EGG TYPES AND OVIPOSITION BEHAVIOUR IN SOME FULGOROID LEAFHOPPERS (HOMOPTERA, FULGOROIDEA)

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Abstract

The oviposition behaviour of *Scolypopa australis* (Walker) (Ricaniidae) is described in detail for the first time. The oviposition sites of *Kallitambinia australis* Muir (Tropiduchidae) and an unidentified achilid are described for the first time. Brief descriptions of the eggs of all three species are given.

The specialisations of oviposition behaviour found in the Fulgoroidea are discussed with respect to egg protection and related to the apparently long evolution of the superfamily.

Introduction

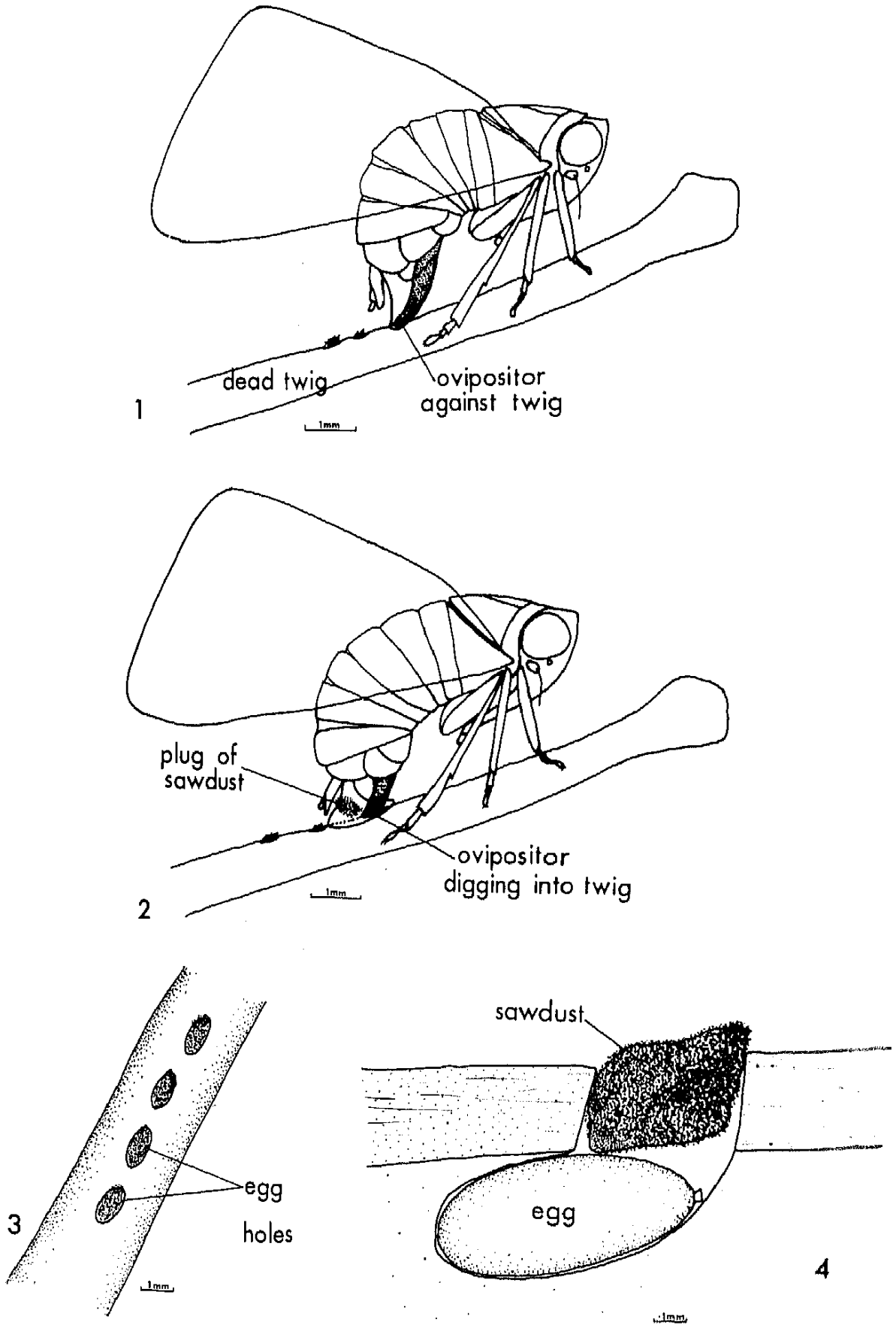
During embryological studies of Fulgoroidea, observations were made on egg types and oviposition of *Scolypopa australis* (Walker) (Family Ricaniidae), *Kallitambinia australis* Muir (Family Tropiduchidae) and an unidentified species of Achilidae.

