Protective devices of the carnivorous butterfly, Spalgis epius (Westwood) (Lepidoptera: Lycaenidae)

The apolly, Spalgis epius is a rare butterfly and an inhabitant of wooded areas. Usually most observers miss it due to its retiring nature, small size and rather drab colour. The species is known to occur in Sikkim, Kolkata, Malda, South India, Burma and Sri Lanka. Lycaenids are unique in their larval stage as they eat unrelated food, including flowering plants, fungi, lichens, cacti, ferns, conifers, ant larvae and homopterans. The larva of S. epius has been recorded as a predator on various species of pseudococcids (mealybugs) and coccids (scale insects). Recently, the larvae of this butterfly were found on different species of croton plants, Codiaeum spp. infested with mealybug, Planococcus citri (Risso) (Homoptera: Pseudococcidae) at the Jnanabharathi campus, Bangalore University. Though the butterfly is known to be a potential predator of different species of mealybugs, its activity is rarely noticed as the larvae often move away from the damaged areas. However, the larva of S. epius is a small butterfly with dark brown wings that are marked with white spots. The body is slender and the wings span about 10–12 mm. The larva is usually found in groups and moves erratically in search of food. The larva is primarily green in color, with a light greenish brown head and a black thorax. The abdomen is greenish brown with a metallic sheen. The larva has a pair of black eyes and a pair of small black antennae.

Adult of S. epius is a small butterfly with dark brown wings above and greenish yellow below. The body is slender and the wings span about 10–12 mm. The larva is usually found in groups and moves erratically in search of food. The larva is primarily green in color, with a light greenish brown head and a black thorax. The abdomen is greenish brown with a metallic sheen. The larva has a pair of black eyes and a pair of small black antennae.

The adult butterfly of S. epius is small and has a wingspan of 12–14 mm. The forewings are dark brown with a greenish tinge, and the hindwings are greenish brown. The body is slender and elongated. The larva of S. epius is often found on the leaves of various plants, especially those of the family Rutaceae, such as citrus and lemon trees. The larva is primarily green in color, with a light greenish brown head and a black thorax. The abdomen is greenish brown with a metallic sheen. The larva has a pair of black eyes and a pair of small black antennae.

The larva of the butterfly feeds on a variety of plants, including citrus and lemon trees. The larva is primarily green in color, with a light greenish brown head and a black thorax. The abdomen is greenish brown with a metallic sheen. The larva has a pair of black eyes and a pair of small black antennae.

Figure 1. a. Male Spalgis epius butterfly. b. Fully grown larvae of S. epius.
avoided attacking the monkey-faced pupae that existed in the same bushes. However, the birds were never found to attack the stationary larvae, probably since they resemble bird-droppings at a distance. Similarly, various lycaenid caterpillars are known to escape from bird predation. Moreover, the ants O. smaragdina and Crematogaster sp. attending the mealybugs are common predators of insects that do not secrete honeydew. Even the pupae of lycaenid Iolaus spp. are devoured by Crematogaster ants, which conversely protect them as larvae. However, these ants never attacked anymorphic S. epius pupae. Even though the pupa is small, it might scare away enemies because of its appearance (monkey-faced). Balduf considers the monkey-faced appearance of some lycaenid pupae as a means of protection, but does not clearly state its significance. Generally, lycaenid pupae are protected from natural enemies either by ants, which are attracted to pupal ant-gland, by camouflage, or by making a creaking noise. As these features are not found in S. epius pupae, the aposomatic sign of the pupae to predators perhaps has a great adaptive value in protecting them in the sedentary stage under vulnerable habitat.

It is generally agreed that the primitive members of lycaenids were plant-feeders, and that homopterous (carnivorous) habit is a secondary specialization arising from association with ants, which live in the vicinity of honeydew-secreting homopterans. Thus many species of Lycaenidae counter attack from natural enemies by associating with protective ants. When many phytophagous--myrmecophilous/homopterophagous--myrmecophilous lycaenid genera get protection by associating themselves with ants, why a few homopterophagous lycaenids, including S. epius evolved as anymorphic cephaliotype is not clearly understood.


