Mass aggregations of Idia moths (Lepidoptera: Erebidae) inside hollow trees in Florida

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Abstract: Large aggregations reaching over 400 individuals of adult Idia moths were observed and photographed inside two hollow trees in different localities in north central Florida between 2010 and 2018. A species of litter moth similar to Glossy Black Idia, *Idia lubricalis* (Erebidae), formed what appeared to be monospecific diurnal roosts consisting of both males and females. While this moth's caterpillars are known to be detritivores, no signs of immature stages or byproducts of larval feeding were found. The uniform orientation of the moths away from the entrance, fluctuation in their numbers, the higher concentration of the moths near the entrance, and the fact that aggregations were found throughout the summer regardless of the weather, suggest that they are formed on the daily basis perhaps using sex pheromones as cues. No mating was observed despite repeated observations at different times of the day, ranging from dawn to dusk. Hence, the exact function(s) of the observed behavior that is akin to the diurnal roosting of bats is yet to be determined.

INTRODUCTION

While mass aggregations are not uncommon among insects, in Lepidoptera such examples are few and for the most part well described in the scientific literature. For instance, among nymphalids, well known and described are aggregations of monarchs and their danaine relatives that overwinter in clusters (e.g., Kitching & Zalucki, 1981; Ivie, 1990; Malcolm & Zalucki, 1993; Shirai *et al*., 2017). In the same family (genera *Heliconius*, *Marpesia*, *Hamadryas*), and in one species of skipper (Hesperiidae), *Celaenorrhinus fritzgaertneris*, nocturnal roosts have also been documented (e.g., Benson & Emmel, 1973; Brown, 1981; DeVries *et al*., 1987; Sourakov, 2007). There are also some aggregations of Lepidoptera that are known, but yet to be well documented in the scientific literature, such as aggregations of hundreds of *Eumaeus childrenae* lycaenids on rocks in Mexico (Conrad, 2007).

Less is known about mass aggregations among adult moths. *Euplagia quadripunctaria* (Erebidae), a day-flying tiger moth, can be found aestivating while sheltering from the summer heat in Petaloudes, on Rhodes, Greece (Walker, 1966). Among nocturnal moths, the Australian *Agrotis infusa* (Noctuidae) migrates to and from the Australian Alps, where it gregariously aestivates during the summer before returning to the breeding grounds in autumn (Common, 1954). Occasionally, moths can appear to be aggregating following emergence from a communal nest, as is the case in *Anaphe* sp. (Notodontidae) (Akai *et al*., 1999).

Here, I report what appears to be a gregarious diurnal roosting behavior inside hollow trees in *Idia* moths (Erebidae), which I observed on several occasions in two different locations in north-central Florida between 2010 and 2018.

Fig. 1. Large aggregation of over 400 moths of the Glossy Black Idia *Idia lubricalis* species complex found inside a large hollow Southern Red Oak in San Felasco State Park, Alachua, Florida. The photograph was taken with a 28 mm lens and flash, with the camera placed at the bottom of the tree, at 20:30 on 8th July 2018.

Fig. 2. Aggregation of Glossy Black Idia *Idia lubricalis* complex, inside a hollow oak tree, San Felasco State Park, Alachua, Florida; 19th-20th May 2018.