Scolypopa australis (Walker)

This species is common on many different host plants in New South Wales, Queensland and New Zealand. Cumber (1966) described briefly its egg and oviposition sites and listed over twenty genera of plant hosts in New Zealand. In the present study it was found breeding on *Aegiceras corniculatum* (L.) (Myrsinaceae), the river mangrove, at Patonga, north of Sydney, N.S.W. This host plant has not previously been recorded for *S. australis*. The female prepares to lay by moving down the plant from the young mangrove shoots to dead twigs about 3 mm wide attached directly to a living branch. Rows of up to sixteen eggs are laid along the axis of the twig, though there are usually three to six eggs per row.

Detailed observations were made on the method of oviposition employed by one female which laid in the laboratory. The ovipositor consists of two pairs of cutting valves (first and second valves) surrounded by a pair of broad plates (third valves).

After the female had chosen a dead twig she lined herself up with the longitudinal axis of the twig and swayed slightly from side to side for three or four minutes. During this time her body was held raised from the surface and the apex of the abdomen held against the twig. The angle of the body to the twig was about ten degrees, whereas the abdomen was at an angle of 45° to the twig. The wings were held slightly higher and slightly steeper than usual (Fig. 1). The first and second pairs of ovipositor valves began to work their way into the twig. The second valves made a hole and as they withdrew the first valves were inserted. The two pairs of valves worked alternately in this manner for about ten minutes. As the hole was deepened and widened, the body of the female was lowered slowly towards the twig (Fig. 2). When the hole was deep enough the female raised her body again and the two sets of valves again worked their



Figs 1-4. *Scolypopa australis* (Walker): (1) female immediately before beginning to dig egg hole; (2) female with ovipositor inserted into egg hole, showing wad of sawdust held in third valves; (3) line of egg holes in twig; (4) structure of egg hole containing egg.

way into the hole shaping and enlarging it. Six more times the valves were pulled out and worked into the hole again before it was ready to receive the egg. After the eighth withdrawal the valves were inserted into the hole and the abdomen was contorted as the egg was laid.

At no time did the large third valves enter the hole. They were held around the edges of the hole and collected the sawdust as it built up from the digging action of the ovipositor. Due to the shape and position of the third valves, this sawdust was compressed into a column which was held by the third valves until after the egg was laid, when it was placed into the opening of the hole to cover the egg. The female then moved forward a short distance along the twig, still holding her abdomen at an angle to the body and immediately began to dig a new hole. Each hole was dug in exactly the same way as the first. The same number of "digs" were used to enlarge and shape the hole before the egg was laid. It took 18½ - 23 min. to lay each egg from the time the digging started to when the plug of sawdust was deposited in the hole. The first "dig" in each hole took 7 - 8 min. to complete. After the final egg had been laid the female walked a short way up the twig and flew away. Her abdomen was still full of eggs.

The same basic technique is obviously employed by all female *S. australis* as all oviposition sites examined were the same in structure and all matched the description of the sites by Cumber (1966). Each row appears to the eye as a line of small pale spots along the axis of the twig (Fig. 3). The structure of each hole was described by Cumber (1966) and is illustrated in Fig. 4.

Twigs approximately 3 mm wide attached directly to living tissue are the only ones selected by the female and she does not choose thicker dead twigs which have suitably-sized twigs branching from them. Consequently, when the nymphs hatch they will be quite close to living tissue and, presumably, their first meal of sap. It is unknown what method the female uses to check the twigs. Cumber (1966) stated that oviposition sites on the several plant hosts he examined were usually in soft stems which subsequently hardened and died. He suggests that the subsequent dieback of the twigs may have been initiated by the plant prior to the insertion of the eggs.

