



Mimetic Relationships of Butterflies, Commonly Found at Taki, North 24 Parganas, West Bengal

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ABSTRACT

Coloration and mimicry are the naturally selected survival tools for lepidopterans, both in larval and adult life either playing the protective or aggressive or advertising or cryptic or camouflaging mechanisms. Besides being nature's priceless artwork, butterflies are one of the most beneficial terrestrial insects, playing a major role as pollinators and an essential component of commercial agriculture, horticulture, wild plant and animal diversity. They also play role as bioindicators. The natural distribution of butterfly populations in any local habitat is primarily defined by the distribution of their nectar plants and larval host plants as there exist species specific relationships among the host and nectar plants and the dependant butterflies. Also there exist specific ecological and functional correlation among the mimetic forms (the models and mimics and the individual members of a mimicry-complex or Mullerian ring) found in any particular habitat. The present study is focussed on observation, documentation and analysis of mimetic butterflies commonly found at Taki, North 24 Parganas; availability and prominence of mimicking sets, their intra- and interfamily relationships, reporting about their larval host plants and nectar plants. The study also has an importance from conservation approach.

Keywords: Butterfly; Mimetic relationships; Host and Nectar plants; Conservation; Taki

1. INTRODUCTION

Taki is a small town situated on the bank of the river Ichhamati, North 24 Parganas, West Bengal. It is comprised of a multiple land usage pattern thus creating fragmentation of the native floral distribution including various nectar and larval host plants nurturing and sheltering the native butterfly populations both in larval and adult life. Seasonal co-occurrence of Models and Mimics and members of Mimicry-Complex is dependent on floral resource availability. As well, the survival and uninterrupted distribution of the mimetic groups acting as potent pollinators of native plants play the key role in the conservation of the wild floral distribution. Thus, butterflies are considered as focal species of conservation in several areas of world (New, 2011). Present survey was aimed to document the prominent mimicking butterflies found at Taki, North 24 Parganas, West Bengal, as there is no such record till date.

2. MATERIALS AND METHODS

Study site:

