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EDITORIAL

MEMBERSHIP

The aims of the Lepidopterists' Society of Africa are to promote the scientific study and the conservation of Lepidoptera in Africa, and to provide a communication forum for all people who are interested in African Lepidoptera. *Metamorphosis,* which is the official journal of the Society, publishes original scientific papers as well as articles of a less technical nature. Fees indicated below refer to surface postage, but if airmail is required, notify the Treasurer and - per issue – add R32.00 for Africa or US $6.00 if Overseas. Membership of the Society is open to all persons who are interested in the study of Lepidoptera. There is no geographical limit to membership. There are four categories of membership:

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Front cover: *Thestor basutus* (Wallengren, 1857), photographed by Jeremy Dobson.

Back cover: *Thestor basutus* (Wallengren, 1857), larvae in formicarium, photographed by Andre Claassens.

Editorial

Typing words like ' butterfly' or ' lepidoptera' into web search engines usually results in tens of thousands of hits. Finding links within web sites to other interesting web sites is also no picnic. After a lot of surfing I have found some good sites, which I would like to share with our members.

www.funet.fi/pub/sci/bio/life/insecta/ lepidoptera leads to Markku Savela' s pages. This is the most extensive listing (although incomplete) of worldwide Lepidoptera on the web that I have been able to find. He states: " ... the organization here must not be taken as any taxonomic statement or study". Nevertheless, he has put in a massive effort and many taxa have distributional and larval food plant information. A small percentage of the entries are accompanied by digital images of the adults.

www.zoologi.su.se/research/wahlberg is Niklas Wahlberg's site and deals mainly with the systematics and taxonomy of Nymphalidae (on a worldwide basis). This is an excellent site and also has a section on molecular (DNA) methods.

www.insects-online.de/frames/papilio.htm is an authoritative checklist of the 550 or so species of Papilionidae of the world (2"d draft, 10 July, 2003). It is the first list of what promises to become an important site (the GloBIS/GART initiative).

www.nhm.ac.uk/entomology/lepindex is the ' baby' of George Beccaloni and his team. George was at our Cape Town international conference a few years back. He and his team are digitising the card index of the Natural History Museum in London - a monumental task, I gather.

www.ent.orst.edu/bnet is the brainchild of Andy Brower, the well-known American researcher, whose main focus is the molecular phylogeny of heliconiines. The web site is titled "Butterfly Net International" and is described as " the hyperlink nexus for butterfly systematists". This is a great idea and needs to be supported by all those working on Afrotropical butterflies. A similar site for moths would also be an idea to consider. Andy has a number of useful links - some to great sites but some not too great ones also.

I have e-mailed this editorial to our webmaster Peter Roos asking him to create links on our website - the most important one on Afrotropical Lepidoptera! - www.lepsoc.org.za

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Being chased by clouds again - Eclipse 2002

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Every time I have heard of a total eclipse of the sun, it has been in Mexico or some ungetatable place like that. Even last year's one in Zambia was too much hassle ... so I was determined to get a look at the South African one on 4 December, 2002.

I took a couple of days' leave. After a late night and a bottle of port (why oh why do we do these things to ourselves?) with an also eclipse bound Kevin Cockburn, who with his daughter Jessica stayed with me on the Monday night, I was off on Tuesday morning. Plan was to have a look at the Buffelsberg near Munnik, hopefully photograph *Abantis paradisea*, then go to Ramadipa River and *Borbo borbonica,* pick up Johan Greyling and head up to Waterpoort. The best la id plans of mice and Woodhalls gang aft agley. I have never seen the Buffelsberg looking so hopelessly dry, overgrazed and miserable. This only a year after it produced *Precis antilope*. The only butterfly on the wing was an apologetic-looking *Leptotes.*

So .. . Ramadipa. Same story! Even though the dam was full and the place looked green enough, all that was on the mud were a few *Azanus jesous* and *Leptotes*. The only thing of interest was a massive Water Leguaan, which favoured me with a basilisk glare before sauntering into the reeds. Of *borbonica,* not a sign.

