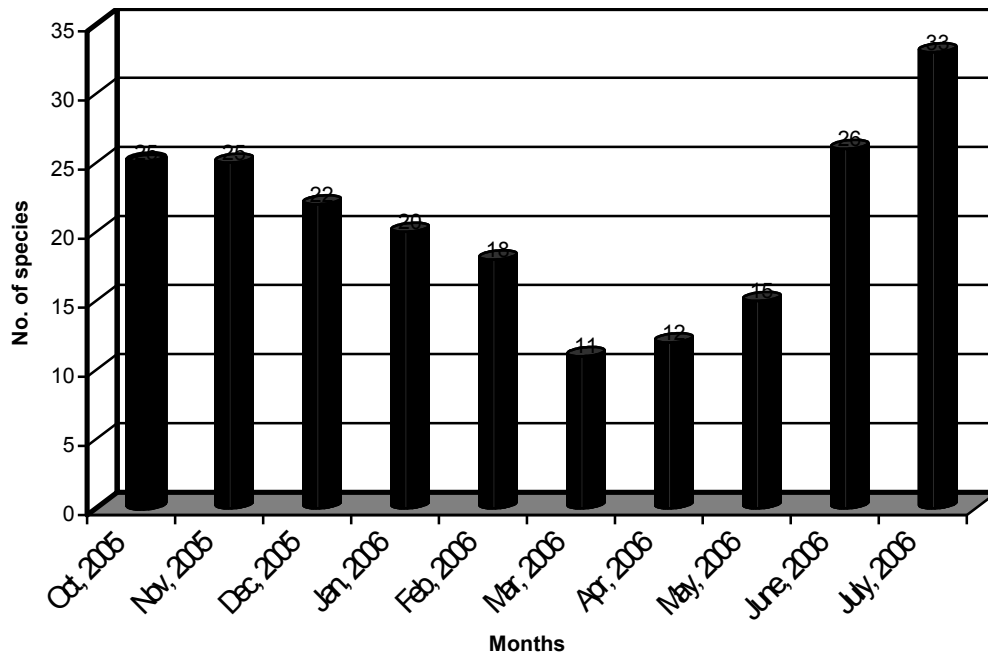


Fig. 4. Number of butterfly species in different months in Coastal Karnataka