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Biology and Immature Stages of *Macropis nuda*, Including Comparisons to Related Bees (Apoidea, Melittidae)

JEROME G. ROZEN, JR.[1] AND NED ROBERT JACOBSON[2]

ABSTRACT

The present study treats the following topics pertaining to the life history of the solitary bee *Macropis nuda* (Provancher), the first North American species of the genus to be found nesting: Nest site localities, nest description, nest construction, flower relationships, provisioning, development (including description of egg), larval feeding habits, cocoon construction, defecating pattern, sleeping habits of adults, mating behavior, daily and seasonal activity patterns, and parasitism and predation. Comparisons of these features are made with several Palearctic species.

The life history of this species agrees with accounts of European species in the literature. Several newly discovered characteristics of the cocoon of *M. nuda* correspond well with similar features in other *Macropis* and *Melitta*, but not with *Meganomia* and *Ctenoplectra* of South Africa.

The last larval instar and the pupa are described taxonomically and agree closely with similar stages of other members of the genus.

INTRODUCTION

The present paper reports on the life history of *Macropis nuda* (Provancher) and compares it with that of several Palearctic species of the same genus. The mature larva and pupa are described and compared with those of other Melittidae (Rozen and McGinley, 1974; Rozen, 1977a; Rozen, 1978).

Macropis, consisting of the subgenera *Macropis* and *Paramacropis*, is restricted to the Holarctic Region. *Macropis, sensu stricto*, contains approximately five species in Canada and eastern and northern United States and six or seven species in Europe, Russia, China, and Japan. *Paramacropis* is known only by *M. ussuriana* (Popov) from the Maritime Province of eastern Russia. The distribution of the species has been treated by Popov (1958) and Mitchell (1960). Because of the distinctive anatomical features of adults, the genus has been placed by itself in the Macropidinae. Numerous larval features of *Macropis* are shared by members

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of other subfamilies, but little taxonomic significance can be attached to these similarities, as most are plesiomorphic (Rozen and McGinley, 1974; Rozen, 1977a; Rozen, 1978).

The nesting biologies of only Old World *Macropis* have been described before (Bouwman, 1921; Lieftinck, 1957; Malyshev, 1929; Phipps, 1948). Nests of a North American species were finally discovered on July 13, 1978, when the second author located an extensive nesting site of *Macropis nuda* on the Edmund Niles Huyck Preserve, Rensselaerville, Albany County, New York. It was studied July 13 to 18, 1978, and again July 27 to 29, 1978. Most of this report is based on field observations made at those times, but some additional information was included in the manuscript from field excavations made on the same site by the first author on July 19 and 20, 1979.

We thank Dr. Robert C. Dalgleish, Director of the Preserve, for his hospitality and assistance during the course of this study. The participation of the second author was sponsored by the Reader's Digest Foundation through the Undergraduate Research Program of the American Museum of Natural History.

Collections of immature stages, cocoons, and nest components are in the American Museum of Natural History.

BIOLOGY

DESCRIPTION OF AREA: The Edmund Niles Huyck Preserve is situated in hilly country consisting of old fields and reforested woodlands of mixed hardwoods and softwoods. The nesting site occurred on an embankment along the eastern side of a dirt roadway, approximately 50 m. south of Ordway House, one of the residences at the Preserve. Although the embankment extended nearly 20 m. and may have been used in its entire length for nesting, four major nest concentrations accounting for most of the active nests occupied only a 4 m. stretch in 1978. The same stretch had the most nests in 1979. Nests were on surfaces that sloped approximately 30 to 45 degrees, where the vegetation of mixed herbs and low-growing woody plants provided approximately 60 percent cover. The nests were 0.5 to 1.0 m. from the ditch at the edge of the roadway. A thick stand of young hardwood trees east of the embankment shaded the nest entrances until about noon, after which the bank was fully exposed to the sun. Because road plows pile snow on the embankment, it is snow-covered until April, according to Dr. Dalgleish (personal commun.).

The ground surface was strewn with shale fragments, and outcroppings of the same rock occurred sporadically. Each nest concentration was in moderately fine, well-drained soil containing small roots. The soil at one concentration had few stones compared to adjoining parts of the embankment, whereas soil at another held many stones. Dominant plants in flower along the embankment included: *Apocynum androsaemifolium* L., *Erigeron annuus* (L.), *Chrysanthemum Leucanthemum* L., and *Hypericum perforatum* L. Although abundant in many moist, partly shaded areas in the Preserve, the pollen plant, *Lysimachia ciliata* L., did not occur at the site. A dense stand, visited by *Macropis nuda,* grew 25 m. away, on the west side of the roadway.