Finally I ended up in good old Woodbush. Can't fail here, I thought, there's bound to be something flying. Well at first I thought I had drawn a blank here too, but on the De Hoek road there were quite a few *Papilio ophidicephalus transvaalensis* on the *impatiens* flowers. A photo opportunity, but I couldn't get one properly in the frame. I was about to give up in disgust when I spied something fast and orange. A male *Precis tugelal.* I have got underside shots of these but until now never succeeded in getting a wings open shot. You should have seen me sukkeling with this

butterfly. Some mountain bikers were using the steep forest track to get their thrills and I was sorely tempted to stick a net handle in their spokes. Every time I got him in the frame along came one of these lurex-covered, noisy pests. Eventually there was a big enough gap between riders to get a single upperside shot, then along came another followed by a Combi, obviously their transport. Lazy devils, I thought, getting a lift uphill and freewheeling down.

Then I saw the badge on the side of the van and was glad I resisted the temptation to put a spoke in their wheels - Polokwane Police!

When they had gone, I found another butterfly I needed badly to photograph - a female *Acraea boopis.* She was much more accommodating.

I wound my way to Pietersburg where, hopefully, Johan would be waiting. No such luck, he had planned to sneak away from the practice at 15h00 but there was the inevitable operation ... we finally got on our way after I 7h00. So off we went to Johan's friends Hardus and Trini Saayman whose farm is not far from the Elysian fields of Die Groot Saltpan. I had hoped there would be purple flowers and lots of butterflies for the next day after the eclipse, but the drought was even worse here ...

After a night of bushveld hospitality (a massive braai with lots of hydraulic sandwiches) we hit the sack early, sleeping on camp mattresses under the stars. The night was warm and balmy, not too many mossies and lots of shooting stars, so we all had lots of chances to wish to see the eclipse... I had heard the forecasts of partial cloud from envious workmates and thought it would be typical lepidopterists' luck to be clouded out of a total eclipse!

Wednesday the 4th dawned beautifully with what looked like a little morning mist. We packed up and set off. To our dismay we saw the classical Soutpansberg tablecloth, spilling gray crud over the bushveld, with some alto-stratos cloud for good measure. To the north it was clear, but our Plan A of Tshipise (the reported crowds had put us off going to Musina) proved a washout. Choosing Plan B, we drove north along the back road to Musina in trepidation, stopping a couple of times where the cloud had cleared but moving on when the grey muck that was spreading from the north-east caught up with us. Our hearts went out to the Cockburns and all the Hermannsburg scholars who had had a 15 hour bus journey to Punda Maria.

If we had cloud, Punda Maria must look like the surface of Venus ...

I know this doesn't really have anything to do with Lepidoptera but it was too good not to share with *Metamorphosis*. I am writing this on the evening of the 4th and I still have goose bumps.

Eventually the eclipse started and we had a position on a north heading section of road, on a hill with blue sky. Slowly 08h00 approached ... the moon ate away at the sun and the light got dimmer – and I spotted more grey cloud spreading from the north-east, creeping up on us. I timed its spread and calculated it would get between us and the sun right at the moment of totality! No time to lose! We drove north, mindful that the further we went the more chance we would move out of the zone. We got to the Limpopo, and the cloud was still heading for the sun! To come all this way and miss the show due to cloud would be even crueller than the many times my Personal Cloud Cover, as Graham Henning calls it, has modified butterflying trips.

And you can't kick a solar eclipse out of the grass like you can an *Aloeides* .. .

And then, hallelujah, we found a road heading west along the border to Musina. As we sped along it we found blue sky and more and more propeller-heads like us waiting for the big E. The clouds went away, it was 08h 15 as we screeched to a halt and I whipped out my Five Roses Tea Bag Foil. Johan, as befits a Doctor, had proper viewing glasses ....

The sun looked weird. All we could see was a big dark circle with a tiny nail clipping of fire along its limb from 2 o'clock to 6 o'clock. The day had become eerie twilight. Then someone turned out the lights – poof! - just like that - and we could see stars - and where the sun had been there was a ring of silver fire - the biggest flames in the solar system, actually moving! No silver foil needed - it was like a moonlit night. It was dark, cool and the birds were silent. Dozens of aircraft could be seen circling overhead. The sky wasn't black; it was like dark blue velvet. The best simile I can think of is a vast plush jewel case with diamonds and a silver ring radiating glowing streamers. Rather like the Eye of Sauron from the Lord of the Rings, but benign. Time stood still and I will never forget that moment as long as I live.

We stood there oohing and aahing with everyone, some noisy sods were letting off car horns etc which was like breaking wind in church.

Then after a minute, on the edge of the sun's corona, a huge flare lit up - the famous diamond ring effect as the returning sun shines through valleys in the mountains of the Moon ...

And it was over.