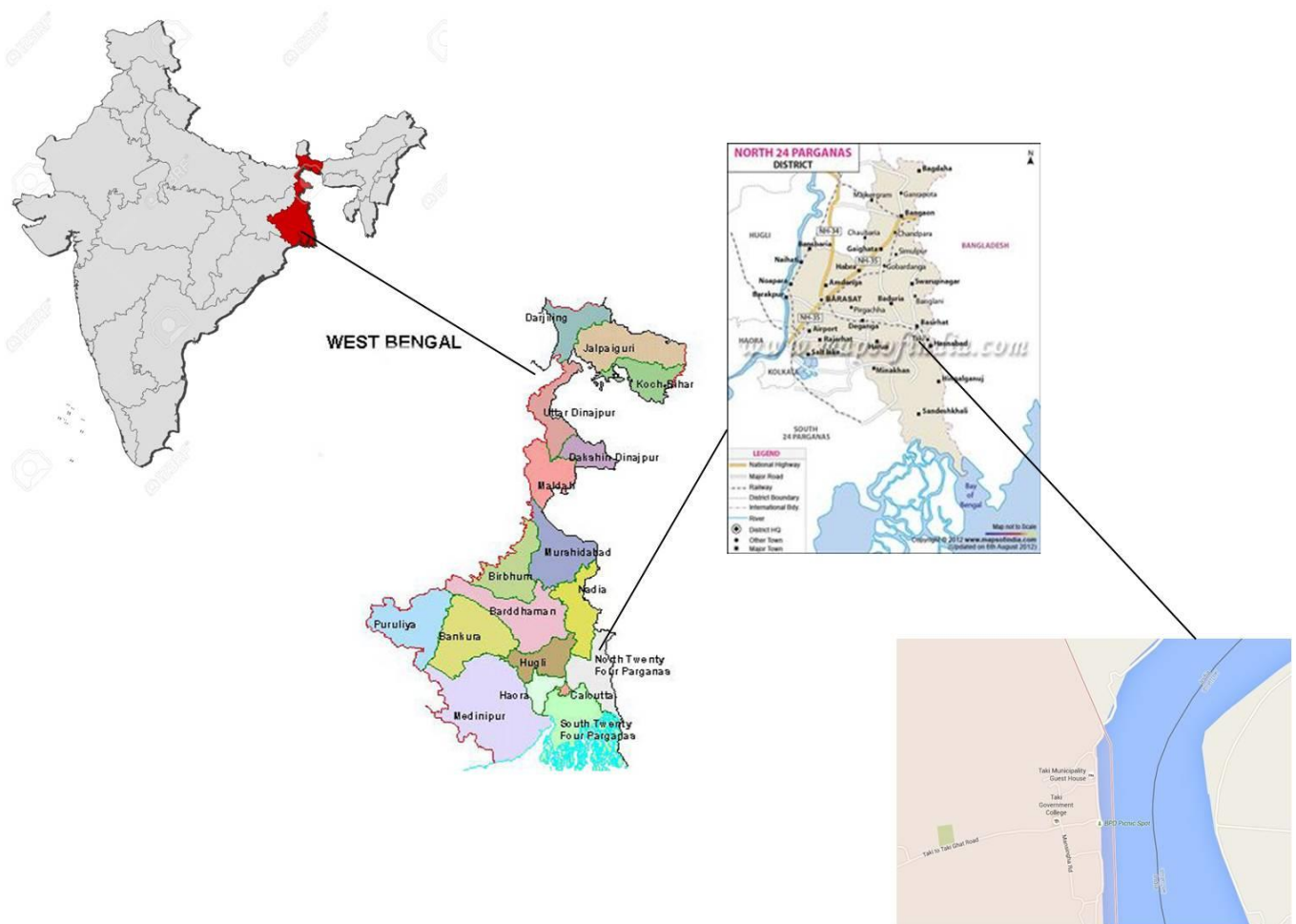


Fig. 1. Study site.

Surrounding areas and the Girls' hostel ground of Taki Government College, are located at Taki (22°59'N and 88°92'E) (Fig. 1). Taki is a municipality under Hasnabad P.S. of Basirhaat Subdivision in North 24 Parganas, West Bengal, at the bank of Ichhamati river, at an average elevation of 5 meters. The climate is of subtropical type, with hot summer, from late March to early June (avg. temp.: 25-40 °C). Monsoon dates from mid-June to late August, receiving an average rainfall of 1640-2000 mm. A cool and dry winter ranges from late November to early February (avg. temp. : 12-25 °C).

Duration of Study: April 2014 to March 2015

Survey Period: Weekly once; for thrice in a day: 9 am to 11 am, 12 noon to 2 pm, 3 pm to 5 pm

Photographs were taken with digital camera. Identification is done following Wynter-Blyth (1957), Kunte (2000) and Kehimkar (2008). Seasonal availability were determined by presence-absence scoring method and by percentage calculation to determine the status.

Table 1. Commonly found mimicking sets at Taki and their annual abundance status.

Set 1	Model	Mimic 1	Mimic 2
Batesian	Blue Tiger/ <i>Tirumala limniace</i> (Cramer) (unpalatable)	Common Mime/ <i>Chilasa clytia</i> (Linnaeus)	Common Wanderer/ <i>Pareronia valeria</i> (Cramer)
Family	Nymphalidae	Papilionidae	Pieridae
Abundance	C	R	M
Set 2	Model	Mimic	
Batesian	Plain Tiger/ <i>Danaus chrysippus</i> (Linnaeus) (unpalatable)	Danaid Eggfly female/ <i>Hypolimnus misippus</i> (Linnaeus)	
Family	Nymphalidae	Nymphalidae	
Abundance	VC	C	
Set 3	Model	Mimic	
Batesian	Common Rose/ <i>Atrophaneura aristolochiae</i> (Fabricius) (unpalatable)	Common Mormon/ <i>Papilio Polytes</i> (Linnaeus)	

Family	Papilionidae	Papilionidae	
Abundance	R	VC	
Set 4	Mimetic Morph 1	Mimetic Morph 2	
Mullerian ring	Common Crow/ <i>Euploea core</i> (Cramer)	Brown King Crow/ <i>Euploea klugii</i> (Moore)	
Family	Nymphalidae	Nymphalidae	
Abundance	VC	C	

[Abundance Status (On the basis of sighting numbers); VR (very rare): 1-2; R (rare): 2-25; M (moderate): 25-50; C (common): 50-100; VC (very common): >100]

Table 2. Common nectar plants of the observed species.

