extending towards offshore up to a water depth of approximately 3000 m. Similar observations have been made suggesting the extension of land tectonic lineaments up to water depths of 3000 m over Cauvery offshore Basin of ECMI[5]. It may be surmised from our studies that it is highly essential to link coastal and offshore lineaments from geophysical data vis-à-vis earthquake activity of the entire ECMI in order to understand the factors responsible for the recent seismic activity over coastal and near shore regions.

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ACKNOWLEDGEMENTS. We thank Dr Satish Shetye, Director, NIO for his constant encouragement. We also thank the MoES, New Delhi for funding. Thanks are also due to anonymous reviewers who provided valuable suggestions for improving the manuscript. This is National Institute of Oceanography contribution No. 4683.

Received 13 April 2009; revised accepted 18 January 2010

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Leafhopper's face mimics the ladybird pupae

Ladybird beetles (Coleoptera: Coccinellidae), amongst the most effective natural enemies of agricultural pests, are well known for their poisons and distastefulness. They contain alkaloids and warn predators by conspicuous body colours and patterning[1]. Ladybird beetles abundantly inhabit a variety of vegetation types throughout the world[2], and diverse arthropods such as cockroaches, leaf beetles and mastophorid spiders mimic the adult ladybirds[3,4]. However, no reports of animals mimicking the ladybird pupae are found. Given that ladybird pupae, although they are almost immobile, exhibit a conspicuous appearance and chemical defenses similar to adults[5], Batesian mimicry of the pupae is predicted to have evolved in various terrestrial habitats. We report here possible mimicry of ladybird pupae by a leafhopper in central Japan.

The black-tipped leafhopper, *Bothrogonia ferruginea* (Fabricius) (Hemiptera: Cicadellidae), widely distributed in Japan, Korea, China, Taiwan and Southeast Asia, sucks the xylem sap of various shrubs and herbs[6]. Adults of this species exhibit conspicuous yellow-green colouration with several black spots on the head and face (Figure 1 *a*), whilst nymphs are cryptic light green. The adult face explicitly resembles the pupae of ladybird beetles such as *Harmonia axyridis* (Pallas) and *Coccinella septempunctata* L. (Figure 1 *b* and *c*). Specifically, the leafhopper's face (including head and prothorax) and frontal view of a ladybird pupa are similar in size (ca. 3.5 mm), hexagonal and have

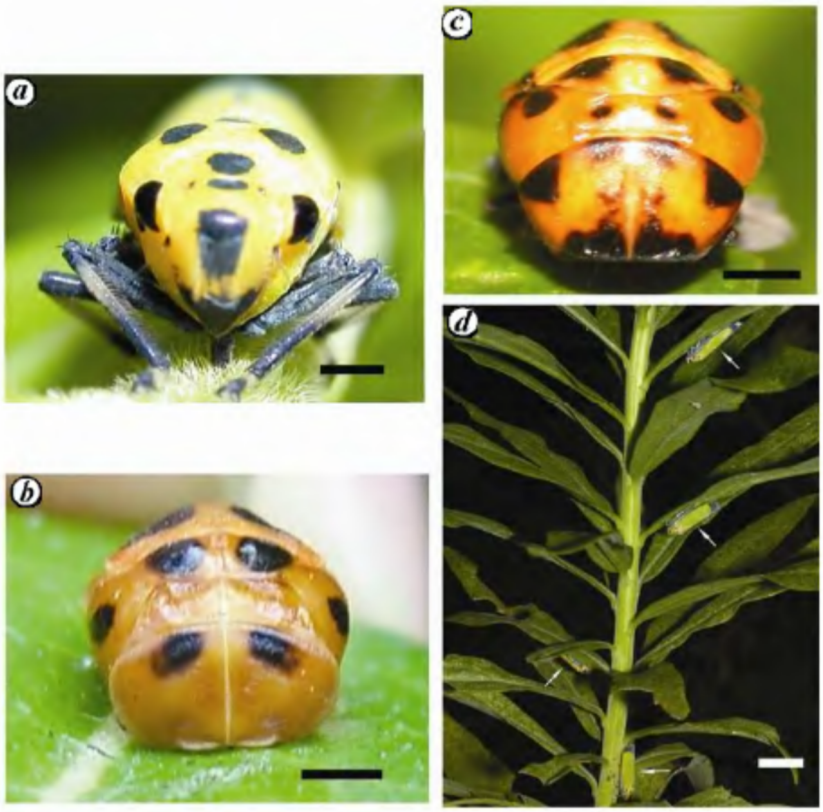

Figure 1. ***a***, Front view of an adult *Bothrogonia ferruginea* face; ***b***, Front view of a *Harmonia axyridis* pupa; ***c***, Front view of a *Coccinella septempunctata* pupa; ***d***, *B. ferruginea* adults (arrows) perching on the goldenrod *Solidago altissima* (scale: ***a***–***c*** = 1 mm; ***d*** = 10 mm).

similar black spots on a yellowish background (Figure 1 *a–c*). In addition, the grey legs of leafhoppers resemble the exuviae of coccinellid larvae that are left under the pupa. In addition to the resemblances in appearance, the species share spatio-temporal similarities. Specifically, *B. ferruginea* adults are abundantly found on shrubs and perennial herbs from spring to autumn in Japan[6,7], and *H. axyridis* and *C. septempunctata* ladybirds are multivoltine and their pupae are commonly found in spring and autumn on various shrubs and herbs[8,9]. Furthermore, the ladybird pupation sites and resting or feeding sites of *B. ferruginea* are similar, i.e. leaf surfaces, the undersides of leaves (usually on main veins) and stems. These characteristics suggest that *B. ferruginea* mimics ladybird pupae, thereby reducing enemy attack.

Agents that promote such unique Batesian mimicry are conceivably visually hunting small animals that forage on plants. Given that birds and insectivorous mammals inevitably see the entire body of *B. ferruginea*, this face-restricted mimicry never works. Jumping spiders, praying mantids, assassin bugs and other predatory heteropterans climb plants and visually prey on various small insects including the leafhoppers. Such predatory arthropods have acute vision and associative learning abilities, and attack even stationary prey[10–13]. Lizards and tree frogs are also likely to climb plants to prey on insects. *B. ferruginea* adults habitually perch on the main veins of leaves as well as stems with their heads directed toward the basal parts of plants (Figure 1 *d*) and exhibit a back-to-back mating posture, resulting in the exposure of their faces. Thus, predatory arthropods and small invertebrates see *B. ferruginea* faces in close proximity and may cease to prey on them if they have experienced the distastefulness of ladybird pupae. In addition to the mimicry effect, the conspicuous patterning of *B. ferruginea* faces may be explained by intraspecific communication. Given that many cicadellid species have disparate facial patterns, their patterns should be studied from the viewpoint of both mimicry and intraspecific communication.

Studies of insect mimicry have focused on vertebrates such as birds as the signal receiver. However, this finding, together with that of Rota and Wagner[14], suggests that predatory arthropods and smaller vertebrates are also important potential selective agents of mimicry evolution, and that the appearance of body parts in various insects should be explored for their adaptive significance.

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