We drove back to Waterpoort in a bit of a dwaal, making plans for how we can do another one! Very mundanely the day got cloudier and there were NO butterflies. After an excellent liver and the works breakfast back at the farm - thanks Hardus and Trini, and Johan for arranging for us to stay - we slunk back to Polokwane and Johannesburg and the ordinary working world. A phone call to Kevin told us that his party had seen the eclipse through a providential gap in the clouds, but all the thousands who went to Shingwedzi in the Kruger National Park saw was momentarily darker overcast.

I don't know if the New Age types are right when they say that seeing a total eclipse is a life-changing event, but I will never look at my old friend the sun in quite the same way again ...

I've seen him in his underwear.

Cops and robbers - Iraq, 1972

Torben B. Larsen
(originally published in 1990 in the *Entomologists' Record and Journal of Variation,* 102: 293-294). (Written in London 1988).

I set off for Babylon from the Palestine Hotel in Baghdad on a fine summer's Friday, the day of rest in Islamic countries. The sun-baked flats of the Euphrates-Tigris depression are not among the best butterfly collecting grounds, but on the other hand few people have ever tried out a net in the area. The day before I had been able to establish that the large swallowtail butterfly, *Papilio dernoleus* Linné, was well established in Baghdad; it hovered about citrus trees in the garden in ministries and agencies, livening up otherwise dull meetings. There was only one previous record, so it is an interesting example of recent colonisation (1977). *Entornops*, 42:37-38). Anyhow, Babylon was probably worth the trip, butterflies or not.

At the time Babylon was not much of a site. The Tower of Babel was a heap or rubble. The Hanging Gardens were a gleam in an archaeologist's eye (Russian or Polish). My most memorable memento of the occasion is the photograph of a big sign proclaiming: *'depArtmenT of anTiquiTise - excavaTe and resToraTe KasHnogaTe'*. I understand that the present government is in the process of resToraTing the site to the point where you can no longer see even traces of the original rubble. Babylon was also poor in butterflies. *Colotis fausta,* Olivier swarmed around caper bushes, and in small wadis with a bit of vegetation. *Junonia orithya* Linne was not uncommon. These tropical species migrate into Iraq every year to breed, in much the same way as *Vanessa atalanta* Linné reaches northern Europe. By two in the afternoon the temperature reached 35 degrees centigrade; tourist and entomologist a like decided to get back to the relative comforts of the Palestine Hotel.

A crowded minibus brought me to the main bus terminal on the outskirts of Baghdad. A very large Buick taxi (of the fish-tail vintage) was soon procured. An elderly man, almost blind, and his nephew asked to

share it - yes, to drop them at the Palestine would be just fine. Being nice to people is often rewarded; after much argument the taxi driver and the old man settled on a price less than half of what I would have agreed to pay.

On leaving the bus station we got stuck in a queue of cars. The traffic police were checking driving permits, taxi licences, or whatever. Progress was slow. The driver was fidgety, more so than seemed appropriate because of the delay. His foot hovered over the clutch. Suddenly he put the car in gear, mounted the pavement, and gunned past the police check-point. The grinning face of the Buick *hit* a portly Iraqi merchant, whose large buttocks suddenly raced across the hood in my direction, glancing off the windscreen. Police whistles blew. The siren of an alert police car went into action. The driver obviously did not have some document that the police wanted to inspect.

Round and round we went, cutting the wrong way round the imposing traffic circles of Baghdad, named after countless coups and counter-coups, the 13th of October, 15th of March, or whatever. Four police cars, lights flashing, horns blaring, sirens screaming, eventually joined the chase. The driver was in a state of total panic by now, with good reason. Landing in the tender care of the Iraqi police or other security services at that time was no less pleasant than it is to-day.

It was when we crossed the same bridge across the Tigris for the third time that I suddenly realized that I had forgotten to bring my passport - the guys in the screaming cars behind would not like that at all. Just then the driver got boxed in by some buses in a one way street. The pursuers stopped and advanced towards us, bristling with guns. The driver reversed - at which point I left the cab - and went past them in the opposite direction at great speed. All the police and militia piled into their cars and set off in hot pursuit. l dived into an alley. Had they really missed seeing me abandon ship? They had. I flagged down a cab and went to the Palestine Hotel. I paid three times the regular fare without a murmur.

The next hour was spent phoning every person of any influence l knew in Baghdad, telling them my story. I hoped it would also count for something that I had an official meeting with the Minister of Health the next day - and had met Saddam Hussein at a cocktail party the day before (he was deeply disinterested in family planning). They must eventually have caught the taxi driver, and I dread to think what they did to him, but at least he had behaved with great stupidity. I was more concerned about

the poor old man and his nephew; the innocent lift I had given them could well become the basis of a spying charge. But there was nothing I could do.