Sl. No.		Common Name	Nectar Plants
1.	Model	Blue Tiger (unpalatable)	<i>Heliotropium indicum</i> , <i>Crotalaria</i> sp., <i>Lantana</i> sp., <i>Cosmos</i> sp.
	Mimic 1	Common Mime	<i>Ixora coccinea</i>
	Mimic 2	Common Wanderer	<i>Ixora coccinea</i> , <i>Pavetta</i> sp.
2.	Model	Plain Tiger (unpalatable)	<i>Calotropis gigantean</i>
	Mimic	Danaid Eggfly (female)	<i>Lantana</i> sp.
3.	Model	Common Rose (unpalatable)	<i>Lantana</i> sp., <i>Cosmos</i> sp., <i>Zinnia</i> sp.
	Mimic	Common Mormon, (<i>stichius</i> female)	<i>Lantana</i> sp., <i>Jatropha</i> sp., <i>Mussaenda</i> sp., <i>Ixora</i> sp., <i>Jasminum</i> sp., <i>Asytasia</i> sp.

4.	Mimetic morph 1	Common Crow	<i>Heliotropium indicum, Crotalaria sp.</i>
1.	Mimetic morph 2	Brown king Crow	instead of flower nectar shows affinity to alcohol rich fallen and rotting fruits and tree sap

Table 3. Common larval host plants of the observed species.

Sl. No.		Common Name	Larval Host Plants
1.	Model	Blue Tiger (unpalatable)	<i>Calotropis gigantea, Asclepius curassavica, Tylophora asthmatica, Marsdenia sp.</i>
	Mimic 1	Common Mime(<i>dissimilis</i>)	<i>Litsea chinensis, Cinnamomum camphora, C. macrocarpum</i>
	Mimic 2	Common Wanderer	<i>Capparis zeylanica, C. rheedii</i>
2.	Model	Plain Tiger (unpalatable)	<i>Calotropis gigantea, Asclepius curassavica</i>
	Mimic	Danaid Eggfly, female	<i>Hibiscus sp., Abelmoschus sp., Barleria prionitis</i>
3.	Model	Common Rose (unpalatable)	<i>Aristolochia bracteolata, A. indica, A. tagala</i>
	Mimic	Common Mormon, <i>stichius</i>	<i>Aegle marmelos, Citrus grandis, Citrus limon, Glycosmis pentaphylla, Murraya koenigii, Murraya paniculata</i>
4.	Mimetic morph 1	Common Crow	<i>Oryza sativa, Zea mays</i>
	Mimetic morph 2	Brown king Crow	<i>Panicum sp., Sorghum sp.</i>