DESCRIPTION OF NEST: We excavated approximately 12 nests with care to determine nest structure. At least 10 more were quickly examined and their contents removed for study and rearing in the laboratory. The presence of old cocoons indicated that the nesting site had been used for a number of years, and the site was again fully active in 1979. The smallest aggregation consisted of seven irregularly scattered, active nests in an area 14 × 20 cm. Other aggregations were similar in density, although some contained more nests. All nests (figs. 1–3) were compact and very shallow, the deepest cells being only 6.5 mm. below the surface.

Although some nest entrances were totally exposed, most were partly or wholly concealed next to or under dried leaves, twigs, rocks, projections of soil, and low-growing plants. Tumuli of dry, loose earth occurred on the downhill side of most entrances. Each

nest was inhabited by a single female and no males. Main burrows, approximately 3.0 to 3.5 mm. in diameter and circular in cross section, descended in a meandering fashion and always were unplugged, open, and without a waterproof lining.

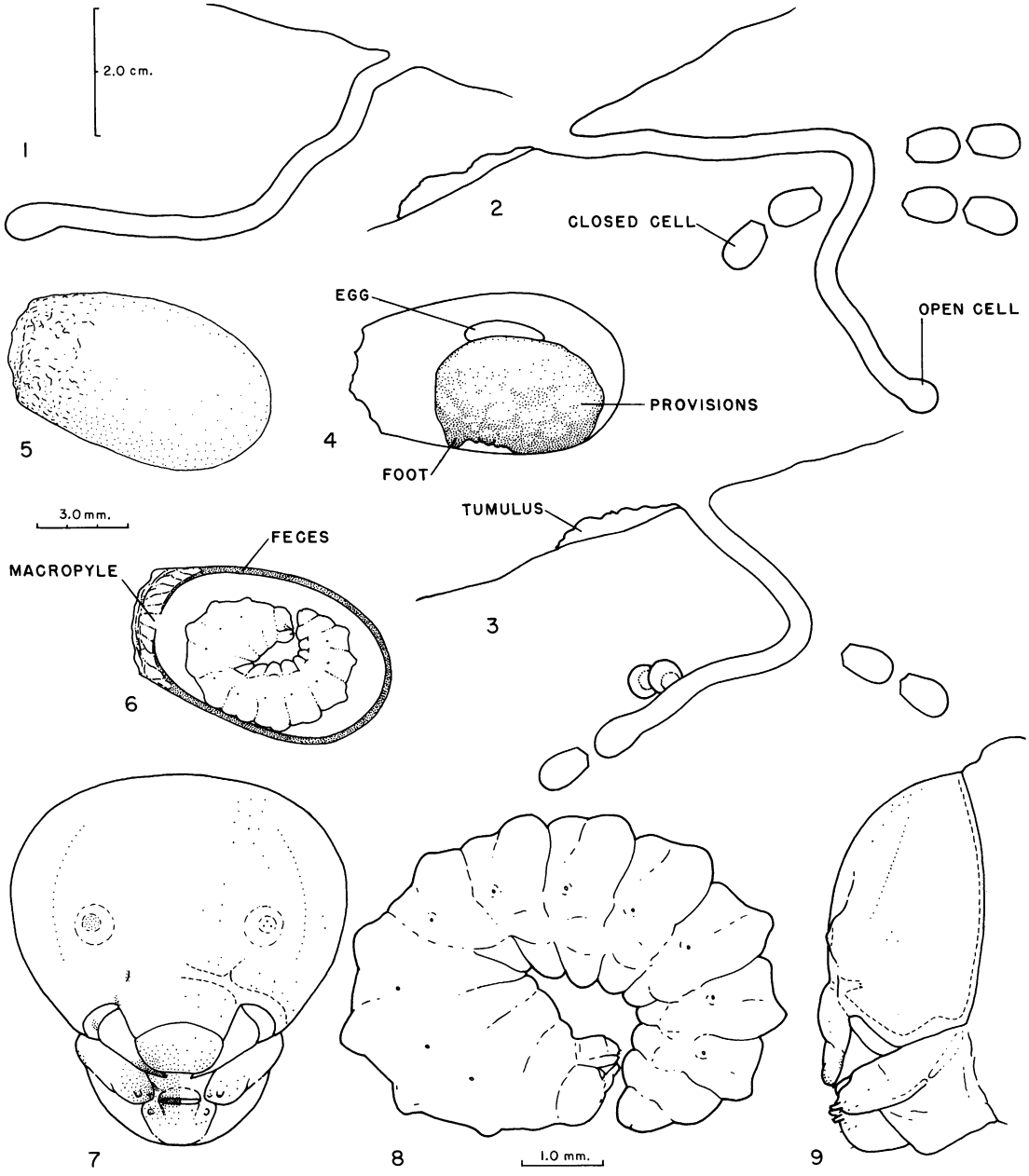
With the exception of one nest in early stages of construction (fig. 1), all nests contained numerous cells (figs. 2, 3). Most cells seemed to be arranged in linear series of two, although a few series of three and four cells were also encountered. Where only single cells were found, the second cell of the series probably had yet to be constructed or the area behind the single cell was occupied by a rock, root, or cell from another nest. In an area 6 cm. square, 25 "active" cells and a number of cells from previous generations were uncovered, all from 2.5 to 6.5 cm. in depth. This surprisingly high concentration was the result of close grouping of nest entrances, short main burrows, cells being near to the main burrows, and cells arranged in linear series. The cell of a series closest to the burrow was approximately 5 mm. from it in all cases, and the short passage leading to the burrow was filled with fine, moderately compact soil. Distances between cells in a series invariably were short, so that the center of the spiral closure was 1 to 2 mm. from the cell in front of it. This passage was also filled with fine, moderately compact soil. Closures were well-defined spirals of fine soil, deeply concave on the inside with about three to four rows to the radius. The closure was not waterproof, in contrast to the cell wall. Sixteen cells each had its long axis ranging from horizontal to tilting about 45 degrees with the front end highest, and cells of a single series usually tilted at different angles. Several cells had the closure end lower than the rear so that the long axis tilted about 20 degrees. Cells (fig. 4) were ovoid, somewhat flatter on the floor than the ceiling, and ranged from 7.0 to 8.8 mm. (five measurements) long and 4.5 to 5.5 mm. (six measurements) in maximum diameter.