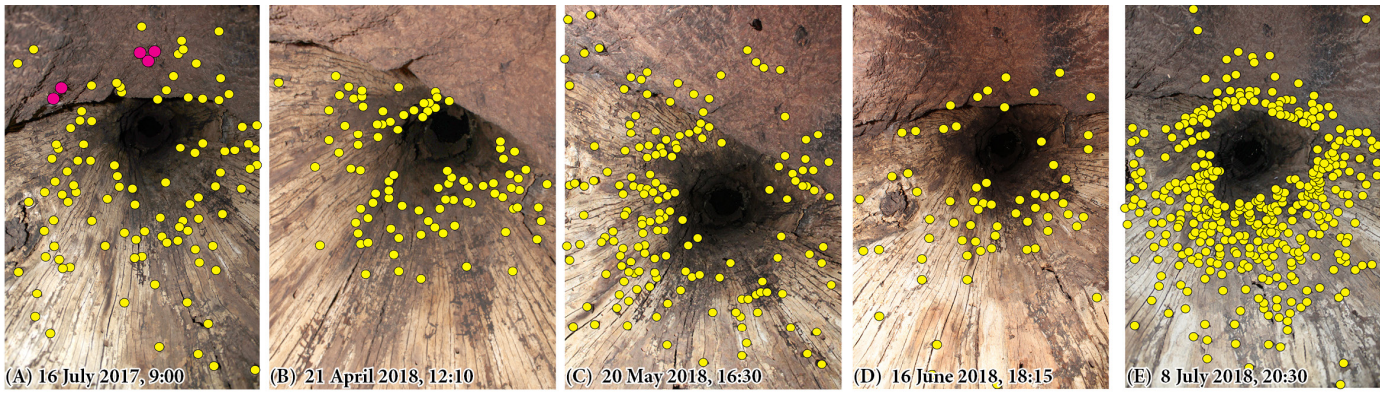

Fig. 3. Change in position and numbers in the aggregation of Glossy Black Idia moths inside a hollow oak tree, San Felasco State Park, Alachua, Florida at different times of the day and seasons (pink dots in (A) indicate mating pairs of walking sticks (Phasmatodea)). The numbers of moths fluctuated with the season typically of the moth fauna in the region in general: (A) & (B) Over 100; (C) Over 160; (D) Over 64; (E) Over 400.

OBSERVATIONS

In the last few years, on dozens of occasions, I explored the insides of hollow trees in two habitats in Florida, with the help of a Canon DSL Rebel camera equipped with a 28-55mm zoom lens and built-in flash. On several occasions in two different trees, including a Sweetgum located in the Natural Area behind the Florida Museum of Natural History on the University of Florida campus in Gainesville, and a Southern Red Oak located on a bike trail at San Felasco State Park near Alachua, these photographic explorations yielded photos of mass aggregations of *Idia* moths (Lepidoptera: Erebidae).

The tree at San Felasco, an extremely tall *Quercus falcata*, 1.5 m in diameter, where the aggregations were much larger (Fig. 1), was surveyed for the first time on 16th July 2017 and again on 21st April, 19th, 20th May, and 6th, 15th -16th June, and 8th July 2018. The same tree was also photographed on 31st March 2018, but was devoid of moths, probably because it was prior to their known period of emergence. On all occasions, moths were oriented with their head towards the top of the tree, indicating negative phototaxis. Some moths were fresh, but other were worn (e.g., Fig. 2), indicating that they were likely returning to the site rather than emerging nearby. The caterpillars of this species are known to be detritivorous, but no frass or any signs of immature stages were discovered inside the tree.

The tree was examined shortly after sunrise, in the middle

Fig. 4. Southern Red Oak in San Felasco State Park, Alachua, Florida at the time of the large aggregation (over 160 Glossy Black Idia moths) inside it that can be partially observed from the outside. 19th May 2018, 07:30.

of the day, and after sunset, but the behavior of the moths did not appear to be drastically different, with the exception that the noon observation of 21st April had the moths positioned further from the entrance than during either of the two morning observations or the four evening ones (Fig. 3). In fact, the moths observed on 19th-20th May and 8th July, immediately after sunrise and shortly after sunset during very overcast days, were visible from the outside through the opening into the hollow (Fig. 4). While on the first two occasions when this tree was examined (16th July 2017 and 21st April 2018) there were approximately 100 moths visible in the photographs, by 19th-20th May 2018 (after the rains arrived and it was overcast and humid for a week) the number of moths increased to 160, dropped to 64 by 15th June and rose again to over 400 by 8th July (Fig. 3). Numerous spiders were observed by 15th June to have set up their webs at the entrance as well as deep inside the tree. Other animals observed inside the tree include wood