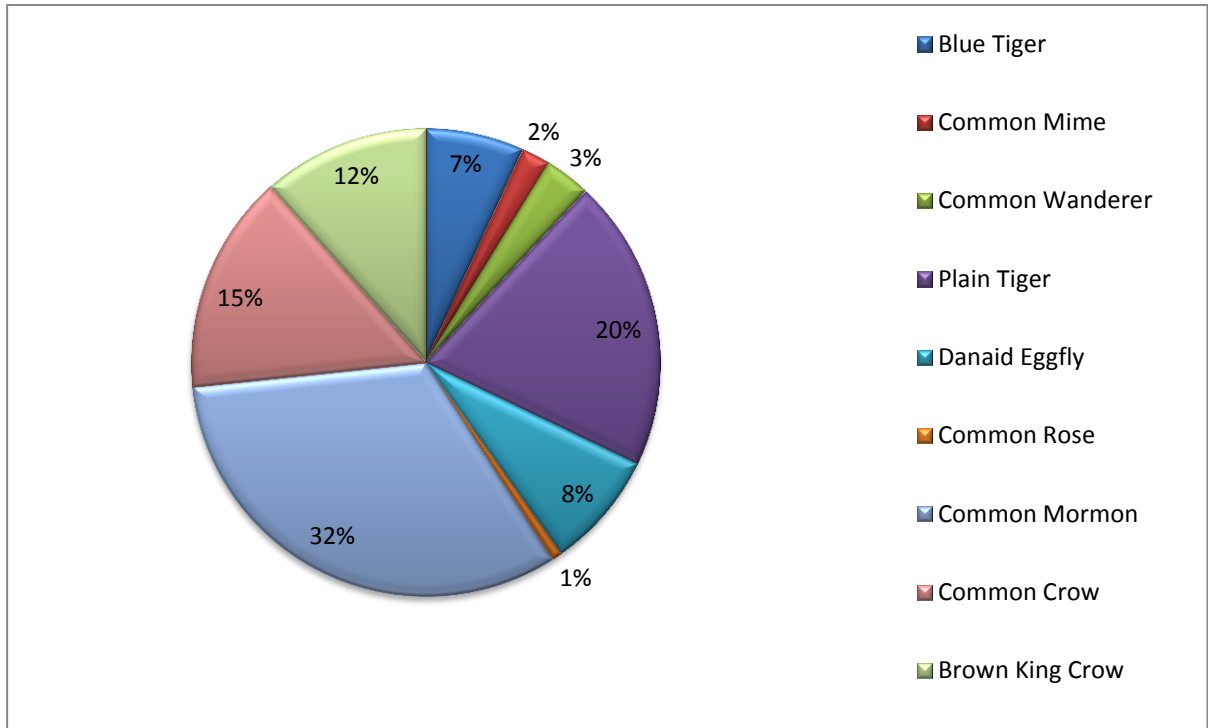


Fig. 2. Overall Availability Status.