The entire inner surface of the cell, except for the closure, was uneven and covered with a rather thick, transparent, waxlike, somewhat shiny coating that had a greenish tinge. A drop of water placed on it did not penetrate to the substrate. The uneveness and greenish hue contrasted markedly with the very smooth, shiny, reddish brown cell lining of an halictine that nested in the same substrate. The darkish transparent coating of the *Macropis* cell melted at a temperature below the boiling point of water. It visibly penetrated the soil surrounding the cell and may have accounted for the cell wall tending to be harder than the soil. The hard cell wall was about 1 mm. thick and occasionally permitted us to excavate cells intact.

We could not determine the sequence of construction of cell series in relation to the main burrow. In some cases, cells with larger larvae seemed to have been connected to the main burrow both above and below cells with younger larvae or eggs. However, all four cells still open and being provisioned when we excavated were the lowest ones in the nests. Clearly a cell was constructed, provisioned, oviposited in, and closed before another cell was started. It is logical that, in a series, the cell farthest from the main tunnel was constructed, provisioned, and closed before the tunnel in front was widened into the next cell. Although most observations corroborated this assumption, larvae in terminal cells of a series in several cases seemed to be associated with larger food masses than the larvae in preceding cells, and consequently, this matter deserves further observation and analysis.

When we visited the site on July 28, 29, 1978, foraging females were no longer seen entering nests, although a few were still visiting flowers. At least some, and perhaps all, burrows were left open, but their entrances quickly eroded and became obscure.

FLOWER RELATIONSHIPS AND PROVISIONING: Females collected pollen from flowers of only *Lysimachia ciliata,* which grew abundantly on the Preserve. They also visited two patches of *Apocynum androsaemifolium* at the two ends of the nesting embankment, but apparently only drank nectar from the flowers or slept in them. Females carried *Lysimachia* pollen on their hind tibiae and basitarsi in the form of very large, moist, yellowish brown masses surrounding the



FIGS. 1–9. Nest components and immature stages of *Macropis nuda* (Provancher). 1–3. Diagrams of nests, side view. 4. Cell with provisions and egg, side view. 5. Exterior of cocoon, side view. 6. Sagittal section of cocoon showing cocoon construction and larva, side view. 7. Head of mature, postdefecating larva, frontal view; pigmentation shown on left, sensilla and internal ridges on right. 8. Live, mature, postdefecating larva, side view. 9. Head of mature, postdefecating larva, lateral view. Scales refer to figures 1–3, 4–6, and 8, respectively.

segments. As reported by Vogel (1976), the liquid providing the moisture is an oil gathered from the flower.