A few days later I left. There were no problems at the airport. I settled down in my seat on the rickety Iraqi Airways Trident aircraft. Finally safe? Suddenly a platoon of heavily armed police charged on board. Oh ... my god!!! It turned out they were the escort of a deportee, who was unceremoniously chained to his seat. Some people were obviously less keen to leave Baghdad than I was. Despite remonstrations from the cabin crew, the deportee succeeded in lighting up a cigarette during take-off. As the wheels left the runway I cannot say that I was unduly perturbed by that.

The Life-history of *Thestor basutus basutus* (Wallengren) (Lepidoptera: Lycaenidae: Miletinae) with new information on its association with pugnacious ants *(Anoplolepis* sp.: Formicidae)

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Abstract: Observed interactions between the host-ant *Anoplolepis custodiens*, and the pupa and fmal instar larva of *Thestor basutus basutus* is described. Larvae frequently interrupted two ants exchanging regurgitations, intercepting the flow of food and substituting itself for the recipient ant. There are strong indications that both organic detritus and ant brood are supplementary food sources. This, together with preying on Homoptera in the early instars, implies that tbis insect exploits all the entomophagous opportunities to which it is exposed. A *Thestor* larva was sometimes observed to groom a host-ant. These behavioural observations are briefly discussed.

Key Words: Lycaenidae, myrmecophily, trophallaxis, aphytophagy, entomophagy, camivory, detritovory, grooming.

Introduction

Clark and Dickson (1960, 1971) recorded *Thestor basutus basutus* ovipositing on *Veronica natalensis* Bep. (Asteraceae) infested by Homoptera (Jassidae=Psyllidae). The first three larval instars of this *Thestor* fed on these Homoptera, which in turn were tended by pugnacious ants, *Anoplolepis custodiens* (Smith) (Formicinae). They described and illustrated fmal instar larva and pupa found in the ant nest but were unable to establish the final instar's diet. Williams and Joannou (1996), studied oviposition and the early stages of the subspecies *Thestor basutus capeneri* Dickson. They found the first three larval instars fed on coccids (Homoptera: Coccidae) infesting grass and the final instar occurred in the nest of the local pugnacious ant. The *Thestor* larvae, when placed in a formicarium with these ants, soon died, hence their normal diet could not be established. In late November, 1999 the present authors received a fourth instar larva of *Thestor basutus basutus* from KwaZulu-Natal,

collected by Sheng-Shan Lu. They introduced the larva into a formicarium similar to that described by Claassens (1974). The formicarium housed a colony of the pugnacious ant taken from Table Mountain Cape Town. This colony contained eggs, larvae and pupae, together with many workers and a queen. The ants took very little notice of the larva, which hardly moved amongst the ants. It was never seen to solicit food from the ants and it was not fed by trophallaxis. It did, however, feed, or try to feed, on detritus from the floor of the plaster of Paris nest and the ants were seen to apparently deposit tiny bits of detritus near the larva, which it seemed to eat (Heath and Claassens, 2000). Although plenty of ant brood was present, the larva did not prey on it. After surviving for four weeks, the larva died, presumably from starvation.

The ant associated with *Thestor* species has so far been recorded as *A. custodiens* but Pierce *et.al.* (2002) considered it "unlikely that so many sympatric species could simultaneously parasitize the same species of ant". A preliminary phylogeny of the ant, based on molecular characters (DNA), suggests at least three distinct clades exist (S.P. Quek, unpublished).
Hence *A. custodiens* may represent a species complex.

The term entomophagy was re-defined by Pierce *et.al.* (2002) as feeding on any insect-derived resource.

Materials and methods

In late November, 2002 four fmal instar larvae of *T. b. basutus* were collected from a nest of the pugnacious ant found in KwaZulu-Natal. A large colony of the host-ant was also collecte<L together with ample brood of all stages. The larvae measured 16 mm in length when at rest and about 7 mm maximum width. The ants and larvae were introduced into a formicarium and arena (see Claassens, 1974). The ants were fed on a mixed diet of insects, chopped up cooked chicken, and other meat. Fresh water, concentrated sugar solution, and honey diluted in water, were placed in small containers in the arena and were regularly replenished.