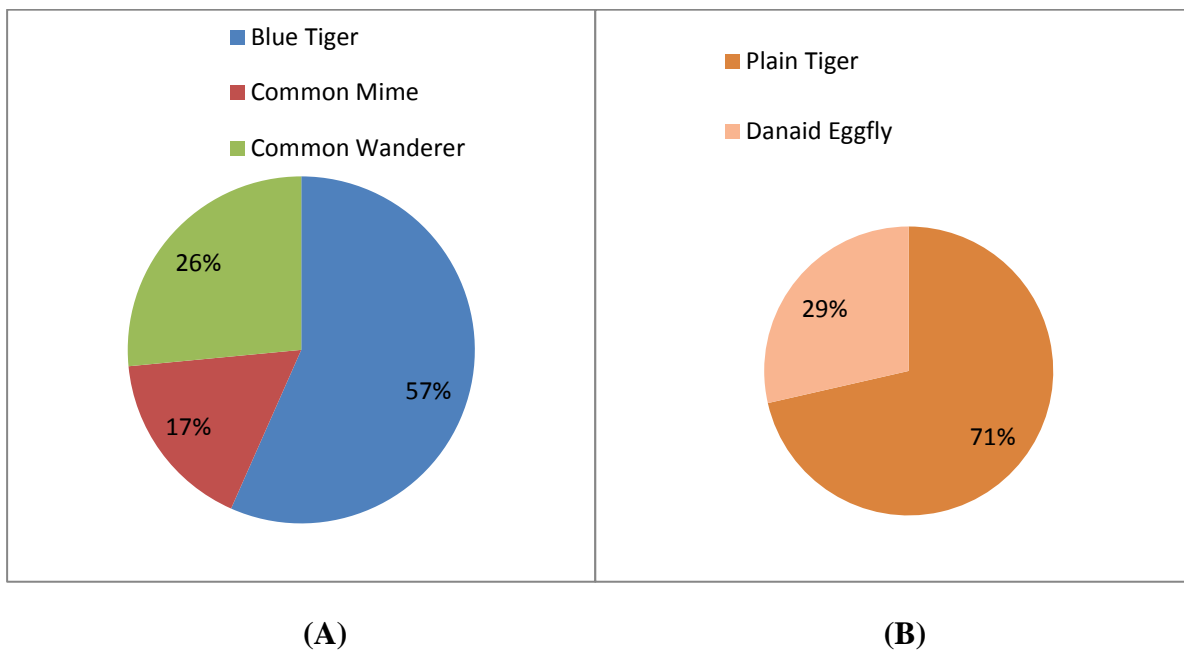
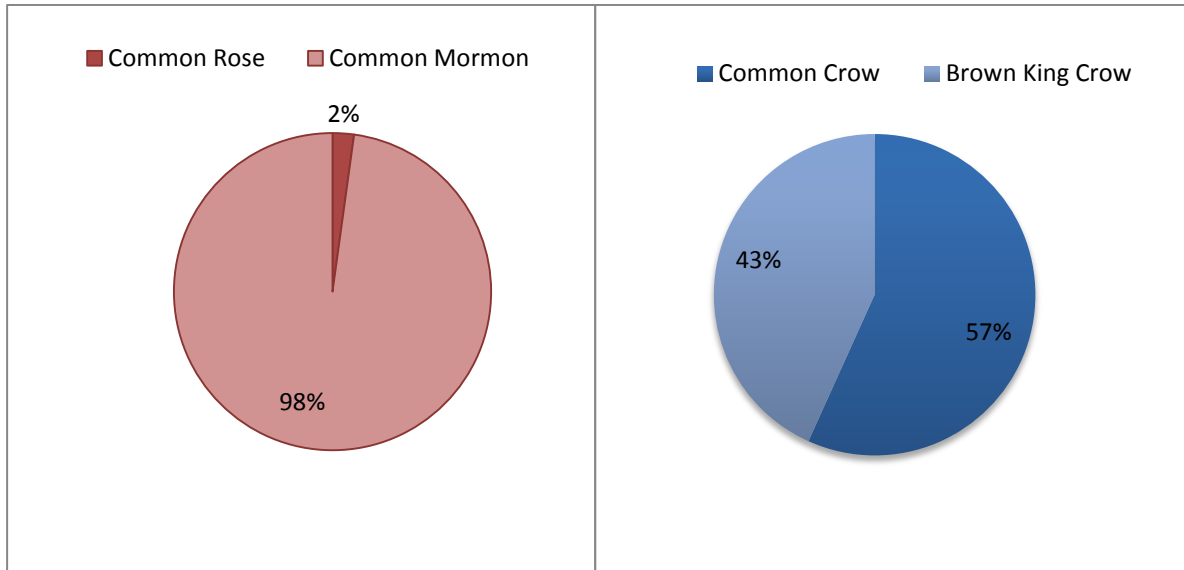
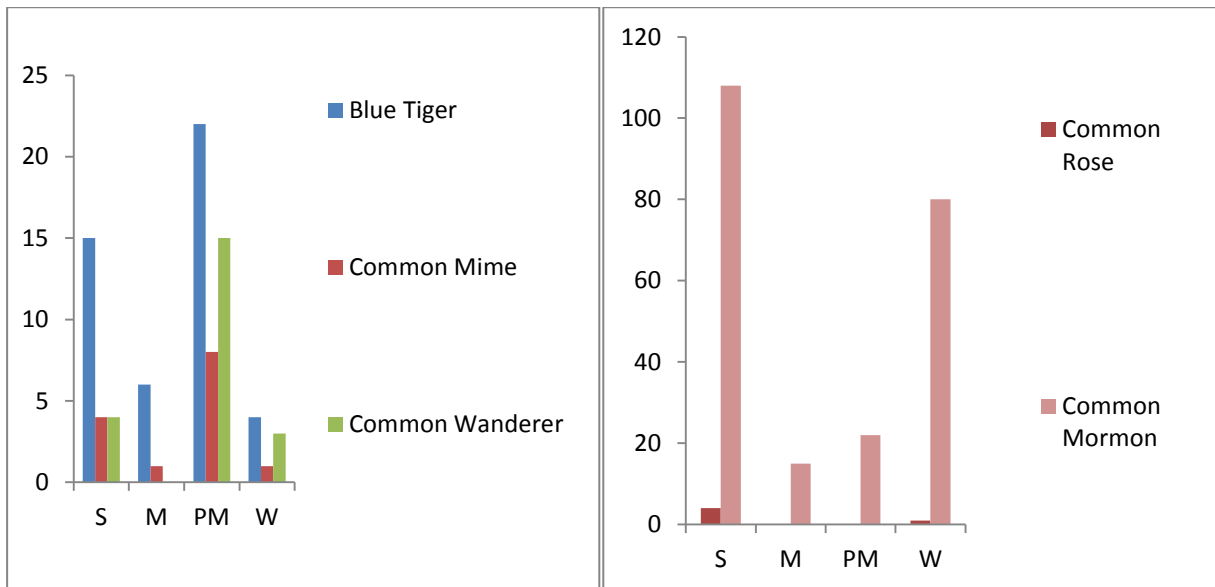