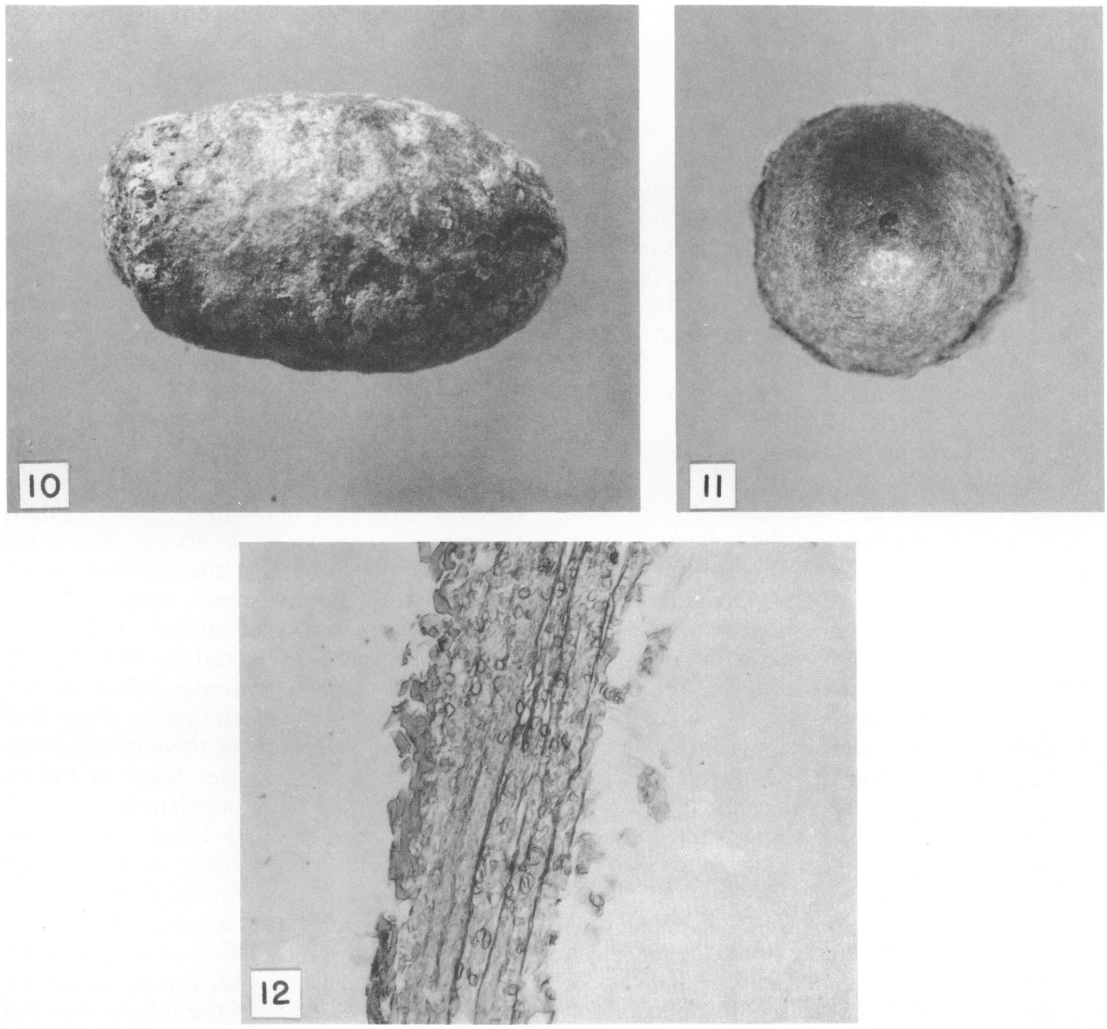
Provisions (fig. 4) were formed into elongate, ovoid loaves which were basically consistent in shape from one cell to the next. However, the entire surface, but particularly the bottom part of each loaf, was remarkably irregular, and the degree of uneveness varied from loaf to loaf. So irregular were the surfaces that we had to examine a number of food masses before we realized that indeed they had a basic, uniform shape. Each loaf had a downward projecting foot at the front end and was 5.0 to 5.5 mm. long (five measurements), 3.4 to 4.0 mm. high (five measurements), and 3.5 to 4.0 mm. wide (two measurements). The food mass (fig. 4) was placed toward the back of the cell so that the rear of the mass rested on the bottom rear of the cell and the foot touched the cell floor in front. The surfaces of the provisions were semi-shiny and often had short mold hyphae growing from them by the time of eclosion. The provisions were mealy-pasty moist throughout. Their overall shape was surprisingly similar to that of the unrelated *Exomalopsis* (Rozen and MacNeil, 1957 and Rozen, 1977b), although the very smooth *Exomalopsis* provisions contrasted sharply with the uneven ones of *Macropis*.