The eggs are ovoid, uniformly translucent and with a mushroom-shaped micropylar cap at the anterior end. The length varies from 770 µm to 870 µm and the width across the widest part, which occurs about midway along the length, is 360-380 µm. The dorsal surface is slightly more convex than the ventral surface.

Kallitambinia australis Muir

Few aspects of the biology of this species were known and no biological information has appeared in the literature. The species has been taken along the eastern coast of Australia between Brisbane, Queensland, to just south of Sydney, N.S.W., and appears to live principally on *Aegiceras corniculatum* (L.) (Myrsinaceae), the river mangrove, on which it was found at Patonga, N.S.W. during the present study.

Eggs of *K. australis* are laid in rows of up to eleven in the thick leaf margins of living leaves of *A. corniculatum*. Each is laid from the ventral surface of the leaf with the anterior end facing inwards. There is no covering placed over the egg in the hole so that the operculum on the dorsal side of the anterior end of the egg is left exposed (Fig. 5). No detailed observations have been made on the method of oviposition employed by the adult female. After the row of eggs has been laid, the damaged portion of the leaf margin dies and hardens forming a brown casing which probably helps protect the eggs from mechanical damage.

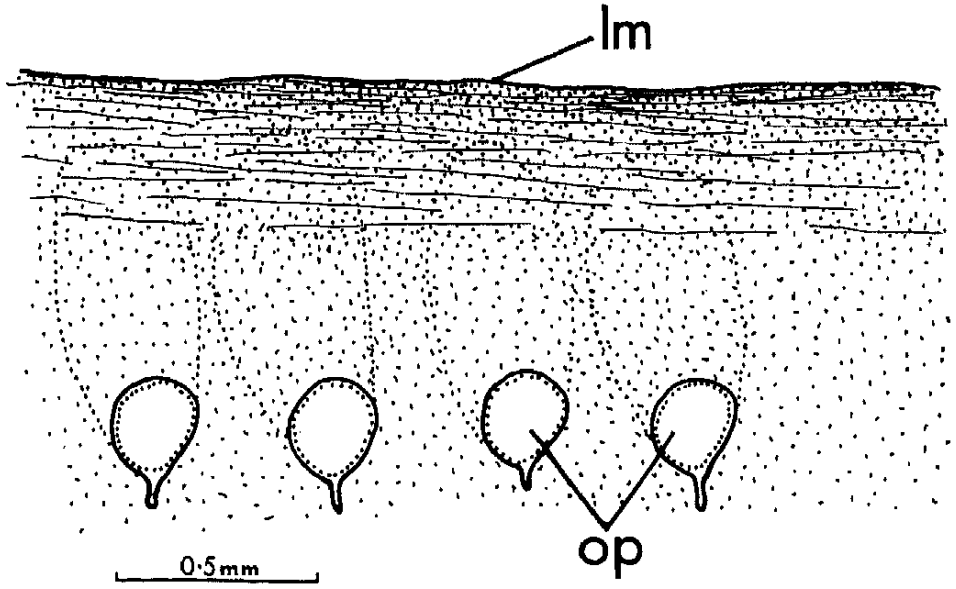


Fig. 5. Eggs of *Kallitambinia australis* Muir in situ in ventral surface of mangrove leaf. lm., leaf margin; op., operculum.

The eggs are ovoid, uniformly translucent, with an elongate, dorsally-curving peg-like micropylar cap anteriorly and a circular operculum anterodorsally. The egg, on laying, is 660-720 µm long and 279-306 µm wide at the widest point. The dorsal surface is less strongly convex than the ventral surface, which is more strongly convex towards the posterior end than anteriorly.

Unidentified Achilid*

The adult of this species was found in large numbers on an Australian native pine, *Callitris muelleri* (Parlot) (Cupressaceae) at Pearl Beach, north of Sydney, N.S.W. in October, 1974. Attempts to place the species in a genus were unsuccessful. Like most Achilidae, the female possesses only short fleshy ovipositor valves incapable of inserting eggs into a woody plant. A detailed study of the leaves, stems, branches, fruits and bark of the pines revealed no eggs.

