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Observations on feeding behaviour of adults of the Common Buff butterfly, *Baliochila aslanga* (Lycaenidae: Poritiinae) at extra-floral nectaries on *Adenopodia spicata* (Mimosaceae)

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Abstract: Novel feeding behaviour by adult Common Buff butterflies, *Baliochila aslanga* (Lycaenidae: Poritiinae), is reported on. Nectar assimilation from extra-floral nectaries is known for a number of members of the Poritiinae, and some species also obtain their energy requirements from hemipteran honeydew excrement. We document the first record for the genus *Baliochila* of an adult butterfly feeding at extra-floral nectaries. *Baliochila aslanga* was observed imbibing nectar from petiolar glands of *Adenopodia spicata* (Mimosaceae) in Sodwana Bay National Park in KwaZulu-Natal, South Africa. The searching behaviour to locate the glands and subsequent feeding behaviour, as well as the petiolar glandular morphology, is described and supported by high quality photographs.

Key words: Behaviour, butterfly feeding, extra-floral nectaries, nectar, petiolar glands.

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INTRODUCTION

Many adult butterflies require the intake of sugar and amino-acid rich fluid for their energy requirements (Reddi & Bai, 1984; Scoble, 1992), as well as to increase their fecundity (Baker & Baker, 1973; Mevi- Schütz & Erhardt, 2005), the most common source being nectar produced by angiosperm flowers as a reward for flower visitation and associated pollination (Baker & Baker, 1975). Alternative sources include excrement produced by sap-sucking Hemiptera (Fiedler, 1993; Wagner & Gagliardi, 2015). Given the large quantities of phloem sap that these insects imbibe and the high digestive throughput rates, the excrement of these bugs is extremely sugar-rich and commonly referred to as honeydew. Within Lepidoptera the Lycaenidae, in particular, make use of this energy source (New, 1993). Another source of energy input for insects is from extra-floral nectaries, which produce an attractive fluid, rich in sugars and amino acids (Baker & Baker 1973; Elias, 1983; Wäckers, 2005). Although ants are common visitors at extra-floral nectaries, and their presence is hypothesised to deter herbivory of the host plant (Heads & Lawton, 1985; Janzen, 1966, 1967; Wilson, 1971), records of adult butterflies visiting extra-floral nectaries are less common. Insect visitation at extra-floral nectaries in the Mimosaceae has been recorded for ants (Buckley, 1983; Raju *et al*., 2006; E. Moll, pers. obs.), and stingless bees (Noll *et al*., 1996). At least 18 species of adult lycaenid forest associated Poritiinae (= Lipteninae) butterflies were recorded feeding from extra-floral nectaries of various forest creepers, bamboos, and tendrils of arrowroot species (Marantaceae) in West and East Africa (Callaghan, 1992; Farquharson, 1922; Larsen, 1991; Larsen, 2005). Here we add a further record of a poritiine butterfly feeding at extra-floral nectaries including description of the butterflies' associated behaviour and structure of the host plant's extra-floral nectaries.

MATERIAL AND METHODS

Location

Observations were conducted in Sodwana Bay National Park situated in the greater iSimangaliso Wetland Park (27.543075 S, 32.676588 E) over a period of 2 days (6–7 July 2019).

Depositories

SAMC: Iziko South African Museum, Cape Town, South Africa (Curator: Simon van Noort).

Photography

Images of the adult butterfly feeding at the petiolar glands were obtained with a Nikon D7000 and AF-S Micro Nikkor 105 mm 1–2.8 G ED macro lens. Images of the petiolar glands were acquired at SAMC with a Leica LAS 4.9 imaging system, comprising a Leica® Z16 microscope with a Lieca DFC450 camera and 0.63x video objective

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attached. The imaging process, using an automated Z-stepper, was managed using the Leica Application Suite V 4.9 software installed on a desktop computer. Diffused lighting was achieved using a Leica LED 5000 Dome.

