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RESEARCH ARTICLE

BUTTERFLIES OF SASAN GIR NATIONAL PARK, JUNAGARH, GUJARAT AND THEIR INTERACTION WITH THE DIFFERENT HOST-PLANTS SPECIES.

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Abstract

The present study is based on host-ranges of butterflies, encountered in and adjacent to the Gir National Park, Gujarat, India. The larval host plants of 67 butterfly species were identified and their host ranges were recorded. Out of 74 host-plants, 22 annuals, 3 biennial and 49 perennials. These plant species are further categorised as to belong to different plant categories which include 21 tree species, 22 herbs species, 24 shrubs specie, 6 species of Climbers and one species of plant parasite. The findings revealed that the plant species belonging to families Mimosaceae, Capparaceae and Caesalpiniaceae were found most suitable food for butterfly species belonging to the 4 different families of butterflies in GNP. In addition, a number of significant differences between butterfly families and their host use patterns such as perination, host specificity etc. were studies and identified. Correlation coefficient (r = 0.785) confirms a strong correlation between host plants and butterflies and was found significant at 1% level (p = 0.01). Hence, more number of host-plant species attracts significantly more species of butterflies.

Introduction:-

During the past century numerous researches have been conducted and findings have been published on insect host plant interactions by earlier researchers. These have been primarily dealt with natural history, but many are theoretical as well (Brues 1946 and Gilbert 1972). Due to high degree of host - specificity, most of the butterflies appear to select their host plants on the basis of secondary products chemistry rather than on the basis of general ecological consideration. Other groups of insects are fewer hosts specific, and with these insects ecological theories have progressed (Gilbert 1972). However, with regard to herbivores such as butterflies, purely ecological data and theory apart from natural history observation is quite scarce (Gilbert and Singer 1975). The foundation for the study of insects host plant relationships were clearly delineated by Charles T. Brues in 1920's (Brues 1920, 1924). Brues used three categories of phytophagous insects which are still widely used. Insects which feed on a definite few host plant species and those which feed upon a wide variety of host plant species are called oligophagous and polyphagous respectively.

The chemicals are characteristic of the host plant used by butterfly; this causes the butterfly to oviposit on the correct type of host plants (Schoonhoven, 1973). The idea of co-evolutionary balance between host plant resistance and herbivore "virulence" was used by Ehrlich and Raven (1964) to explain the observed pattern of butterfly/ host plant taxonomic relationship. Thus, the relationship between any given butterfly species and its host plant is very specific. Among all the resources required by butterflies that comprise a habitat (Dennis et al. 2003, 2006; Dennis 2010), the larval host plants are the key resource, being fundamental for reproduction. Knowledge of butterfly host plants is a prerequisite for any butterfly conservation programme. Therefore, it is necessary to know the exact needs of the immature stages to make conservation successful (New et al. 1995). But, knowledge concerning larval host

plants is still poor in the case of many butterfly species, especially in the tropics (Kunte 2000). As such, the present study focuses on larval host plant use in the butterflies of biotopes within the confines of Nagpur City, India, building on the work of previous scientists. Janz, et al., (2006) stated that Plant-feeding insects make up a large part of earth's total biodiversity. While it has been shown that herbivory has repeatedly led to increased diversification rates in insects, there has been no compelling explanation for how plant-feeding has promoted speciation rates.

Material and methods:-

Study sites:-

Constitution of the study site contained Teak forest mixed with dry deciduous species .The flora of Gir forest published by the FRI in 1955 is comprised 403 species of plants which was updated later to 606 species by some later identification (Meena and Sandeep, 2012). Some flowering and many non-flowering plants which appear during rains, were also identified far later after various research and monitoring program in Gir. The vegetation changes along with west to east axis. Thirteen vegetation types were categorized by Chavan (1993), eleven habitat types were identified by Khan (1993) and fifteen vegetation association were categorized in Gir National Park.