Food masses placed in water did not "dissolve," but remained intact and unaltered for more than six hours, probably an indication that the food is a mixture of oil and pollen. Furthermore, the taste of the food was not sweet. Chemical analyses should be conducted on the food mass to confirm that oil and not nectar, or a combination of both, is the moistening substance.

DEVELOPMENT: All eggs (fig. 4), 2.3 to 2.9 mm. long and 0.50 to 0.55 mm. in maximum diameter (three measurements), were on the anterior top of the pollen masses, in the sagittal plane of the cell. Each was curved, translucent white, and possessed a thin, shiny chorion. Its front end was closest to the cell closure; the posterior end tapered gradually and was somewhat more pointed. All but last stage larvae crawled slowly as they fed on the surface of the provisions for young larvae of various sizes were discovered on the top, on the sides, and even under the provisions. They did not make a groove in the provisions, as do those of *Diadasia* and *Exomalopsis*. Partly eaten provisions were smoother than fresh, uneaten ones. Last instars, but not earlier instars, encircled oblong, flattened masses of provisions, which no longer contacted the cell wall. Last, penultimate, and perhaps younger larvae chewed into food masses with fast, strong biting action of their mandibles, in contrast to certain bee larvae (e.g., *Protepeolus*, Rozen, Eickwort, and Eickwort, 1978) that "shave" the food mass with partly closed mandibles. The larval feeding period is short, probably about two weeks, judging from how quickly partly grown larvae matured when brought to the laboratory and from the fact that whereas only a few cocoons were encountered on July 16, most larvae (43 out of 57) collected on July 28, 1978 had started cocoon-spinning. When starting to spin, larvae also discharged watery fecal material, although most of the meconial mass was voided after the outer layer of the cocoon had already been constructed.

Cocoons (figs. 5, 6, 10–12) completely occupied the cells and assumed the exact shape of the cells with the exception of the cell closure. Freshly constructed cocoons strongly adhered to the cell surface, but not to the closure, so that when excavated, sections of cell wall were bonded to the fabric. The outside of the cocoon, with soil removed, was dark brown. At least some cocoons were truncate at the front end, indicating in these cases that the fabric did not touch the apex of the closure. Cocoons spun in artificial containers in the laboratory conformed to the shape of the container. Hence, the shape and size of the cocoon in the ground is determined by the configuration and dimensions of the cell, a situation that probably holds for most, but not all, cocoon-spinning bees.

From the outside, the front one-quarter of the cocoon and the rear three-quarters had different textures. The rear three-quarters consisted of dense, parchment-like fabric



FIGS. 10–12. Cocoon of *Macropis nuda* (Provancher). 10. Cocoon, side view. 11. Front end of cocoon showing macropyle in center, inner view. 12. Microscopic section of fabric from the rear of cocoon showing dark, coarse fibers of exterior layer on left next to middle layer of light gray, granular, vacuolate pollen (feces), separated by thin lines of dark sheet silk; inner layer of cocoon not clearly defined in this preparation.

with the silk fibers matted and without conspicuous openings between the fibers. The silk fibers of the front one-quarter were much less dense and not matted so that many spaces occurred, giving the fabric a soft, spongy appearance.

In longitudinal section (fig. 6) the casing of the rear three-quarters of the cocoon was approximately 0.1 to 0.2 mm. thick, and consisted of three main layers. Beneath the outer layer of parchment-like fabric, the middle layer seemed to be a thin stratum of feces which, when sectioned and examined with a compound microscope, actually consisted of a number of thin strata of feces separated by fine sheets of silk (fig. 12). The innermost layer of the cocoon was a thin deposit of mostly fibrous silk. These three main layers

indicated that larvae (1) first spun the outer layer (2) then smeared most of the meconial mass onto it, spinning sheets of silk at the same time, and (3) finally, after voiding the feces, fabricated the inner silken layer. The feces were applied as long smears, parallel to the longitudinal axis of the cell, for when the cocoon was viewed with transmitted light, the elongated streaks of feces could be detected, particularly toward the rear end of the cocoon where the feces were less dense and the casing was consequently less opaque. The feces, when extruded in large containers in the laboratory, were simple elongate pellets, so that the parallel fecal smears in cells are determined by the motions of the larva in relation to the size and shape of the cell.