Results

Observations on the habits of *T. b. basutus* fmal instar larvae

Trophallaxis: The larvae were often observed to move among the host-ants with their 'neck' extended and head raised well above the floor of the nest.
After searching for two ants engaged in trophallaxis it approached close enough to place its head between them and intercept the regurgitations passing between them. One of the ants usually retreated shortly thereafter, but the guest larva continued being fed by the remaining ant. This feeding behaviour differed markedly from that of *T. pictus* van Son and *T. yildizae* Koçak, which waited for individual passing ants and solicited food from them by quickly extending the neck and attempting to engage mouth-parts.
The larvae of these two species were fed by trophallaxis without either the larvae or the ants raising their heads high (Claassens and Heath, 1997; Heath and Claassens, 2000, 2003). Claassens (in this issue) compared the method of feeding of *T. b. basutus* larvae with a similar method employed by a myrmecophilous fish.moth, *Atelura* sp. (Thysanura: Nicoletiidae), which were also kept in a formicarium with a colony of the pugnacious ant.

Carnivory: On a few occasions a larva was seen to drag a host-ant egg or small ant larva beneath its carapace. When, after a considerable time, the larva moved on, there was no sign of the prey and it is concluded that it was devoured by the larva.

Detritus feeding: A larva was occasionally seen to 'apparently' scavenge the floor of the plaster of Paris nest. This took the form of moving the head from side to side as if searching for something, or laying silk (although no silk was laid). This observation was also recorded for fmal instar larvae of *T. b. basutus*, as well as of *T pictus*, where the ants also deposited small particles for the larva to eat (Heath and Claassens, 2000, 2003). The larvae did not feed on the many tiny red mites, which moved between and over them. These tiny myrmecophiles were completely ignored by the host-ants and presumably survive as scavengers.

Grooming: A *Thestor b. basutus* larva was occasionally seen to 'lick' a host-ant, head, body and even legs. The ant remained motionless during this treatment, which sometimes lasts for several minutes. Claassens (1976) observed similar behaviour in final instar larvae of *Lepidochrysops trimeni* (Bethune-Baker) and *L. methymna methymna* (Trimen), which were kept in formicaria together with their host-ant *Camponotus maculatus* Fabricius (Camponotinae). The purpose behind this grooming is not clear. One possibility is that cuticular secretions or detritus particles adhering to the ant are somehow attractive to the larva.

Pupation: Six or seven days after their introduction into the formicarium the larvae gradually fed less often by trophallaxis, they turned lighter in colour, shortened a little, assumed a more arched shape and eventually stopped moving altogether. This pre-pupal behaviour lasted for three to four days after which pupation proper was observed. During the pre-pupal stage the ants' attention to the larvae increased and sometimes several ants crowded on their surface, presumably feeding on some secretion. However, during the actual change from larva to pupa which was observed from beginning to end, taking about an hour, the ants showed no interest at all. The pupae were about 12 mm long and about 6 mm at maximum width. The actual size of the pupae depended mostly on their sex, females being a little larger than males. Like the pupae of other *Thestor* spp. examined the pupae of *T. t. basutus* were rather stout in relation to their length. They were loosely attached to the floor of the plaster of Paris nest at their posterior end, although they lacked cremastral hooks. They stayed in the same position during the entire pupal stage, which lasted about 22 days. The pupae were often visited by ants, sometimes 10 or more congregating on one pupa, touching it with their antennae (palpating) while pressing their mouth parts against the pupal surface. The ants may have obtained an epidermal secretion produced by tiny lenticels or PCO's (perforated cupola organs) present on the larval cuticle, as well as the pupa. This palpating behaviour gradually became less frequent during the development· of the imago but increased again immediately prior to eclosion, probably due to increased secretion by the pupa.

Eclosion: The pupae turned from light to dark amber, through to brown. Eclosion took place early in the morning but not before dawn. During eclosion the ants showed no interest in the pupa and the imagines worked their way out of the pupal shell unassisted by the ants. Three of the imagines, one male and two females, soon found their way to the nest exit and into the arena about 30 cm away where they completed wing expansion. Fluffy material on the adult's abdomen and legs prevented ants from approaching while it escaped from the nest. The fluff would presumably be shed during its first flight. One male, with a defective wing, did not make it to the exit, was attacked, killed and devoured by the host-ants, in spite of being covered in loose material. A similar observation was also made earlier in respect of an eclosed *T. pictus* imago which did not escape to the exit (Claassens, unpublished). In the arena the perfect imagines were not interfered with by foraging ants. Initially the ants showed considerable interest in the pupal shell, but soon left it alone and undamaged. After eclosion the pupal shell remained in the same position for several months.