Fig. 3(A,B). Percentage of co-occurrence of mimetic species.



(C) (D)
Fig. 3(C,D). Percentage of co-occurrence of mimetic species.



(A) (B)
Fig. 4(C,D). Comparative Seasonal Distribution of Mimetic Butterflies.

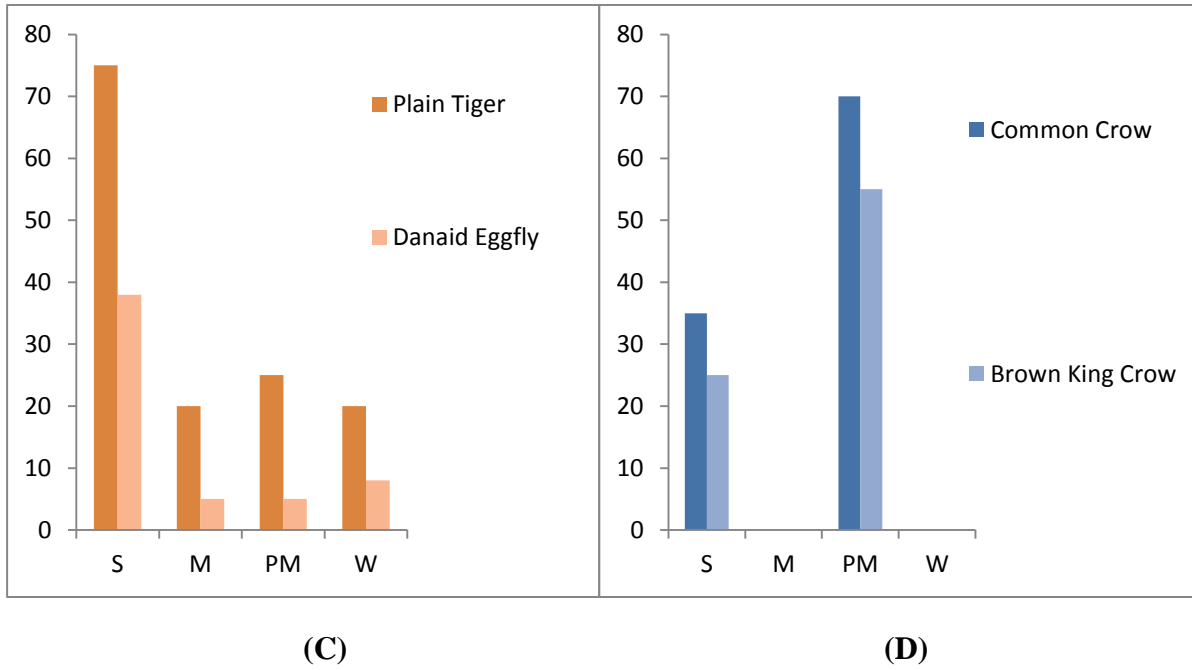


Fig. 4(C,D). Comparative Seasonal Distribution of Mimetic Butterflies.

