Mouthpart Morphology of the African Ant *Oecophylla longinoda* Latreille (Hymenoptera: Formicidae)

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Abstract: The mouthparts of the African ant *Oecophylla longinoda* Latreille are generalized structurally and closely resemble the mouthparts of other species in the subfamily Formicinae. They are essentially identical to those of *O. smaragdina* (Fabricius). Mandibular dentition and midline overlap contribute to the efficiency of predatory attack.

INTRODUCTION

The ant genus *Oecophylla* (subfamily Formicinae) is represented by two living species and several fossil forms. One extant species, *O. smaragdina* (Fabricius), is Oriental and Australian in distribution, while the other, *O. longinoda* Latreille, ranges throughout tropical Africa. One fossil species, *O. leakeyi* Wilson and Taylor, is also Ethiopian in distribution (Wilson and Taylor, 1964). Although Wheeler (1922) recognized *longinoda* and *smaragdina* as distinct species, the differences between the two are based almost solely on the allopatric nature of their distribution (Vanderplank, 1960).

Ants of the genus *Oecophylla* build arboreal nests of leaves bound together by larval silk. Nest-building behavior is extraordinary, for the larvae that supply the silk are carried about by the worker ants and are utilized as "animated shuttles" (Wheeler, 1922). The biology of *O. longinoda* has been studied in detail by Ledoux (1950), Way (1954), and Vanderplank (1960).

O. longinoda is aggressive and territorial, a single colony vigorously defending its tree or trees against intruders. Workers can inflict a painful bite on human skin (Weber, 1943, 1949), although the pain is due in part to the effects of "poison" sprayed on the wound from the tip of the gaster (Vanderplank, 1960). Thus, in East Africa, its reputation as a painful biter is implied in its Kiswahili name, "maji ya moto" or hot water ant (Vanderplank, 1960). *O. longinoda* is an efficient predator and effectively attacks notoriously aggressive ants such as the *Anomma* driver ants (Gotwald, 1972). Vanderplank (1960) noted that the efficiency of *Oecophylla* as a predator is positively correlated with colony size.

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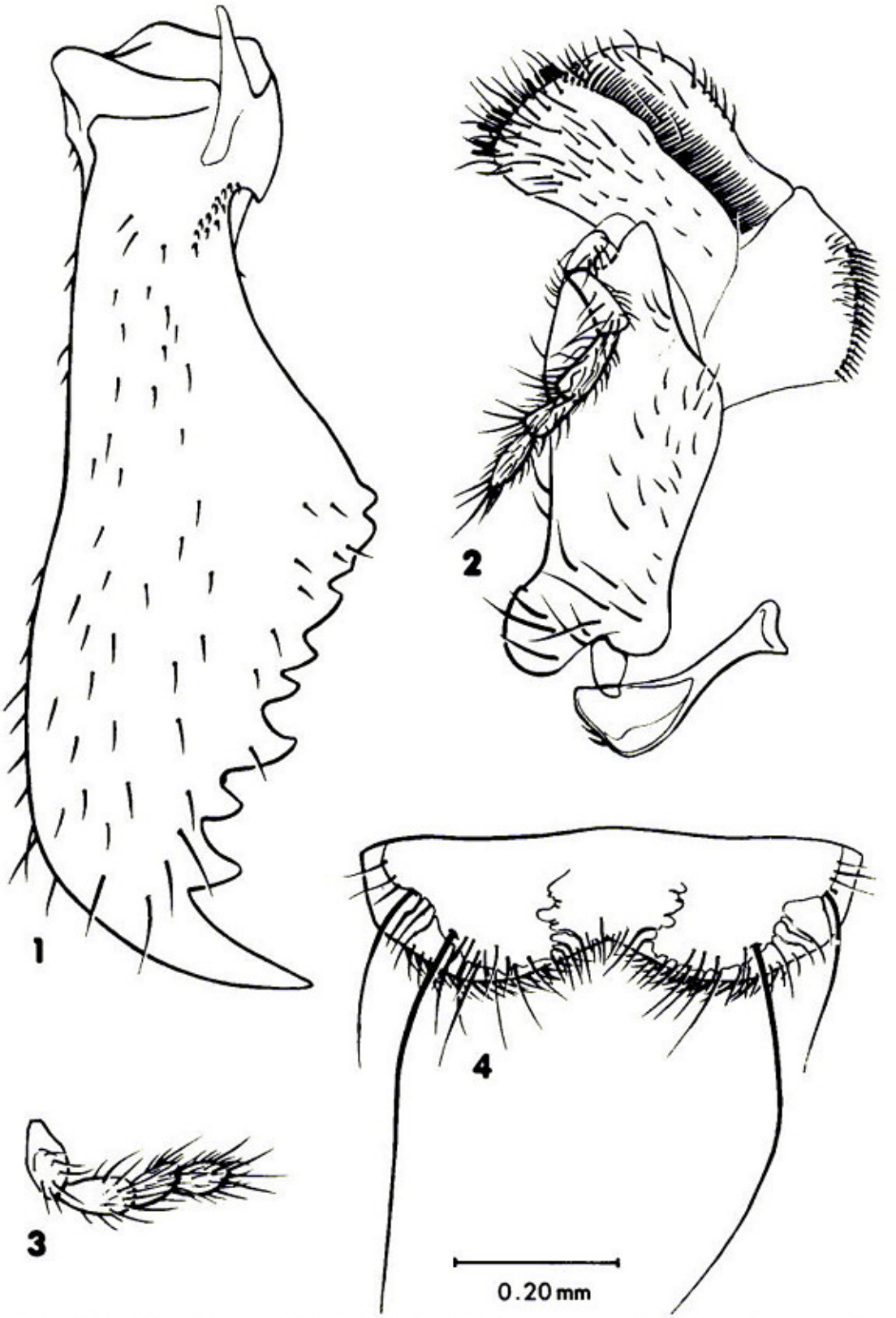