Discussion

Feeding methods: Having observed *T. yildizae* and *T. pictus* final instar larvae fed by trophallaxis after soliciting single passing host-ants, the authors might have concluded that this precise method of feeding would apply to all *Thestor* spp. Observations on *T. b. basutus* larvae have now proved otherwise.. There are about 30 species of *Thestor* known from southern Africa and so the feeding habits of many more species need to be observed before a total picture can be drawn. The inference that *T. b. basutus* fmal instar larvae complement their usual diet by feeding on ant brood and detritus may be an indication that the balance of these feeding behaviours may vary considerably among *Thestor* species. Carnivory and detritovory may well be important in circumstances where a host-ant colony has become marginally too small or is otherwise unable to support adequate trophallaxis feeding for the larvae. Indications are that *T. b. basutus* exploits, in various degrees, all the entomophagous opportunities to which it is exposed, namely Homoptera and their secretions, ant regurgitations, ant brood and ant-derived detritus.

Host-specificity: It was learned that when keeping *Thestor* larvae for observation in a formicarium, the ants must be taken from a colony in which the larvae were found or at least the same species of ant found in the immediate vicinity. Pugnacious ants of Table Mountain, for instance, did not successfully substitute KwaZulu-Natal ants. A similar situation was noted for *Chrysoritis dicksoni* (Gabriel) (Heath and Brinkman, 1995:121). This host-specificity was one of the important lessons learned from rearing *T. b. basutus* larvae in captivity. Reconstruction of the *Anoplolepis* ant phylogeny and mapping it against a *Thestor* phylogeny may reveal some interesting new associations.

Grooming: Grooming of host-ants by lepidopterous larvae has now been reported for two unrelated species of lycaenid larvae and two unrelated species of ant. Future observations may prove this behaviour to be more common than was initially thought. To understand this behaviour many detailed laboratory observations are still required, however, it indicates the degree to which larvae can integrate themselves into the host-ants' social life.

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Observations on the occurrence, general appearance, behaviour and feeding habits of two myrmecophilous bristletails (Insecta: Thysanura) in nests of ants associated with lycaenid larvae (Lepidoptera : Lycaenidae)

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Abstract: An account is given of two species of myrmecophilous bristletails (Thysanura), where they can be found their general characteristics and the manner in which they obtain food in ants nests. Similarities and differences between the feeding habits of myrmecophilous late instar larvae of two species of *Thestor* (Lycaenidae) and one species of bristletail are noted.

Key words: Thysanura, Necoletiidae, Lepismatidae, Lycaenidae, Formicinae, Myrmicinae, formicarium, myrmecophily, trophallaxis, myrmecophiles, myrmecleptic, synoeketes

Introduction

When stones covering the nests of certain ants are turned over, one often sees small yellow bristletails, also known as fishmoths (Thysanura) running among the ants on the underside against a stone or in a nest itself. A black bristletail with tiny light spots occurs in carton nets of *Crematogaster* ants. These insects are relatives of the fishmoths or silverfish often found in homes, where they feed on starch containing substances such as bread, paper and certain glues. The yellow bristletail is an *Atelura* species of the family Nicoletiidae, but exactly which species has not been determined with certainty. The black bristletail is probably *Neoasterolepisma braunsi* (Escherich) of the family Lepismatidae (Irish, pers. comm.). A few of these bristletails, together with their host-ants, were often introduced into plaster of Paris nests of the kind described by Claassens (1974) and used in the study of myrmecophily in several lycaenid butterflies. It was thus

possible to observe their behaviour and feeding habits. It could not be established how, where and when they multiply, but they probably do so in a safe place, such as among debris deposited by the ants on the periphery of their nests. It is doubtful whether these highly specialised insects, because of their dependence on ants for food, would be able to survive outside their hosts' nests.

Ants found hosting the yellow bristletail

A few myrmecophilous bristletails are found in the nests of many ants, but most are broadly host specific (Irish, pers. comm.). My records of the yellow bristletail are mainly from the south-western Cape, where I have found them in nests of those ants which 'adopt' lycaenid larvae such as the pugnacious ant, *Anoplolepis* sp. (Formicinae), and the spotted sugar ant, *Camponotus maculatus* (Myrmicinae). Skaife (1961) found them also in nests of the brown house ant, *Pheidole capensis* (Myrmicinae). Dr J. Irish (pers. comm.) has collected them from ants' nests from about the Cedarburg to Port Elizabeth, and from sea-level to the Escarpment, usually in fynbos, very seldom in drier areas like the Karoo, and mentions that there is a possibility that different ants host different *Atelura* species, but that we will not be sure of until the genus *Atelura* has been revised.