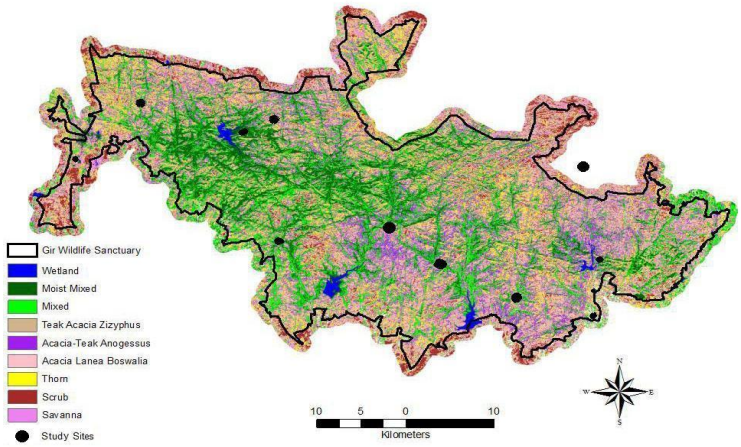

Figure 1: Different habitat types of Gir National Park and Santuary with one Km buffer.

The study sites were selected in GNP and observations on assessment of host – range of various species of butterflies were recorded in 10 selected study- sites GNP, located in the Saurashtra peninsula of Gujarat India (20^{o} 40' N to 21^{o} 50' N and 70^{o} 50' E to 71^{o} 15' E) extended upto 1412.1 sq.kms. The original biome in the area was very dry teak forest which falls under the type 5A/Cla.

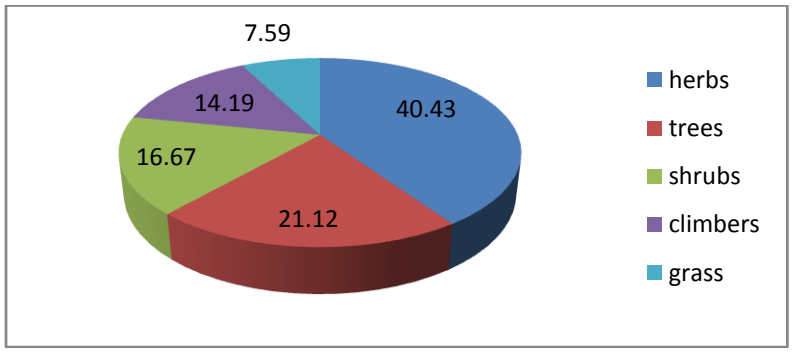

Figure 2: Percentage contribution of plant habits in GNP.

During the survey female butterflies were followed and collected the eggs along with the plant parts on which eggs were laid. The foliage was also searched, along with other plant parts for eggs and larvae. The larvae observed during the survey were collected and brought to the laboratory along with their host plant leaves for rearing. The cage containing larvae were cleaned daily before old foliage was replaced by new leaves. The pupae were left in the cages undisturbed until their adult eclosion, and identification. Although some larvae and broods were lost to mortality, larvae were often sufficiently distinct to identify to species level.

Butterfly species and larval host-plants were scored for a number of variables considered to influence herbivory. Butterfly species were distinguished for their host- specificity. Host - plants were scored for their growth or habit (such as herb, shrub, tree, climber, and stem parasites), biotope (wild, cultivated and exotic), abundance (rare, frequent and abundant) and perennation (annual, biennial and perennial). These variables include common occurrence of the host - plant along with herb or shrubs track edges at rock face or wall, along stream or river bank and on hill tops etc. Those plants that were difficult to identify in the field were photographed or preserved by making dry herbarium sheet specimens including all details of plants for further identification. The herbarium specimens were later identified in the Botanical Survey of India and Zoological Survey of India, Jodhpur.

Data on oviposition; larval feeding and butterfly numbers were collected from ten study-sites during the year 2011-2012 in GNP. Different type of habitats was sampled. Butterflies were monitored, collected in different seasons as per the methodology of Pollard and Yates (1993). The sites differ in biotopes (vegetation structure) and in resources of butterflies (eg. larval host plants, flowering nectar plant species and physical structures used for oviposition and breeding).The relative abundances of butterfly species, were obtained from the transect records taken within confined bounds while walking at a steady path as per the methodology adopted by (Tiple et al., 2009, 2010). Although transect counts do not provide absolute estimates of butterfly populations and owing to their different biotope association and conspicuousness to recorders, are not directly comparable (Dennis et al. 2006), the large range in numbers obtained for different species are regarded here as adequately reflecting relative differences in population sizes of butterfly species. Oviposition and breeding records, as well as nectar use and plant distributions, were obtained during independent surveys of the same sites.

Results and Discussion:-

Larval host-plant database: A total of 67 species of butterflies were observed and recorded from ten study-sites of Gir National park in Gujarat during the extensive field surveys, conducted in different seasons during 2011- 2012. The host-plants of all the species of butterflies were authentically identified except two species viz. Mycalesis sp. and Faegana sp., which could not be identified because these species were always observed flying near river reservoirs.

