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The biology of *Olios* spp., huntsman spiders (Araneae, Sparassidae) from Queensland and Sri Lanka: predatory behaviour and cohabitation with social spiders

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Summary

Four species of sparassid spiders were observed in the field to cohabit with cribellate web-building social spiders: *Olios diana* (L. Koch) and *Olios* sp. indet. with *Badumna candida* (L. Koch) (Amaurobiidae) in Queensland; *Olios lamarcki* (Latreille) and *Olios obesulus* (Pocock) with *Stegodyphus sarasinorum* (Karsch) (Eresidae) in Sri Lanka. *Olios diana* and *Olios* sp. in the laboratory and *Olios lamarcki* in nature were observed to feed on insects ensnared in the alien webs. *Olios diana* and *Olios* sp. also captured insects away from webs in the laboratory. The behaviour of these web-invading sparassids is compared with that of web-invading salticids.

Introduction

Spiders are often placed informally into two behavioural groups, the web-builders and the cursorial hunting spiders. A minority of species belong to another, smaller, behavioural group, the web-invaders: spiders which frequent webs built by other species of spiders. In general, web-invaders and web-builders have poorly developed vision; but the cursorial spiders can be divided additionally into two sub-groups: species with acute vision ('visual hunters'), namely the Salticidae, and species lacking acute vision ('non-visual hunters'). Although cursorial spiders do not live in webs, they often build silken nests in which they moult, oviposit and usually remain when inactive. The nest consists of enclosing layers of silk, only slightly bigger than the spider itself and often tubular in shape.

Because of the large size and crab-like shape of many species, the Sparassidae are one of the most distinctive groups of non-visual hunting spiders. Sparassids are particularly diverse and common in Australia, but little detailed information is available concerning their behaviour and natural history (see Coleman, 1938; Main, 1976). Since they are generally regarded as nocturnal species with predatory behaviour consisting of little more than a sudden lunge at close range on insects, perhaps their neglect in behavioural studies is not surprising.

In this paper, observations will be presented concerning the behaviour of Australian and Sri Lankan sparassids of the genus *Olios* which frequent the webs of spiders of other families. Web-invasion behaviour is apparently aberrant for spiders of this family.

Materials and Methods

Four species were observed in the field in Queensland and Sri Lanka; and two species, *Olios diana* (L. Koch) and *Olios* sp., were collected in Queensland along with their host, a social spider *Badumna candida* (L. Koch), and taken to Christchurch for laboratory studies. Colonies of the social spiders were set up in glass tanks and the sparassids were allowed to occupy them. Maintenance, observation procedures and terminology were as in previous studies (Jackson & Hallas, 1987). Two *O. diana* in the laboratory were blinded by covering their eyes with opaque enamel paint. They were kept with colonies of *B. candida* and observed. Voucher specimens have been lodged at the British Museum (Natural History) (Sri Lankan species) and the Queensland Museum (Australian species).

Observations

Four species of *Olios* — *O. diana, Olios* sp., *O. lamarcki* (Latreille), and *O. obesulus* (Pocock) — were observed occupying alien webs in Australia and Sri Lanka (Table 1). Individuals of 3 of these species were also seen away from webs occupying nests in masses of leaves on *Acacia* trees. About equal numbers of adult males, adult females, and large juveniles (body size 1-2 cm) of each species were observed. They were found both in and away from alien webs. These spiders were mottled brown with bright blue and yellow markings on their forelegs. Small juveniles, which are uniform bright green, were not seen in the field.

The two species of host spiders, *Badumna candida* (Amaurobiidae) and *Stegodyphus sarasinorum* (Karsch) (Eresidae) are social spiders (communal, non-territorial: Jackson, 1978) which build large communal webs (diameter: 50-100 cm) on leaves and stems of *Acacia* and other trees and shrubs. Usually, 20-200 spiders freely share the communal web and feed together on prey, especially beetles, cockroaches and moths, which are often considerably larger than the individual spiders. Their webs are cribellate (see Discussion) and highly adhesive. Often the webs contain considerable amounts of debris (dead leaves,

Sparassid	Site*	Host	No. Observed in Host Web	No. Observed Elsewhere
Olios diana	Mareeba (Queensland, Australia)	*Badumna candida*	*c.* 20	*c.* 5
Olios sp. indet.	Mareeba (Queensland, Australia)	*Badumna candida*	*c.* 10	*c.* 5
Olios lamarcki	Trincomalee (Sri Lanka)	*Stegodyphus sarasinorum*	11	2
Olios obesulus	Werawewa (Sri Lanka)	*Stegodyphus sarasinorum*	8	0

* towns close to or at which observations were made (additional information about each locality: Jackson & Hallas, 1987).