The fabric of the front one-quarter of the cocoon was different from the rest of the cocoon, as viewed in cross section. Although grading into the rear part of the cocoon, it was much thicker and much looser in construction at the very front and was composed of several layers of fenestrated, loose, sheetlike webbing arranged as in figure 6. Its innermost layer, identical with and a continuation of the innermost layer of the rest of the cocoon, was a dense fabric. The very front end of this layer exhibited a large circular opening, the macropyle (figs. 6, 11), approximately 0.5 mm. in diameter. This aperture, present in all cocoons examined, as well as those of some other melittids (see below), suggests this hypothesis: The exchange of oxygen and carbon dioxide through the thick, waxy cell lining and a dense cocoon fabric may be limited, and, therefore, most of the exchange takes place through the unwaxed cell closure and the macropyle and loose outer webbing next to the closure. The webbing might also serve as a filter, barricading the *Macropis* against potential parasites and predators.

With the exception of the macropyle, the entire inner surface of the cocoon consisted of fine, brown, closely appressed fibers and also some cellophane-like silk (fig. 11) that provided an irregular, glistening appearance. The surface was faintly shiny, not polished. At the rear of the cocoon the inner fabric was coated with an irregular thin blotch of white material, apparently the final meconial discharge.

The cocoon fabric was strong and difficult to tear with forceps. Although the front end seemed to be softer and therefore more fragile than the rear part, it was structurally stronger, resisting denting more readily.

ADULT ACTIVITY: Adults, on sunny days, became active in the morning around 10 A.M. and continued foraging and mating until approximately 6 P.M. Both males and females slept on the flowers of *Apocynum androsaemifolium* that grew abundantly in two patches at both ends of the nesting embankment. They assumed various sleeping postures, some grasping the top of the nodding corolla, others clinging upside down to the rim of the corolla, and still others inserting part of their body into the corolla. A number of adults were also seen sleeping on top of the upright floral heads of *Erigeron annuus*. *Macropis* slept only on those plants near the nesting site, although we did not check to determine whether they slept on the *Lysimachia ciliata,* which occurred elsewhere. Perhaps one method of discovering future nesting sites of this or other species of *Macropis* is to search in the vicinity of numerous individuals sleeping on flowers. Females with established nests were presumed to spend the night in them as more males than females slept on flowers. Males were not seen searching for places to sleep on the nesting surface, in the evening.

During the warm part of the day males were observed both at the *Apocynum* patches and on *Lysimachia,* flying swiftly over and among the inflorescences. Their flight was swifter than that of foraging females. Encounters of couples occurred on both *Lysimachia* and *Apocynum*. Although too short to be observed carefully, the encounters were presumed to be matings. The couples do not produce any form of sound, as has been reported for *Meganomia* (Rozen, 1977a), and neither females nor males have pregradular stridulatory areas, as do *Meganomia*. In several cases males quickly approached the females on the flowers. Almost as soon as they clasped, they became dis-

lodged from the flowers and separated in air or dropped to the vegetation below, where they immediately separated. The entire process took a second or two. Males did not search for females by flying over the ground at the nesting embankment, nor were copulations observed there.

Females carrying full loads of pollen occasionally landed on horizontal leaves in the vicinity of the nesting site, where they groomed themselves. Some females flew directly to their burrows and entered immediately, whereas others appeared to be disoriented and took considerable time searching out the nest entrance.

Presumably both males and females nectared on *Apocynum* at the vicinity of the nesting site. Males were not seen to land on the flowers of *Lysimachia*.

SEASONAL ACTIVITY: As no pupae were encountered when we excavated, and all nests contained active larvae or ones just starting diapause, the population at this site clearly had only one generation a year. This was confirmed by the fact that both bee activity and flower abundance were greatly reduced on our visit of July 28–29, 1978, and that all live larvae brought into the lab were, or soon became, dormant. Two of the larvae in the laboratory pupated on March 27 and 31, 1979, but, as of August 2, 1979, 22 of the 27 remaining larvae were still alive and dormant, and three had died in their cocoons. As this date was toward the end of the 1979 flight season, we conclude that breaking diapause is controlled by some environmental factor that had not been generally met in the laboratory. Interestingly, 22 larvae in the laboratory were in cocoons, and the two pupae had emerged from the five naked larvae that either had been removed from the casing or had spun incomplete cocoons in the bee-rearing dishes. This suggests that the unknown factor breaking diapause may be influenced by cocoons. The entire period of adult activity presumably extended for about a month.

PARASITISM AND PREDATION: Adults of the bee genus *Epeoloides,* almost certainly cleptoparasitic on *Macropis,* were not found at the nesting site, and none was collected in the area in 1978 and 1979. Bombyliids were infrequently seen at the site and no larvae were noticed in the cells. Meloids were not found in association with these bees. Some cells were moldy, but whether this was the cause or effect of the immatures dying is unknown.