RESULTS

Adults of the Common Buff, *Baliochila aslanga* (Trimen, 1873) (Lycaenidae: Poritiinae) were observed by the first author repeatedly feeding at petiolar glands situated at the base of the rachis of *Adenopodia spicata* (E. Mey.) C. Presl (Mimosaceae), the Spiny Splinter-bean, at Sodwana Bay National Park, situated in the greater iSimangaliso Wetland Park (Fig. 1). The host plant was common and growing as a low scrambling shrub prevalent in coastal dune thicket. A small localised population of three adult butterflies were observed over a period of two days. The adults were fairly sedentary with limited, sporadic, slow fluttering flight occurring in a small area at heights of 30–100 cm just inside or close to the edge of scrubby coastal bush with most time spent perching on the branchlets of *A. spicata* or of plants in the near vicinity (Fig. 1A), behaviour typical for the genus. Only if disturbed would they fly further away over a volumetric area of a couple of cubic meters, but always returned to their original haunt situated within the thicket. Once diurnal temperature had reached a suitable level for flight activity the butterflies would take short erratic flights typical of the genus.

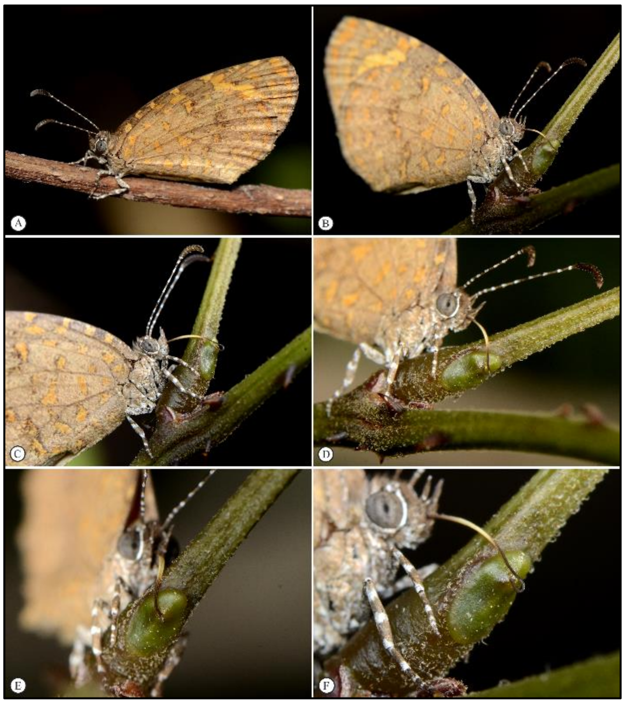

Figure 1 – *Baliochila aslanga*. A. Resting specimen; B-F. Different views of *B. aslanga* feeding at an extra-floral nectary situated on a leaf rachis of *A. spicata*, to illustrate position of the tip of the curved proboscis placed against the central gland opening of the extra-floral nectary.

In the mid-morning these flights were associated with searching for suitable branchlets of *A. spicata* where petiolar glands were present and active on young, fresh twigs. Once terminal pinnae were identified the adult butterfly would land on the leaves near to a petiolar fork and shuffle down to the petiole where it would commence probing with the proboscis around the fork junction. If the gland was not located the butterfly would quickly move back to the main branchlet where it would shuffle up and down the main stem (reversing backwards, without turning around), continually probing the surface with the tip of the proboscis over a couple of centimetres. The searching behaviour was always located within approximately five centimetres of a potential gland location in a terminal rachis fork. Once a gland was located by means of the probing proboscis the adult butterfly remained absolutely still, with feeding at the gland lasting for a period of 5 to 10 minutes. The proboscis was maintained in a sedentary position throughout the feeding period with the proboscis tip curled (Figs 1B–F), possibly to maximise contact with the exudate of the extra-floral nectary. The glands in *A. spicata* are illustrated (Figs 2 & 3) and can be seen as a lens-like structure at the junction of the pulvinus and rachis (situated on the adaxial surface at the base of the petiolar rachis). In the larger glands observed on *A. spicata* there is an obvious off-centre nipple-like raised area (Fig. 2). This is less evident in smaller glands (Figs 3A–C).