Table 1: Locations of sparassids observed in nature.

carcasses of insects, etc.). (For additional information about these two social spider species, see: Jacson & Joseph, 1973; Gray, 1982.)

The sparassids were found in their own silk nests (cup-shaped silk chambers, usually open at only one end and slightly larger than the sparassid) within the social spiders' communal webs. The nests were usually fastened to debris or living leaves and stems of the plant, and they were completely surrounded by the silk of the alien web. Sometimes, part of the surrounding webbing was old and disused (i.e., no longer sticky and no longer occupied by social spiders), but more often the surrounding web contained an active colony of social spiders. Each species of sparassid moulted, oviposited, and presumably mated in the social spider colonies: eggs were sometimes present in nests with females; some nests contained newly moulted sparassids and their exoskeletons; and males were found cohabiting in nests with subadult females.

The two Queensland sparassid species were sympatric, and on one occasion an individual of each species was found in the same amaurobiid colony. Otherwise, except for cohabiting pairs of conspecific males and subadult females, sparassids were found only one per colony. On one occasion, *O. lamarcki* was seen at night feeding on a moth. The sparassid stood facing downwards on debris and partly on silk near the bottom of an eresid web with the moth, which was about 0.75 times the size of the sparassid, held away from the silk. No eresids were near the sparassid.

To ascertain whether the sparassids were vulnerable to the sticky silk of their hosts, individuals of each of the four species were collected and dropped directly onto fresh portions of communal webs in the field. Silk obviously adhered to the spiders, and they moved across the webs with difficulty by forcefully lifting their legs and bodies to break free from the sticky silk. However, no sparassids were immobilised for more than a few seconds. The social spiders often began to approach; and, occasionally, a few bit at the sparassid's legs but failed to hold on.

Similar tests were carried out in the laboratory with *O. diana* on *B. candida* webs, with similar results. Colonies of another social spider, *Stegodyphus mimosarum* (Pavesi), an eresid from Kenya, were available in the laboratory. *O. diana* was tested on these webs, also, with similar results except that the sparassids tended to become immobilised for longer (up to 15 min). During these tests, the eresids were removed from the web to avoid risking injury to the sparassids.

In the laboratory, *O. diana* built nests within the occupied communal webs of *B. candida*. Generally, they remained inactive in their nests during the day, but they often came out at night to stand or walk about either in the web or completely away from it. While in the web, the sparassid usually rested with its legs primarily on stems and debris rather than on the silk. It walked mainly by following stems. However, being considerably larger than the stems, the sparassid continually contacted the amaurobiid silk.

Often silk could be seen to adhere to its legs, which the sparassid forcefully pulled free as it walked. If a leg could not be pulled free quickly, the sparassid tended to back away and try a different route. Occasionally, it chewed at the silk around a leg that became stuck and freed it.

Sometimes the sparassid forced its way across expanses of open silk. Amaurobiids sometimes approached the sparassid; and one or two might bite at its legs but move away when the sparassid jerked its leg away or kept walking.

While walking and resting, the sparassid's legs were usually held to the side, and its body was positioned near or on the substratum (Fig. 1). On a web, this laterigrade leg arrangement was disadvantageous since the body made contact with and tended to adhere to the silk. Away from webs, a disturbed sparassid would pull its legs in under the body, raising the body high above the substratum, to run away. However, sparassids on webs could not be induced to run.

The varied sizes (0.25-1.5 times the sparassid's body size) and types of insect prey which were made available by being released into the tanks were eaten both by the sparassids and the social spiders: beetles, *Tenebrio molitor* L.; blow flies, *Calliphora vicina* (Robineux-Desvoidy); cockroaches, *Periplaneta americana* (L.); houseflies, *Musca domestica* (L.); locusts, *Locusta migratoria* L.; moths *Ctenopseustis* sp. (Tortricidae), *Graphania* sp. (Noctuidae).