Received 6 March 2004; revised accepted 30 June 2004

M. G. VENKATESHA*  
L. SHASHIKUMAR  
S. S. GAYATHRI DEVI

Department Studies in Zoology, Bangalore University, Jnanabharathi Campus, Bangalore 560 056, India
*For correspondence e-mail: mgvenk@eth.net

Figure 2. a. The black ant, Crematogaster sp. attending mealybugs. S. epius larva seen nearby.  
b. Monkey-faced pupae of S. epius.
On the efficacy of recent crustal images of the Indian shield from receiver functions

The availability of broadband digital data has significantly improved our ability to 'see' the crust-mantle domains with more precision than hitherto possible. Modern seismological tools such as the receiver functions (RFs) are used to generate crust-mantle images that permit finer interpretations of their evolution and structure. Recent efforts to obtain crustal images of the Indian shield using RF analysis are one of the latest additions in this direction. While admitting the efficacy of these new tools, it is important to recognize the limitations starting with data quality to interpretations. Clearly, this topic deserves a much more rigorous treatment than what can be done in a short correspondence. Here we wish to restrict our discussion to two recent papers by Gupta et al., hereafter referred to as GA and GB respectively, that have presented new images of the crust beneath the southern Indian shield comprising mainly the western Dharwar Craton (WDC) and the eastern Dharwar craton (EDC) using the RF approach. Major conclusions by GA and GB, based on crustal multiple phases (Pps and Pss) and direct P-to-S converted phases at the Moho (Ps; see Figure 1) can be summarized as follows: (a) the Mid-Archaean segment (3.4–3.0 Ga) of the WDC is underlain by an anomalously thick crust (43–52 km) with felsic-intermediate average composition; (b) EDC, the adjoining late Archaean (2.7–2.5 Ga), is much thinner (33–40 km) and Poisson's ratio varying between 0.23 and 0.26; (c) GB concludes that the southern Granulite Terrain (SGT) is characterized by a thick crust (42–60 km) and the Poisson ratio varies from 0.25 to 0.28. Studies on the thickness of the lithosphere using teleseismic residual data presented by GA suggest that the velocity in WDC is higher and its thickness is about 60–80 km more than the 200-km-thick EDC.

Obviously, these observations have important implications on the evolution and dynamics of the Indian crust and it is necessary to understand the limitations of the techniques used. In particular, we must pay attention to the quality of the basic data and processing strategies adopted. Here, we provide a brief review of the techniques followed by these authors in developing these crustal images, paying attention to the potential sources of errors.

What is a receiver function

A seismic signal (time series or seismogram) that essentially contains the effects of local structure (primarily crust) beneath a station devoid of effects due to source complexities and path effects is termed as RF (Figure 1). Owing to the large velocity contrast across a discontinuity (e.g., Moho, Lehmann, etc.), part of the steeply incident teleseismic P-wave energy becomes converted to an SV' wave (e.g., P-to-S-converted wave from the Moho) and forms part of the P-wave coda. Besides the direct/primary P-to-S conversion, there are also many multiple reflections and conversions that occur between the surface and the interface. The P-wave and its multiples dominate the vertical component (Z), while the P-to-S conversion and its multiples are registered prominently on the horizontal radial (SV) component. Therefore, to isolate P-to-S energy (that contains information about Moho, in our case here) from that of P, we need to indulge in appropriate component rotation to arrive at the SV' component time series or seismogram (Figure 2). The effects related to source, mantle propagation and instrument response are

---

**Figure 1.** a, Schematic sketch showing the propagation (travel paths) of various types of seismic waves recorded at a seismic station (triangle) that are used in receiver function (RF) studies. Besides the first arrival designated as P, of importance are the P-to-S converted wave (Ps), and the reverberations between the surface and the interface (e.g., Moho), named as Pps and Pss. The Pps wave is a multiple that is converted at the interface, while Pss is a conversion at the free surface and reflected by the interface. The S-paths are stippled lines and P-paths are solid lines. Note that both Pps and Pss have three legs of travel, while the Ps has only one leg between the interface and the station. Also, the Pps wave travels only one leg as S-wave (after conversion from a P-wave) and Pss has only one leg as a P-wave and two as an S-wave. Naturally, after the first arrival, P, Ps arrivals follow by Pps and then Pss. b, Typical RF sketch showing the Ps, Pps and Pss arrivals. Note the size and polarities of the amplitudes of these waves and their corresponding delayed arrivals after the P-arrival. Vertical stippled line marks the first arrival P-wave.