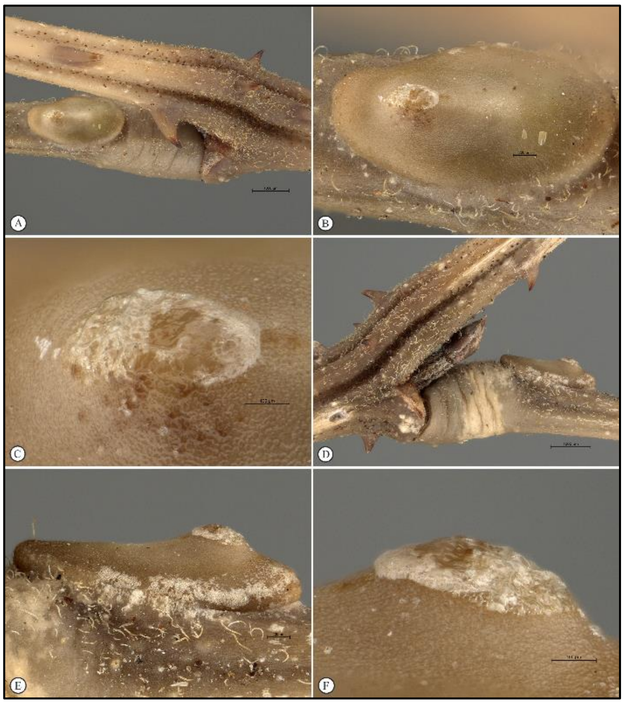

Figure 2 – *Adenopodia spicata* large gland A. Position of gland on rachis, dorsal view; B. Gland, dorsal view; C. Gland opening, dorsal view; D. Position of gland on rachis, lateral view; E. Gland, dorsal view. F. Gland opening, dorsal view.

An overview of published records of species of Poritiinae that have been recorded visiting extra-floral nectaries is provided in Table 1.

DISCUSSION

Lycaenid species in the subfamily Poritiinae (= Lipteninae) are known to feed as adults at the honeydew exudate of various sap-sucking Hemiptera, and from extra-floral nectaries (Callaghan, 1992; New, 1993; Pringle *et al*. 1994; Woodhall, 2012). Within the genus *Baliochila*, adult *B. aslanga* and *B. singularis* Stempffer & Bennett, 1953 have both been recorded feeding from hemipteran honeydew (Pringle *et al.* 1994; Woodhall, 2012), but to our knowledge this is the first record of a *Baliochila* species feeding at an extra-floral nectary. The caterpillars feed on lichens and/or Cyanobacteria (Pringle *et al*. 1994; Woodhall, 2012). A South African and Swaziland endemic, *A. spicata* is distributed from around East London in the Eastern Cape through KwaZulu-Natal to the Soutpansberg in Limpopo Province (van Wyk *et al*., 2011) and the distributional range of *B. aslanga* largely mirrors this distribution, extending from KwaZulu-Natal north through Swaziland and Mpumalanga into Mozambique and Zimbabwe (Pringle *et al*., 1994). It is therefore likely that this interaction occurs elsewhere within the distribution of this butterfly species, and possibly other plants with extra-floral nectaries are also used by *B. aslanga*.

Figure 3 – *Adenopodia spicata* small gland A. Gland, dorsal view; B. Gland opening, dorsal view; C. gland, lateral view; D. Cross-section through gland and rachis.

Scant attention has been paid to the structure and function of petiolar glands in the African Mimosaceae (Ross, 1975). These structures have been described for *Vachellia mangium* (Zhang *et al*., 2012) as being composed of parenchyma cells and a nectar cavity. The current observations provide some insight into the structure of one species, *A. spicata*, for the family Mimosaceae, and provide evidence of utilisation of these glands by insects. No ants were observed attending the glands, but ant attraction and their subsequent presence and patrolling on the plant, thereby reducing herbivory, is likely to be the main underlying evolutionary driver for extra-floral nectary development in these plants (Heads & Lawton, 1985; Janzen, 1966, 1967; Vishwakarma & Thomas, 1991; Wäckers, 2005; Wilson, 1971). Given that the adult butterflies always land within the proximity of petiolar glands prior to active tactile searching, suggests that the initial long-distance location of suitable terminal petioles is via detection of an associated semio-chemical released either by the young pinnae, or by the petiolar glands themselves.