The sparassids captured insects away from webs by suddenly lunging and grabbing them when they came near. Insects ensnared on the amaurobiid silk were sometimes attacked in the same way when the sparassid contacted them as it walked along stems through the web. However, the sparassid sometimes clearly responded to ensnared insects, before making physical contact, by turning towards struggling insects on the web away from the stem. Next the sparassid waved legs I slowly up and down and stepped slowly out onto the web in the general direction of the insect, keeping at least legs IV on the stem and shifting to the right and left as it advanced. If it contacted the insect with its legs, it moved forwards and bit it. Generally, it did not lunge but simply walked forwards to bring its chelicerae to the insect. Usually, if contact could not be made with

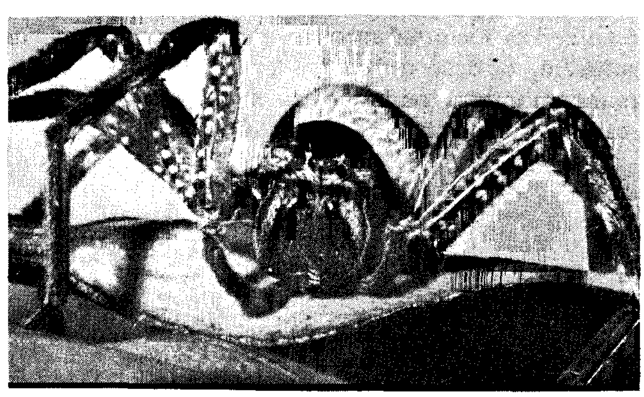

Fig. 1: Female *Olios diana* standing on *Acacia* leaves. Note laterigrade positioning of legs. Markings on forelegs are yellow and blue. Body length of spider: *c.* 20 mm.

legs I while legs IV remained on the stem, the sparassid backed away and ignored the insect. Also, if amaurobiids were feeding on the insect, the sparassid usually backed away when it contacted them.

However, one sparassid was seen to attack a large moth on which two amaurobiids had already begun to feed. The amaurobiids decamped as the sparassid approached. And occasionally sparassids walked across several centimetres of open web, forcing their way over the sticky silk, to attack an insect.

After attacking, the sparassid sometimes returned immediately to the stem to feed, by stepping backwards and dragging the insect along. This almost always happened if amaurobiids were active in the vicinity. At other times, especially if the insect was large, the sparassid remained in place for as long as 5 min before backing off with its prey.

To feed, the sparassid usually faced downwards, after pulling the insect free from most if not all of the amaurobiid silk (Fig. 2). If the sparassid was in a location from which this was difficult or impossible, it usually walked along the stem, carrying the prey, until it reached a more suitable feeding site.

Blinded *O. diana* occupied *B. candida* webs and captured insects both at and away from webs. In casual observations, blinded and normal *O. diana* were not distinguishable in their behaviour or their efficiency at prey capture.

Discussion

Cohabitation with web-building social spiders is apparently a routine form of behaviour in the four species of *Olios* that have been studied, although these species also live away from webs. Sparassids are generally envisaged as being cursorial, but these four species can be accurately referred to as 'web-invaders', a behavioural category of spiders for which the best known examples are various species from the family Mimetidae and from the theridiid genus *Argyrodes*. The mimetids seem to be primarily araneophagic, eating spiders in the webs they invade (Czajka, 1963; Jackson & Whitehouse, 1986), and *Argyrodes* may be primarily kleptoparasitic, pilfering insects from their hosts' webs (Vollrath, 1984; Whitehouse, 1986). The adaptive significance of web invasion for the sparassids, however, is unclear. Araneophagy was not observed, but kleptoparasitism was practised and may be an important feeding tactic of these spiders.

Large insects ensnared on the host's web become available to the sparassids, and perhaps they are captured more efficiently by the sparassids on rather than away from webs. The dense social spider web may also provide an especially safe refuge from many predators that would be deterred by the sticky silk.

The sparassids are able to glean insects from the edges of the webs, while keeping some or most of their legs on a stem or some other non-web substrate; or they can walk across the silk to their prey. Prey detection and localisation is apparently by tactile or vibratory cues, and there is no evidence of vision being significant.