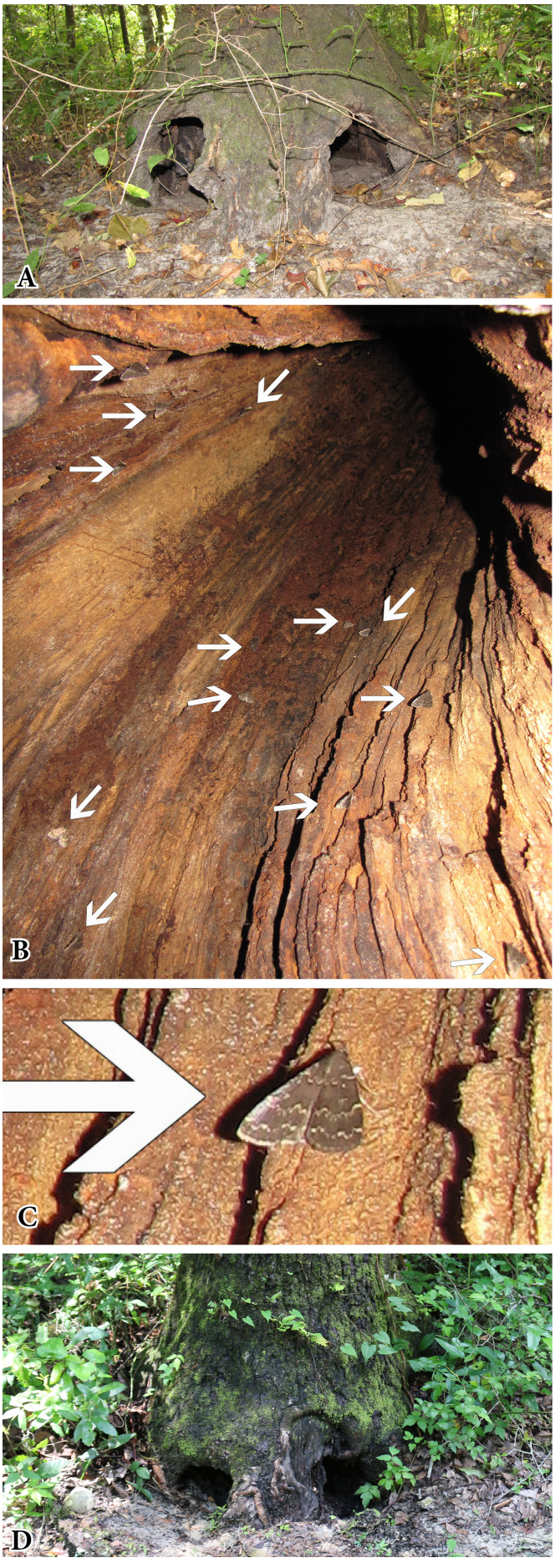

Fig. 5. A Sweetgum tree on the University of Florida campus, Gainesville; (A-C) on 22nd September 2010, when a small aggregation of Glossy Black Idia moths was found inside it and (D) on 18th May 2018, when no moths were observed.

roaches *Eurycotis floridana*, walking sticks *Anisomorpha buprestoides*, and mosquitoes.

In the 2010 observation on the University of Florida campus, the aggregation was much smaller - 12 moths were counted in a single image (Fig. 5A-C). Since then, the hollow tree in question, a 1 m diameter *Liquidambar styraciflua*, has undergone a change in morphology (Figs. 5D), with openings into the hollow mostly covered by soil, and the inside of the tree becoming moist and covered with fungus, unlike the hollow of the oak in San Felasco, which is dry, smooth and clean inside. Possibly due to this change, no moths were discovered inside the Sweetgum tree in May 2018.

DISCUSSION

Idia moths belong to the group known as litter moths (Herminiinae) and, as caterpillars, they consume organic matter including litter inside animal nests (e.g., Wagner *et al.*, 2011). As caterpillars, they “shun light” according to Wagner *et al.* (2011). It appears that the moths in my observations can be identified only as the "*Idia lubricalis* complex"; according to Wagner *et al.* (2011: 41), DNA “barcodes of eastern collections segregate into at least four distinct groupings (JBS) – it seems certain that more than one species is going under the name *lubricalis*..”.

The presence of the moths, all seemingly of the same species, in such high numbers, can hardly be explained by the proximity of the hostplant, as it appears that the caterpillars are highly opportunistic. While lekking could be an explanation (both sexes appear to be present based on the shape of the abdomens in some photographs), no mating was observed. Instead, it is more likely that these observations capture diurnal roosts. While pheromone studies would be the only way to confirm or reject such a hypothesis, it is possible that both males and females of *Idia* discussed here can detect their own pheromones and use them as an aggregation signal; the above-mentioned *Euplagia quadripunctaria*, which aggregates in huge numbers, is capable of pheromone autodetection in both sexes (Schneider *et al.*, 1998).

The change in abundance of moths likely reflects the normal seasonal fluctuation of moths in this part of Florida, where during the summer many moths show three distinct peaks in their abundance (May, July, September) which possibly correspond to three generations (Sourakov & Austin, unpubl. data).

The fact that Idia have developed such behavior among all the many moth species found in Florida is not surprising, as the genus includes some very specialized species that have a strong affinity for confined spaces; one species in the genus is thought to live in pack rat nests, while another is believed to develop exclusively within gopher tortoise and armadillo burrows, where its caterpillars feed on scat or the fungi growing on scat (Wagner *et al.*, 2011).

The phenomenon described here may be of interest for further in-depth investigation, including the function by which the roosts are formed, how widespread is the phenomenon, the species involved and the seasonality. Observations of over a hundred moths inside the trees representing the same species complex suggests that this is a specialized behavior. However, the fact that I found this phenomenon only twice among the many (likely over 30) hollow trees that I examined over the years suggests that such investigation will not be easy.

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