A total of 74 plant species were recorded, serving as host-plants for 67 species of butterflies in GNP. Of them, 66 plant species were found as wild species whereas remaining 8 species were either cultivated or found in wild form. These plant species are further categorized as to belong to tree species (21 species), herbs (22 species), shrubs (24 species), Climber (6 species) and stem parasite (1 species). It has also been observed that out of 74 host-plants, 49 species belong to perennials whereas 22 species as annuals and remaining 3 species were recorded as to belong to biennial category of plant species.

During the present investigation, it has also been observed that the following four butterfly families were found to feed on 74 host-plants species representing 32 plant families at GNA (Table-1). The plant species belonging to families Mimosaceae, Capparaceae and Caesalpiniaceae were found to be the most suitable food for butterflies.

Table 1: Utilization of plant families as larval host plants by species of butterflies at Sasan gir National Park.

S.No.	Host Plant Family	Papilionidae	Pieridae	Nymphalidae	Lycaenidae
1.	Rutaceae	2	0	0	0
2.	Aristolochiaceae	1	0	0	0
3.	Magnoliaceae	1	0	0	0
4.	Annonaceae	2	0	0	0
5.	Asclepiadaceae	0	0	3	0
6.	Verbenaceae	0	0	3	0
7.	Asteraceae	0	0	3	0
8.	Periplocaceae	0	0	1	0
9.	Moraceae	0	0	1	0
10.	Malvaceae	0	0	7	0
11.	Mimosaceae	0	1	1	4
12.	Passifloraceae	0	0	1	0
13.	Capparaceae	0	10	1	0
14.	Urticaceae	0	0	1	0
15.	Euphorbiaceae	0	0	2	0
16.	Flacourtiaceae	0	0	1	0
17.	Poaceae	0	0	3	0
18.	Dipterocarpaceae	0	0	1	0
19.	Caesalpiniaceae	0	8	1	0
20.	Loranthaceae	0	1	0	1
21.	Salvadoraceae	0	2	0	0
22.	Rhamnaceae	0	0	0	4
23.	Fabaceae	0	0	0	5
24.	Amarantaceae	0	0	0	1
25.	Leguminosae	0	0	0	2
26.	Meliaceae	0	0	0	1
27.	Sapindaceae	0	0	0	1
28.	Apocynaceae	0	0	1	0
29.	Acanthaceae	0	0	8	0
30.	Combretaceae	0	0	0	1
31.	Conneraceae	0	0	0	1
32.	Punniceae	0	0	0	1
	Total	6	22	39	22

Taxonomic contrasts in host use and herbivory; Significant contrasts among butterfly families occur for host use of different host plant life forms , biotopes, host plant perennation but not for host plant abundance nymphalidae used more herbs than expected. An excess of nymphalidae host plant occurred wild as compared to an excess of papilionidae that were cultivated/wild. Corresponding with these contrasts, an excess of nymphalidae used annual/ biennials, whereas papilionidae, lycaenidae and, to a lesser extent, pieridae, used more perennials than expected. Families also differed for host specificity (phagy) having a significant tendency towards monophagy and lycaenidae towards polyphagy.

Landscape contrasts among host plants for butterflies families occurred for stream banks and hill tops but not shrub wood edges. An excess of nymphalidae hosts plant were found on stream banks, and a deficit of host plants belonging to papilionidae and pieridiae. Hill tops had an excess of pieridae and nymphalidae host-plants and deficit of papilionidae and, to a lesser extent, hesperiidae host plants. The number of absences was too small for a comparison of host-plant occurrence along tracks through herbs and shrubs of all families, but an excess of hesperiidae occurred along tracks compared to those of nymphalidae and lycaenidae, the latter two not differing in frequency.

Table 2: Data collected to establish correlation between host-plant species and butterfly species pertaining to their abundance and herbivory.