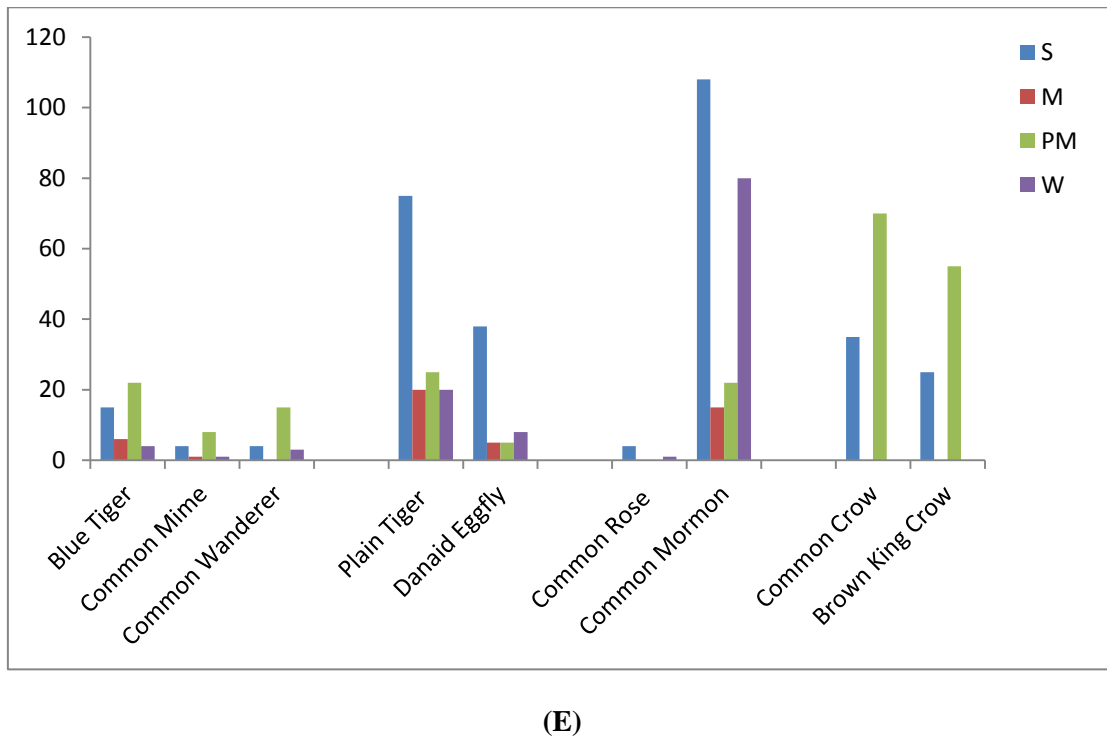


Fig. 4(E). Comparative Seasonal Distribution of Mimetic Butterflies.
Legends: S-Summer, M- Monsoon, PM-Post Monsoon, W-Winter

3. DISCUSSION

In the present study, four sets of mimicking butterflies belonging to three different families, Nymphalidae, Papilionidae and Pieridae are recorded (Table 1, Plate 1). Both intra (Nymphalidae/Nymphalidae; Plate 1: Set 2 and Papilionidae/Papilionidae; Plate 1: Set 3) and inter-family (Nymphalidae/Papilionidae/Pieridae; Plate 1: Set 1) mimetic relationships are found. The seasonal abundance of each of the members of two sets (Blue Tiger/Common Mime/Common Wanderer and Plain Tiger/Danaid Eggfly (Fig. 4) significantly displays that the model species (the unpalatable one) outnumbers the mimic corresponding to the Batesian mimicry (Figs 2&3). However, in one particular case, the mimic (Common Mormon) hugely outnumbers the model (Common Rose) (Fig. 3). Another set represents the members of Mullerian ring (Common Crow, Brown King Crow (Plate 1: Set 4). In Table 2, the commonly found nectar plants and larval host plants catering to the studied species are documented. Host and nectar plant correlation to the butterfly populations present in any particular habitat is mostly family specific, in few cases specificity restricted at generic or species level (Wynter-Blyth, 1957). Mimic and model must be sympatric (Dronamjuru, 1960).