BEHAVIORAL COMPARISONS IN *MACROPIS*

Although the preceding account of the biology of *Macropis nuda* is the first for a North American species of *Macropis,* Malyshev (1929) presented an informative report on the nesting biology of *M. fulvipes* (Fabricius). Observations on the life history of *M. europaea* Warncke [as *labiata* (Fabricius)] have been given by Bouwman (1921), Lieftinck (1957), Malyshev (1929), and Phipps (1948).

The nesting biologies of these three species (*nuda, fulvipes,* and *europaea*) are quite uniform. All nest in the ground and apparently prefer banks. The nature of the soil in the various accounts varies from fine sand (*europaea,* Phipps, 1948) to "rich in rotten dung" (*europaea,* Malyshev, 1929) to stony (*nuda,* present study). Nests tend to be constructed close to the pollen source (various species of *Lysimachia* in all cases). At least *nuda* and *fulvipes* tend to nest in small aggregations and occupy the same site over a number of years. Nest entrances may be hidden by objects on the ground, and the surface of the nesting site tends to be partly covered with moss or other low vegetation. Tumuli of unconsolidated earth are usually situated either on the downhill side of nest entrances or surround nest entrances (*europaea,* Phipps, 1948) if the slope of the surface is shallow. Presumably the main tunnel is open in these three species, although the literature is not explicit. Nests are shallow with main tunnels traveling considerably horizontally. Cells of *nuda* and *fulvipes* are usually in linear series of two; cell arrangement of *europaea* as depicted by Malyshev (1929, fig. 6) and reported by Lieftinck (1957) is single.

Malyshev reported the cells of *fulvipes* to be slightly inclined, but the inclination of those of *nuda* is quite variable, as described above. The greenish, waterproof, waxy, uneven lining covering the entire cell surface is characteristic of these three species, as is the non-waxy, distinctly spiraled and deeply concave cell closure.

Provisions were described and pictured as sticky or moist ovoid loaves for the European species, and no mention was made of the foot at the front end, characteristic of *nuda*. Malyshev (1929) indicated that the loaf of *fulvipes* was smooth on top and rough on the bottom, a description suggesting that the provisions of *fulvipes* are smoother on the top than those of *nuda*. However, even with *nuda* the upper surface is smoother than the bottom. Because of its proximity to the rough lower surface of the provisions, the foot may well have been overlooked by the European workers. At least with *nuda* and *fulvipes* the provisions are placed to the rear of the cell. Eggs of all species are on the top of the food mass, somewhat front of center. Phipps's (1948) account of the egg of *europaea* "attached to the side of the cell" probably refers to an egg that had been dislodged during excavation, for it does not agree with other published accounts for this species. With these three species, and probably all others in the genus, females transport the moistened provisions as large masses surrounding the hind tibiae and basitarsi.

The literature does not give detailed accounts of the activities of feeding larvae, but various pictures and descriptions suggest that the European species, like *nuda,* crawl as they feed, and when large, encircle the provisions. All three species spin cocoons, which externally have the front one-quarter to one-third composed of fibers that are less dense and looser than those of the remainder of the cocoon, as evidenced by Malyshev's (1929) pictures of the cocoon of *fulvipes* and by specimens of *euorpaea* kindly sent to the first author by Dr. M. A. Lieftinck of Holland. Cocoons of *europaea, nuda,* and probably all other *Macropis* possess a macropyle in the inner layer of the front end. The cocoon fabric (except at the front end) of *europaea,* like that of *nuda,* is composed of two layers of silk with a middle stratum of feces. Also, like that of *nuda,* the fecal stratum may contain sheets of silk that are not visible except if sectioned. Malyshev (1929) reported that the cocoon is "feebly glued" to the walls of the cell and "can be easily extracted," and shows the cocoon fabric free of soil. Cocoons of *europaea* sent to Rozen by Dr. Lieftinck likewise are free of soil. Hence, these two European species differ from *nuda* in that its cocoon adheres closely to the cell wall so that the soil can be removed only with considerable scraping and chipping.

Males of both *nuda* and *europaea* sleep on flowers, and the females presumably sleep in their nests. The mating and premating behavior of these two species is apparently the same in that males search for females on the flowers and copulating pairs fall to the ground. Lieftinck (1957) suspected that only females without pollen will copulate.