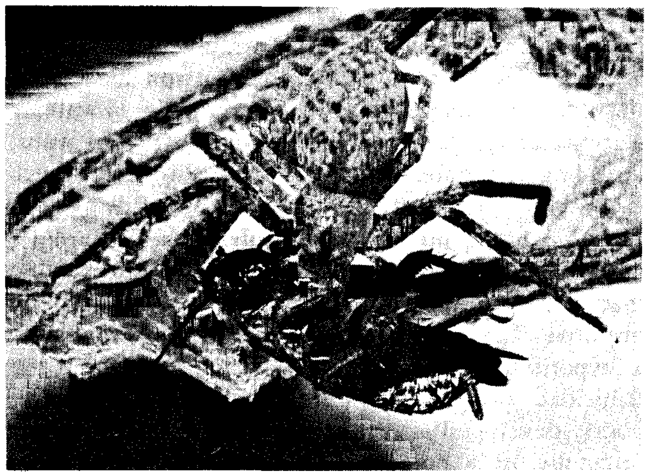

Fig. 2: Juvenile *Olios diana* at edge of social spider web (*Badumna candida*) feeding on cockroach.

Although mimetids and *Argyrodes* are apparently highly skilled at moving about and interpreting vibratory stimuli on the webs they usually invade, the sparassids are different. Although the silk of their host's web adheres to them, they are able to force their way across it by virtue of their large size and brute strength. As far as possible, they keep to stems, leaves and detritus, avoiding close contact with the silk.

The biology of these sparassids is of interest in relation to recent research on web-invading salticid spiders. The salticids, which are unique because of their complex eyes and acute vision (Land, 1969a,b; Williams & McIntyre, 1980), are generally envisaged as strictly cursorial spiders. A small group of salticid species, however, are web-builders, the most aberrant of these belonging to the genus *Portia*. Five species of *Portia* have been studied and all were found to be distinctively versatile predators that not only catch prey as cursorial hunters but also spin large prey-catching webs and invade diverse types of alien webs where they feed on the host spider and, to a lesser degree, on ensnared insects (Jackson & Hallas, 1987). *Portia* differs from *Olios* by performing vibratory behaviour that deceives the host spider (aggressive mimicry), but resembles mimetids (Jackson & Whitehouse, 1986) and *Argyrodes antipodiana* (Whitehouse, 1986) in this respect. *Portia* differs from *Olios* and all studied non-salticid web-invaders by invading and capturing prey efficiently on diverse types of webs.

Webs of spiders range from sparsely woven three-dimensional space webs and highly organised two-dimensional orb webs to densely woven sheet webs (Foelix, 1982). The stickiness of some webs is enhanced by the host spider adding special substances ('glue') to the structural lines of the web (cribellate spiders: an adhesive 'wool'; some non-cribellate spiders: droplets of sticky fluid). Webs to which glue has been added will be referred to as 'sticky'. The social spider webs frequented by *Olios* can be described as cribellate sheet webs.

Web-building spiders have no difficulty in walking on their own webs but, as a rule, experience difficulty in walking on the webs of other spiders. Also, cursorial spiders and spiders that spin non-sticky webs tend to adhere to sticky webs, while the builders of non-cribellate sticky webs tend to adhere to cribellate webs and vice versa. Although *Portia* spins a non-sticky web, this unusual spider experiences no difficulty in walking across and capturing prey on diverse types of webs, including the cribellate social spider webs to which *Olios* seems to be restricted.

Portia has a number of primitive (plesiomorphic) morphological characters (Wanless, 1984), suggesting that some of its behaviour patterns might also be primitive. The biology of *Portia* became the impetus for a hypothesis which included the proposal that the Salticidae evolved from web-building spiders with poorly developed vision and that acute vision evolved originally in a spider like *Portia* that became an araneophagic predator proficient at invading diverse types of webs (for details, see Jackson & Blest, 1982). As a non-visual web-invader, *Olios* is consistent in its biology with the predictions of this hypothesis. *Olios* does not seem to invade diverse types of webs. Being so large and heavy probably restricts it from many of the webs invaded by *Portia.* However, even on the webs of social cribellate spiders, it does not seem to be comparable to *Portia* in locomotory or prey-localisation abilities.

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