Initially, females with abdomens full of apparently mature eggs and with spermathecae filled with spermatozoa would not lay in the laboratory. After a number of unsuccessful attempts to get females to lay, it was found that access to a piece of bark was necessary. A piece of *Callitris* bark was placed into each of several tubes containing live females and in all cases females began laying eggs within two days. Each egg was coated with small pieces of bark material and dropped to the bottom of the tube in which it was laid.

Specimens have been deposited in the collections of the Biological and Chemical Research Institute, Rydalmere.

The eggs were ovoid, slightly smaller than those of *Scolypopa australis* and with a large quadrangular micropylar cap at the anterior end. There were no other chorionic adornments.

In the field the female hopper coats the eggs in a similar way before dropping them into leaf litter. The camouflaged eggs were very similar to small pieces of vegetable matter and were extremely difficult to find in the leaf litter under the plant.

Covering the eggs in this way is presumably a means of protecting them either from parasitism, predation or from dehydration as they lie in the upper layers of the leaf litter.

Discussion

The eggs of Fulgoroidea are of various shapes, but frequently ovoid, and are laid in a variety of situations. Some have chorionic adornments, such as micropylar caps or opercula.

Previous workers have described the eggs and/or oviposition sites of *Siphanta acuta* (Walker) (Muir and Kershaw, 1912), *Melicharia unicolor* (Walker) (Grylls, personal communication), *Platybrachys leucostigma* (Walker) and *Platybrachys maculipennis* (LeGuillou) (Hacker, 1924), *Perkinsiella saccharacida* Kirkaldy (Kirkaldy, 1906), *Oliarus felis* Kirkaldy (Hacker, 1925), *Pyrilla perpusilla* Walker (Sander, 1956) and *Pyrops candelaria* (L.) (Kershaw, 1910). These species represent the fulgoroid families Flatidae, Eurybrachidae, Delphacidae, Cixiidae, Lophopidae and Fulgoridae.

The present work, in which the eggs of *Scolypopa australis, Kallitambinia australis* and an unidentified species of Achilidae have been described, adds the families Ricaniidae, Tropiduchidae and Achilidae to the list. In all species described the oviposition behaviour is somewhat specialised. In the two species which lay their eggs in the ground (*Oliarus felis* and the unidentified Achilid), care is taken to ensure that the eggs are adequately protected. *O. felis* covers the eggs with a waxy secretion to protect them from salt water at high tides, since this species lives below high water mark on the roots of salt water couch grass (Hacker, 1925). The achilid protected its eggs with pieces of bark as described above. The females would not lay in the laboratory until bark was provided for them.

Eggs laid into living plant tissue are usually covered with a waxy cap to prevent dessication and possible hardening and contraction of the plant. *K. australis* and *P. leucostigma* has each adapted to a single species of plant. *K. australis* required the thick leaf margins of *Aegiceras corniculatum* as discussed above and *P. leucostigma* the characteristic bark type of *Eucalyptus maculata* (Hacker, 1924).

S. australis lays its eggs into dead tissue (in this study) and covers them with a plug of sawdust. It also appears to select only those twigs which are close to living parts of the plants. Cumber (1966) suggests that when living tissue is selected it may be tissue in which the sap flow is reducing. *M. unicolor* appears to have similar oviposition habits to those of *Scolypopa australis* (Grylls, personal communication).

Such a diversity of behaviour patterns and specialisations indicates long evolution. Comparative study of the structure of the ovipositor suggests the same. Those species that insert their eggs into the plant itself have a strong, sclerotized, toothed ovipositor. These species are *P. saccharacida, M. unicolor, S. australis* and *K. australis.* The othe rspecies, *S. acuta, O. felis, P. leucostigma, P. perpusilla* and *P. candelaria* have short ovipositors, sometimes only a series of soft lobes whose main function is to manipulate the egg into the right position and then spread any waxy covering. It is of interest to note that *Melicharia unicolor* and *Siphanta acuta,* although belonging to the same family (Flatidae), have quite different oviposition behaviour.

Such morphological variation can only be reached by long evolution and is associated, in the Fulgoroidea, with specialisation of oviposition habits.

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