The comparative seasonal distribution of the mimetic species also shows their seasonal co-existence (Fig.4). Butterflies play role as significant pollinators (Psychophily), next to the bees. They particularly pollinate those native plants, bearing the nectar, the flight fuel for them. Although they lack any dedicated pollen carrying structure. Butterflies and their nectar plants and larval host plants are often highly coevolved. So, butterfly diversity may directly serve as surrogate for plant diversity (Ehrlisch and Raven, 1964). Butterflies are sensitive to local climate and light levels (Ehrlisch *et al.*, 1972), thus they may serve as good indicator of the environmental changes and as an excellent biomonitor of urbanization (Blair and Launer, 1997). The common threats faced by these flying creatures are both natural (local and global climate change, wildfires, predators like dragonflies, robber flies, frogs, lizards, insectivorous birds, trapping by spider web, etc.) and anthropogenic (unplanned forestry, urbanization, overgrazing, air pollution, unscrupulous agrochemical application, restricted plantation practice, unplanned tourism, construction of dams, illegal butterfly trade) (Kearns and Inouye, 1997). As a scope of conservation of butterflies, small nature reserves may be constructed, restoration of their natural habitats by protecting the native floral structure, eradication of polluting agents and adoption of pollinator friendly practices are also necessary (Robbins, 1997). Unpalatable butterflies (models) may be either mere distasteful or toxic. Poison chemicals are derived from food plant during larval phase and stored within.

First encounter with the inexperienced predator affects with strong heart beats, followed by retching and vomiting caused by the stored plant poison of those butterflies. Their mimics evolved with wing color and behavior patterns (flight, resting posture etc.) similar to those of models to survive on their model's distasteful reputation. In case of the 'ring' of mutually resembling distasteful butterfly species, with every exposure to the distasteful butterflies, the predator's mind gets repeatedly imprinted to avoid that particular colors and patterns. Thus all the mimics share the derived benefit.

Among Indian species, wing pattern wise Tigers and Crows together form maximum mimics. Nymphalidae (Brush footed Butterflies) and Pieridae (Whites and Yellows) are with highest number of mimics. Papilionidae (Swallowtails) with moderate numbers of mimics. Hesperidae (Skippers) and Lycaenidae (Blues) lack any mimetic forms. The female Common Mormon occur in three forms, the *stichius* mimicking the Common Rose, *romulus* mimics the

Crimson Rose, the *cyrus* resembles the male (Plate 1). In Common Mime, both sexes occur in two forms, in which the dark form resembles the Common Crow and the pale form looks like Blue Tiger (Kehimkar, 2008). Mimicry or coloration is not conscious effort, natural selection of favorable genes over several generations reflected in these features. In dimorphic species, upon females, there is interplay of both natural selection and a sort of dilution factor imposed by genetic correlation.

Through evolutionary pathway, natural selection overpowers on genetic correlation dilution. Moreover, natural selection acts differentially on different wing surfaces. The undersides are closer mimics to the models to get rescued from the predator attack when they rest folded-winged. The predator attacking frequency increases with lesser mobile phase and often act as a stronger driving force (Kunte, 2009). Last but not the least, flower color is one of the key factors determining the butterfly visits to the nectar plants (Duara, 2014).

4. CONCLUSION

Habitat modifications and changes in local climatic conditions (Danda *et al.*, 2011), primarily due to anthropogenic interventions are the potent factors for organising the population distribution of native butterflies. Under the present scenario, further studies on the exploration of larval food plants and niche specificities may help consider them as focal or indicator species for ecosystem management and conservation programmes.

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Plate 1: SET 1



Tiger Blue, Model



Common Mime, Mimic 1



Common Wanderer, Mimic 2

SET 2



Plain Tiger, Model



Danaid Eggfly, female, Mimic

SET 3



Common Rose, Model



Common Mormon, female (*stichius*), Mimic

SET 4



Common Crow, Mimetic Morph 1



Brown King Crow, Mimetic Morph 2