FIGS. 1–4. Mouthparts of *Oecophylla longinoda*, major worker. 1, right mandible, dorsal view; 2, left maxilla, external view, the maxillary comb is drawn as seen through the transparent galea; 3, right labial palpus, lateral view; 4, labrum, extensor surface.

While the predatory success of *O. longinoda* is due in large part to behavioral adaptations, the ant is also morphologically adapted to its role. Since the species lacks a sting, it relies almost completely on its strongly dentated mandibles for prey capture and transport. The mandibles are used during foraging to grasp and pull at the prey until it is immobilized (Gotwald, 1972). Workers are dimorphic with maxima and minima forms. In a related division of labor, the maxima workers forage as predators, while the minima workers remain in the nest (Weber, 1946, 1949).

The morphology of *O. longinoda* has been neglected in most investigations. This paper compares the mouthparts of *O. longinoda* with those of other species of Formicinae and particularly with those of *O. smaragdina*. Because the mandibles play a role in the predatory success of *O. longinoda*, their morphology is evaluated relative to function in prey capture, immobilization, and transport.

METHODS

Specimens of *O. longinoda* examined in this study were collected by the author in the coastal scrub and grassland region of Ghana at Legon on 5 June 1971. These workers were attacking (Gotwald, 1972) a column of the driver ant *Dorylus* (*Anomma*) *nigricans* Illiger. The specimens of *O. smaragdina* examined were collected by Dr. Rossiter Crozier (University of Georgia) at Kuala Lumpur, Malaysia on 25 August 1967.

Mouthparts of major workers of both species were removed from the head capsule, dissected into component parts, stained, and mounted in Canada balsam on microscope slides. The descriptive terminology is that previously used by the author (Gotwald, 1969). Drawings were made with the aid of a microprojector.

DESCRIPTION OF THE MOUTHPARTS OF *Oecophylla longinoda*

Mandible (Fig. 1): Mandible linear and triangular with distinct masticatory and basal margins; masticatory margin provided with large apical tooth and up to eight subapicals; transitional denticles present at juncture of masticatory and basal margins; in dorsal view, basal margin recurved proximally to form a sharp ridge.

Maxilla (Fig. 2): Maxillary palpus five-segmented. Stipes subrectangular; lateral margin forming a smoothly rounded lateral shoulder; distal margin drawn to a point; medial margin with convex expansion proximally; numerous setae inserted on external face, particularly on proximal third and lateral half. Galea with well-developed maxillary comb; galeal crown not conspicuously developed; distal margin of galea with ten or more broad setae; several setae inserted so as to approximate a galeal comb, but lacking characteristic shape of comb setae (Gotwald, 1969). Lacinia subquadrate with well-defined gonia; apex poorly developed; lacinial comb conspicuous, continuous, and occupying two-thirds of lateral margin; a second series of setae inserted laterad of lacinial comb.

Labium: Labial palpus four-segmented (Fig. 3). Premental shield lightly sclerotized and bearing numerous, scattered setae; subglossal brushes composed of densely packed setae of moderate length; epimental sclerites fairly well defined; paraglossae absent.