Description of the yellow bristletail

A mature yellow bristletail measures about four mm in length. Smaller juveniles occur in nests in various sizes. They are golden-yellow in colour, torpedo-shaped and shiny. Externally the sexes are very similar. When I found them in an ant's nest, they usually occurred in small numbers of half a dozen or less.

General behaviour of yellow bristletails and their hosts

The yellow bristletail was studied in some detail in nests of the pugnacious ant, but it may be assumed that their behaviour in nests of other species of ant is the same. These bristletails moved about freely between the ants, their brood, and late instar larvae of *Thestor*. spp. kept in the same formicarium. They appeared to avoid making contact with the ants and only approached them to rob them of food. Ants were never seen attacking them and rather seemed to tolerate them, although their presence does not seem to benefit them in any way. These bristletails are therefore

myrmecophilous synoeketes and because they rob their hosts of food, they are myrmecleptic synoeketes (Steyn, 1954).

Feeding behaviour of yellow bristletails

The yellow bristletails were not seen to feed on ant brood or on detritus, but Wheeler (1910) states that the species he observed survive in ants nests partly as scavengers. Nor were they observed feeding on various kinds of food, including sugar solutions, live termites, and dead insects offered to the captive ants. Although yellow bristletails are not actually fed by the host-ant, they do feed on ant regurgitations. However, unlike *Thestor* larvae which are regarded by the ants as members of the colony and solicit food by approaching ants either individually as in *T. yildizae* larvae (Claassens and Heath 1997; Heath and Claassens, 2000), or join two ants engaged in trophallaxis as in *T. basutus basutus* larvae (Claassens and Heath, 2003; Heath and Claassens, 2003), bristletails cunningly steal the regurgitations. In other parts of the world bristletails have been observed robbing their host-ants of liquid food as it is passed from one ant to another when they feed each other by trophallaxis (Wheeler, *loc. cit.).* It was a privilege and a delight to be able to observe how exactly yellow bristletails rob their host-ants of food. When two pugnacious ants exchange food by trophallaxis they raise their he.ad and thorax high so that their mouth parts, normally facing downwards, are placed horizontally opposite each other, leaving a little more space than usual between their heads and the substrate below. At the very moment liquid food is exchanged between the ants, the bristletail takes up position between them, lifts its head high intercepts some of the food as it passes overhead and imbibes it. The thief then quickly retreats and mingles with other ants, ready to strike again. One must realise that this remarkable behaviour was observed in daylight or under artificial light, but that in nature this is not a case of daylight robbery as it takes place in complete darkness. In any case the yellow bristletails, like all Nicoletiidae, have no eyes and are therefore found in cryptic habitats: mostly ant and termite nests, but also in caves, soil etc.

How bristletails become aware of where and when trophallaxis is about to take place

When bristletails were observed darting about between their host-ants, it was thought to be a safety manoeuvre on their part to avoid close contact with the ants. It was, however, soon realised that these movements were

aimed at bringing them in close proximity of two ants engaged in trophallaxis. Their delicate antennae probably sense what is happening and swiftly placing themselves between the unsuspecting ants they do their trick.

Ants also feed their own larvae by trophallaxis, but bristletails were not seen to take advantage of that opportunity. It was also noted that they did not steal regurgitated food passed regularly between the ants and *Thestor* larvae kept in the same formicarium. Future observations may prove otherwise.

Feeding habits of *Thestor yildizae* and *Thestor basutus basutus* larvae compared with the feeding habits of yellow bristletails

Recently it was observed that late instar larvae of *Thestor basutus basutus* are fed by trophallaxis in a manner reminiscent of that of yellow bristletails. Unlike the larvae of *T. yildizae* and certain other *Thestor* spp. which sway their heads stretched out far and more or less horizontally above the floor of the nest in order to meet host-ants willing to feed them by trophallaxis, the larvae of *T. b. basutus* walk about the nest often raising their head, 'neck' and anterior part of their body well above the floor of the nest. It appeared that this was done to increase their chances of meeting ants engaged in trophallaxis. Once a pair of ants thus occupied is met by a *basutus* larva, it quickly sticks its head, which is more or less held at the same height as that of the ants, between theirs. While the ants continue with trophallaxis the intruder shares the food passed between them. One of the ants, the recipient one, sooner or later stopped feeding, allowing the guest larva to take its place and continue to feed (Claassens & Heath, 2003). The way in which *T. b. basutus* larvae practically force their host ants to feed them by trophallaxis resembles that employed by yellow bristletails. However, the two methods differ in that the latter steal the regurgitated food almost out of the host-ants' mouths, while *basutus* larvae, as adopted members of the colony, are fed by trophallaxis, even though they substitute for an ant.