COMPARISON OF COCOONS IN THE MELITTIDAE

Larvae of the Dasypodinae do not spin cocoons, whereas those of Melittinae (*Melitta, Meganomia*), Macropidinae (*Macropis*), and Ctenoplectrinae (*Ctenoplectra*) do. Comparisons of the cocoons of *Macropis* with those of other melittids in the American Museum of Natural History show some interesting similarities and differences. Cocoons of the European *Melitta leporina* (Panzer) are of the same general type as those of *Macropis,* in that the front part consists of loose fibers, whereas the rear part is more parchment-like and in cross section is composed of three apparent layers. They differ from those of *Macropis* in that they are medium tan rather than dark brown. The loose fiber at the front end is finer, and the macropyle, while conspicuous, has a more poorly defined shape, probably because the inner fiber of the cocoon is thinner. No soil adheres to the cocoon of *Melitta leporina.*

The cocoon of the African *Meganomia*

binghami (Cockerell)[3] described and figured by Rozen (1977a), like the cocoons of *Macropis* and presumably *Melitta*, occupies the entire cell and assumes the shape of the cell. It consists of only two layers, the outer one a dull reddish brown fiber that is coarser than the fibers of *Macropis* and *Melitta* and an inner layer with a shiny brown surface. Feces (although not found) are not incorporated into the cocoon, and the outside fabric at the front is not different in appearance from the rest of the cocoon. The fabric of the whole cocoon is sufficiently loose that it has numerous small fenestrations. There is no macropyle.

Rozen (1978), reporting on the cocoons of the African *Ctenoplectra armata*, stated that the fabric apparently consists of two laminate layers and incorporates no feces. It is colorless, semitransparent to completely transparent, and is smooth and glistening where appressed to the cell wall and highly polished where covering the feces. A single specimen with the front end intact, in the collections of the American Museum of Natural History, has no macropyle.

DESCRIPTION OF IMMATURE STAGES OF *MACROPIS NUDA* (PROVANCHER)

Mature Larva

Figures 7–9

The mature, postdefecating larva of *Macropis nuda* is essentially identical with that of *M. europaea*. The following description primarily addresses matters that were overlooked in the description of *europaea* rather than features whereby larvae of the two species differ. *Macropis nuda* tends to be smaller than *europaea*.

Head (figs. 7, 9). As described for *Macropis europaea* (Rozen and McGinley, 1974; Rozen, 1978) except for the following: Pigmentation on uncleared head evident on mandibular articulations and hypopharyngeal sclerites; following areas slightly pigmented: Antennal papillae, apex of cardines, anterior part of labrum, and apex of labial maxillary region, including palpae; pigmentation of head capsule of this species not significantly different from that of uncleared head capsule of *europaea*. Anterior tentorial pits situated somewhat higher above epistomal suture than in *europaea*. Vertex somewhat less produced on each side than in *europaea*. Area immediately behind posterior mandibular articulation as in *europaea*, i.e., not projecting and not beset with numerous sensilla, as is the case with *Meganomia binghami* (Rozen, 1977a). Labroclypeal suture not significantly different from that of *Macropis europaea* in spite of illustrations. Maxillary palpus slightly smaller in relation to rest of labiomaxillary region than in *europaea*; galea with one or two setae. Labial palpus perhaps slightly longer than maxillary palpus.

Body: As described for *europaea* except for following: Integument nonspiculate except for following areas: Each pronotal dorsal tubercle with very few, very fine, scarcely noticeable tubercles at apex; meso- and metathoracic dorsal tubercles each with patch of fine spicules; dorsal tubercles on abdominal segments I through VIII each with patch of fine spicules at apex; dorsum of abdominal segment IX with patch of fine spicules on each side extending almost to median line; abdominal segment X with dorsal surface mostly spiculate up to but not including perianal area; integument of body with very short, scattered inconspicuous setae (contrary to description in Rozen and McGinley, 1974, *europaea* with spicules and setae as described for *nuda*).

Material Studied: More than 12 postdefecating larvae, alive and preserved, Huyck Preserve, Rensselaerville, New York, July 16–29, 1978 (J. G. Rozen and N. R. Jacobson).

Pupa

The female pupa of *Macropis nuda* is nearly identical with that of *M. europaea*. A de-

[3] Charles D. Michener (personal commun.) has informed us that *Meganomia binghami* referred to by Rozen (1977a) is actually a new species, similar in appearance to true *binghami*. Michener plans to provide a description and a name in the near future.

scription of the latter (Rozen and McGinley, 1974) characterizes both species and no significant differences could be detected in comparing specimens of both species side by side.

MATERIAL STUDIED: Two females, Huyck Preserve, Rensselaerville, New York, collected as larva July 16, 1978 (J. G. Rozen and N. R. Jacobson), pupated in laboratory March 27, 31, 1979.

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