S.No.	Host Plant Family	Host plant species	Number of host plant species	Number of Butterfly species	Number of Butterfly family
1.	Rutaceae	Aegle marmelos, citrus limon, Murraya Koenigii	3	2	1
2.	Aristolochiaceae	Aristolochia indica	1	1	1
3.	Magnoliaceae	Michelia champaca	1	1	1
4.	Annonaceae	Polylathia longifolia	1	2	1
5.	Asclepiadaceae	Calotropis gigantia, Ceropegia bulbosa	2	3	1
6.	Verbenaceae	Lantana spp.,	1	3	1
7.	Asteraceae	Helianthus annus, Emilia sonchifolia	2	3	1
8.	Periplocaceae	Hemidesmus indicus	1	1	1
9.	Moraceae	Ficus bengalensis, Ficus religiosa	2	1	1
10.	Malvaceae	Hibiscus ovalifolius,Hibiscus rosa sinensis,Hibiscus lobatus, Hibiscus Sabdariffa, Abutilon indicum, Sida spp.	6	7	1
11.	Mimosaceae	Mimosa spp. Acacia leucophloea Acacia ferruginea, Albizzia lebbeck,Mplumbago zeylanicaimusa, Pithecellobium dulce,	6	6	3
12.	Passifloraceae	Passiflora edulis	1	1	1
13.	Capparaceae	Cleome viscose, Cadaba indica, Maerua arenaria, Capparis heyneana, C. Zeylanica, Capparis grandis, Capparis sepiaria, Maerua oblongiflora	8	10	1
14.	Urticaceae	Pouzolzia zeylanica	1	1	1
15.	Euphorbiaceae	Ricinus communis, Jatropha curcas	2	2	1
16.	Flacourtiaceae	Flacourtia indica	1	1	1
17.	Poaceae	Sorghum halepense, Zea mayas, Grasses	3	3	1
18.	Dipterocarpaceae	Shorea robusta	1	1	1
19.	Caesalpiniaceae	Tamarindus indica, Piliostigma malabaricum, Cassia fistula, Cassia tora Pithecellobium dulce, Albizia Spp.	6	8	2

20.	Loranthaceae	Dendropthoe faleata	1	1	1
21.	Salvadoraceae	Salvadora persica, S. oleoides	2	2	1
22.	Rhamnaceae	Zizyphus glabrata, Zizyphus mauritiana, Zizyphus oenoplia, Zizyphus xylopyrus, Zizyphus nummularia, Z. rugosa	6	4	1
23.	Fabaceae	Taphrsposia purpurea, Erthrina indica, Butea spp., Desmodium spp.	4	5	1
24.	Amarantaceae	Amarantus gracilis	1	1	1
25.	Leguminosae	Zornia diphylla, Pongamia pinnata, Derris scandens, Xylia dolabriformis	4	2	1
26.	Meliaceae	Abrus precatorius, Heynia trijuga	2	1	1
27.	Sapindaceae	Sapindus marginatus, S. trifoliatus	2	1	1
28.	Apocynaceae	Nerium indicum,	1	1	1
29.	Acanthaceae	Barleria prioniti	1	8	1
30.	Combretaceae	Quisqualis indica	1	1	1
31.	Conneraceae	Connarus wightii,	1	1	1
32.	Puniceae	Punica granatum	1	1	1

The basic objective of the GNP study was the construction of a database on resources for butterflies to further their conservation. A database allows progress in two important areas. First, it supplies firm information on resources and resource use by butterflies; secondly, it provide the means for identifying taxonomic contrasts for and interactions among life history and ecological variables to ensure that resources are allocated in an efficient, holistic manner to conserve and build butterfly communities in suitable sites.

Table 3: Correlation between butterflies and host plant species.

	Host Plant species	Butterfly species	Butterfly families
Host Plant species	1		
Butterfly species	0.784731**	1	
Butterfly families	0.45418**	0.39366*	1

Correlation coefficient between number of host plant species and Butterfly species was found ($r = 0.785$) and was significant at 1% level ($p = 0.01$), shows strong correlation between host and plant. Hence, more number of host-plant species attracts significantly more species of butterflies. Similarly, correlation coefficient ($r = 0.454$) between number of host plant species and butterfly family was also found significant at 1% level ($p = 0.01$) and also shows that more butterfly families were attracted significantly the host plant species as their number increases. Whereas, correlation coefficient between butterfly species and butterfly family calculated as ($r = 0.394$) which shows medium correlation between these two but was significant at 0.5% level ($p = 0.05$) (Table-3).

The study has focused on collecting fundamental information of butterfly resources within Gir National park, India. Data on the other vital consumer resource, nectar flowers (Tudor et al., 2004) have already been reported (Tiple et al., 2006, 2009). Basic information has been collected on host plant life forms, basic biotopes, perennation, abundance, and host plant distribution.

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