Black bristletails of *Crematogaster* ants

I have found the black bristletail in carton nests of *Crematogaster* ants (Myrmicinae) in several coastal habitats of the south-western Cape. Dr J. Irish (pers. comm.) collected them in coastal scrub, from Port Nolloth to Port Elizabeth, and only in *Crematogaster* nests. These bristletails

constantly intermingle with their black hosts and are, at frrst sight, not readily distinguishable from them. Like the ants, mature black bristletails are three to four mm long.. They are torpedo-shaped but of slender build compared with the yellow bristletail. To study them, carton nests were broken up and placed in the arena (free roaming and feeding compartment) attached to a plaster of Paris nest. Destruction of the nests was necessary to encourage the ants to occupy the plaster of Paris nest part of the formicarium which, being covered with glass, allows all activities inside to be observed, when the dark lid normally covering the glass to keep the nest dark during the day, is temporarily removed. Carton nests of *Crematogaster* ants harbour vast numbers of individuals, but, for the present observations, only small carton nests or portions of bigger nests were used to prevent overcrowding in the formicarium. At the same time unnecessary removal of entire large carton nests from their natural environment was avoided. In captivity *Crematogaster* ants, like pugnacious ants, were fed on sugar solutions, dead insects, fruit, etc. None of these foodstuffs were eaten by the black bristletails. They behaved in a way similar to that of their yellow relatives, but at least in captivity they also followed the ants into the arena to join their trails up and down living plants placed there for the ants as a possible extra source of food. One wonders whether these bristletails, following pheromone trails of their hosts, are perhaps able to move to and from food sources outside their nests and there share a meal with them, at the same time enjoying their protection. It is interesting to note also that this black bristletail, like all Lepismatidae, has eyes and therefore most likely can see while outside the carton nests of their host ant. They might even indulge in a sip of the secretion of the honey-gland of *Chrysoritis* (Lepidoptera: Lycaenidae) larvae which are often visited by these ants to imbibe that secretion (Heath and Claassens, 2000, 2003), or even live in their carton nest, such as the larvae of *C. dicksoni*, which are fed by the ants by trophallaxis (Heath, 1998). Outside the host's nest their black colour would be to their advantage as predators would mistake them for their black aggressive hosts. In this connection J. Irish (pers, comm.) comments that while the black colour of these fishmoths and their host ants make them resemble each other, their different body shapes are a dead giveaway.

However, the white spots on the black bristletail serve to break up its body shape and make it resemble its host-ant a little bit more. Part of the diet of the black bristletail almost certainly consists of ant regurgitations. Their mouth-parts were often briefly in contact with those of the ants, strongly suggesting that like the yellow bristletails they rob their hosts of food during trophallaxis, or that they are fed directly by trophallaxis. However, because of their small, slender, black bodies and random, quick movements, the bristletails, of which sometimes a dozen or so were counted in a single formicarium, were not easily distinguishable from the numerous hosts and it could not be established with certainty what food they ate and how they procured it.

Discussion

No other work has been done on the behaviour of southern African myrmecophilous Thysanura. In fact little has been done on this subject elsewhere in the world, certainly not recently. Biogeography and systematics of South African Thysanura have been published by Irish (1994, 1996), while a further two publications, parts 3 and 4, by the same author are in preparation. Apart from the two myrmecophilous bristletails dealt with in this paper, there are other Thysanura myrmecophiles known from the southern Cape, the taxonomy of which has been sorted out (Irish, pers. comm.). The present contribution to the knowledge of two myrmecophilous bristletails, insignificant as it may seem, will hopefully stimulate others, especially those studying myrmecophilous lycaenid larvae, to observe these interesting insects, record their hosts, and note details about their life-cycles and interactions with their host ants. Understanding the behaviour of one myrmecophile can help to understand that of another even unrelated species. There is so much to learn about these and other myrmecophiles, that any further investigation into their life-histories can only prove to be rewarding.

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