These preliminary observations highlight the need for further, more detailed investigation of the structure and function of extra-floral nectaries in the Mimosaceae and the role that these glands play in providing lycaenid butterflies with an energy source, and potentially amino-acids that may be necessary to increase fecundity in these butterflies.

Table 1 – Published records of Poritiinae species visiting extra-floral nectaries.

Taxon	**Host plant and behavioral observations**
Epitolini	
Aethiopana honorius	On rare occasions it feeds at extrafloral nectaries on the tendrils of Marantaceae (Larsen, 2005).
Epitolina dispar	Specimens are often seen at extrafloral nectaries (Larsen, 2005). Farquharson (1922) observed that they drove ants away from extra-floral nectaries in the same manner as did individuals of *Teratonera isabellae* (see this species for details of this behaviour).
Pentilini	
Ornipholidotos tiassale	Specimens have been seen feeding on extrafloral nectaries on Marantaceae (Larsen, 2005).
Ptelina carnuta	Both males and females feed, during the morning hours, at extrafloral nectaries of vine tendrils and bamboo (Callaghan, 1992). Up to four individuals, together with other liptenines and ants, were noted at these nectaries (Callaghan, 1992). Larsen (2005) found specimens feeding from the extrafloral nectaries on shoots of plants belonging to the family Marantaceae.
Pentila hewitsoni	Small aggregations are readily seen on *Marantochloa* tendrils, feeding from extra-floral nectaries (Larsen, 2005).
Pentila nigeriana	Adults of both sexes feed from extrafloral nectaries on bamboos and vines between 10:00 and 12:00 (Callaghan, 1992).
Pentila petreia	Flies about slowly and is often encountered feeding from extrafloral nectaries (Larsen, 2005).
Pentila picena	Callaghan (1992) noted that they are avid feeders at bamboo nectaries, with up to six individuals on the same stem.
Pentila tropicalis	Large numbers of individuals have been recorded feeding from the nectaries of a species of *Crotalaria* (Fabaceae) in the Chyulu Hills in Kenya. These nectaries were concurrently being utilized by ants, aphids and specimens of *Ornipholidotos peucetia* (Hewitson, 1866) (Larsen, 1991).
Telipna acraea	Ones or twos are often seen perched on twig ends or at extrafloral nectaries (Larsen, 2005).
Torbenia wojtusiaki	A rare species, occasionally found feeding from extrafloral nectaries on *Marantochloa*

	shoots together with *Ornipholidotos* species (Larsen, 2005).
Liptenini	
Baliochila aslanga	at extra-floral nectaries on *Adenopodia spicata* (Mimosaceae) (this paper)
Eresiomera bicolor	Often seen together at extrafloral nectaries, with *Liptena simplicia* and *Micropentila adelgitha* (Larsen, 2005).
Falcuna libyssa	Both sexes feed at extrafloral nectaries of Marantaceae and other creepers, often in the company of other poriitines. Males of *libyssa* are aggressive at such feeding sites, pushing other individuals away with sharp flicks of their wings (Larsen, 2005).
Larinopoda lircaea	Specimens are attracted to extrafloral nectaries; when ants are present the wings are opened slowly, meeting below the legs, then brought upright rather more quickly (Larsen, 2005). Larsen (2005) speculates that this behaviour may be related to pheromone dispersion in butterfly-ant related communication.
Liptena simplicia	Small clusters of two to five specimens are often encountered feeding from the extrafloral nectaries of Marantaceae, often in the company of *Micropentila adelgitha* or *Eresiomera bicolor* (Larsen, 2005).
Liptena submacula	Roosting aggregations of up to six specimens are often noted on twigs, about 1.5 m above the ground, and ones or twos are frequently encountered on the extrafloral nectaries of Marantaceae (Larsen, 2005).
Micropentila adelgitha	The only relatively common member of the genus, most often encountered while feeding from extrafloral nectaries of Marantaceae. Here they are found as singles or in small groups, often together with other poriitines, especially *Liptena simplicia* and *Eresiomera bicolor* (Larsen, 2005).
Mimeresia libentina	They also visit extrafloral nectaries (Larsen, 2005).

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