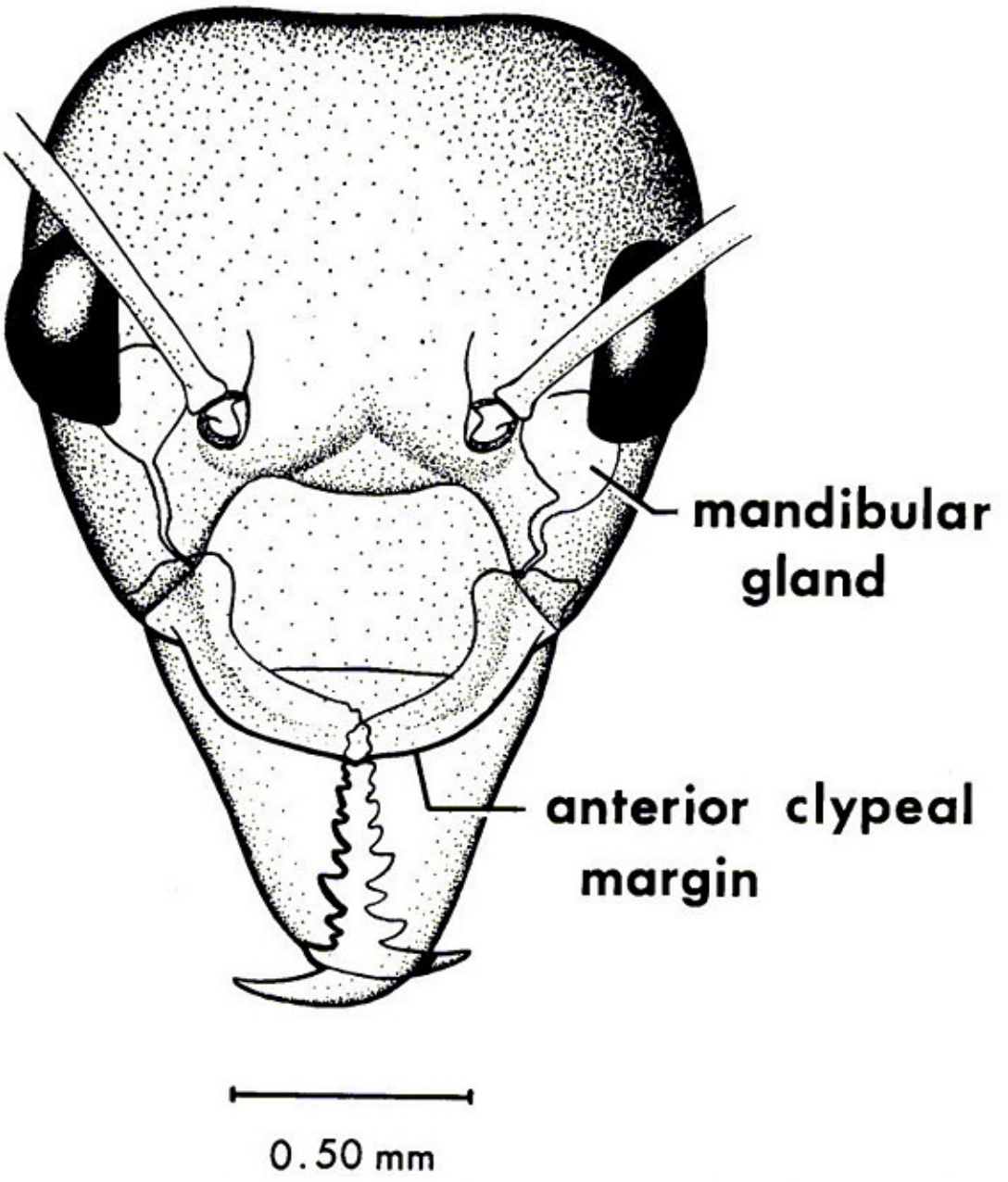

FIG. 5. Head of an *Oecophylla longinoda* major worker, frontal aspect. The head is drawn as rendered transparent in the laboratory preparation. Note the mandibular midline overlap.

Labrum (Fig. 4): Distal margin emarginate but not cleft medially, forming two smoothly rounded lobes; hemocoel extending into each lobe; numerous small setae inserted along the distal margin, several long setae inserted along or close to the lateral and distal margins of hemocoel; of these setae, four are conspicuously longer than all others; most of extensor surface posterior to margins of hemocoel devoid of setae; labral tubercles absent.

DISCUSSION

The mouthparts of the subfamily Formicinae, with few exceptions, are generalized structures (Gotwald, 1969), and palpal segmentation is usually primitive (i.e., maxillary palpus is six-segmented and labial palpus four-segmented). In these characteristics, the subfamily closely resembles the dolichoderines and myrmeciines (Gotwald, 1969). The mouthparts of *O. longinoda* differ little from other species in the Formicinae. The triangular mandible, with distinct basal and masticatory margins is typically formicine, although in being more linear, it resembles the dolichoderine ant, *Dolichoderus attelaboides* (F.) (Gotwald, 1969). The sharp ridge at the proximal termination of the basal margin is unique to *Oecophylla* and has not been observed in any of the 107 ant species from all subfamilies (from 61 genera) previously examined in detail by the author (Gotwald 1969, 1970; Brown et al., 1970; Gotwald and Lévieux, 1972).

The maxilla of *O. longinoda* is also typically formicine, although the maxillary palpus is five- and not six-segmented as in *Prenolepis*, *Camponotus*, and *Formica*. The stipes closely resembles that of some *Camponotus* species. The conspicuous lacinial comb of *O. longinoda* sets it apart from many of the formicines where the comb tends to be composed of relatively thin, short setae. The presence of wide, conspicuous setae on the galeal crown is characteristic of many formicines. The maxillary palpus, on the other hand, is unusually short in *O. longinoda*, even when considering the fact that it has one segment fewer than most formicines.

The labrum of *O. longinoda* lacks the cleft or deep emargination observed in the Formicinae and Dolichoderinae but is not otherwise unusual. The primitive labial papal segmentation is retained in *O. longinoda* in spite of reduction in the maxillary palpus.

Bugnion (1930) described the mouthparts of *O. smaragdina*, including the worker, queen, and male in his study. His lengthy descriptions are sometimes ambiguous and the drawings often inaccurate. Although shapes of the stipes and lacinia of *O. smaragdina* as illustrated by Bugnion, for instance, differ considerably from those of *longinoda*, my reexamination of *O. smaragdina* mouthparts revealed that they are essentially the same as those described here.

The mandibles of *O. longinoda* and *O. smaragdina* are identical, even to the presence of the transitional denticles at the juncture of the basal and masticatory margins and the sharp ridge at the proximal end of the basal margin. The labrum in each species is the same and both possess the four prominent setae of the extensor surface. Palpal segmentation is the same for each species. The only divergence noted was in the setal pattern of the lacinia. In *O. smaragdina* a larger number of setae are inserted laterad of the lacinial comb and the comb itself is inserted farther laterad of the lacinial margin than it is in *longinoda*.

The relationship of mandible morphology to predatory behavior patterns

must ultimately focus on the fact that the mandibles maintain a vise-like grip on prey individuals under conditions of stress created by prey escape movements and by tugging actions of the immobilization phase of predatory attack [the prey individual is pulled at from opposing directions, "spread-eagle" fashion, by cooperating foragers (Gotwald, 1972)]. One morphological condition is primarily responsible for this gripping efficiency: The closed mandibles exhibit considerable midline overlap (Fig. 5). Because of this overlap, teeth of the masticatory margin trap and prevent prey structures (particularly legs and antennae) from sliding proximally or distally along the masticatory border. Field observations support this conclusion and are corroborated by laboratory examination of numerous *Oecophylla* workers preserved while grasping prey. Additionally, contraction of the powerful mandibular adductor muscles [the adductors are voluminous and are the most prominent muscles in the head capsule (Gotwald, 1969)] could exert great force on any structure wedged between the mandibles at the points of overlap. The large, sharply pointed apical teeth may effectively pierce some prey structures, and Weber (1949) reported that after biting human skin, *O. longinoda* mandibles were difficult to dislodge. These same morphological features make *Oecophylla* mandibles useful manipulative organs. For instance, worker ants make extensive use of their mandibles in handling the living leaves that are incorporated into the nest (Ledoux, 1950).

Of parenthetical note are the mandibular glands of *O. longinoda* (Fig. 5). These glands are placed within the head capsule partly behind the compound eyes. As in other Formicinae, the mandibular glands of *O. longinoda* discharge chemicals that presumably function in the alarm-defense system of the species (Wilson and Regnier, 1971). Although conspicuous in the head cleared with clove oil, the relatively small size of the glands indicates their primitive condition (Wilson and Regnier, 1971).

CONCLUSIONS

1. The mouthparts of *O. longinoda* are generalized structures that do not depart significantly in morphology from those of other formicine ants.
2. The mouthparts of *O. longinoda* are essentially identical to those of *O. smaragdina*, further supporting, although not proving, the hypothesis that the two are conspecific.
3. Mandibular dentition in combination with midline overlap contribute to the effectiveness of *O. longinoda* mandibles as instruments of prey capture, immobilization, and transport.

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