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Studies on Nesting and Hunting Behavior of *Pison punctifrons* Shuckard, 1838 and *Sceliphron madraspatanum* (Fabricius, 1781) (Apoidea: Hymenoptera: Insecta) in Dehradun, Uttarakhand, India

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ABSTRACT: The studies on nesting and hunting behavior of *Pison punctifrons* Shuckard, 1838 and *Sceliphron madraspatanum* (Fabricius, 1781) has been conducted in Dehradun, Uttarakhand, India during 2019-21. Both species of wasps constructed their nests in pre and early monsoon period in the safest places away from rain and sunlight. Wasps carry moist soil with their mandibles, jaws and forelegs to the nest site and fix it to the solid surfaces. *Pison punctifrons* pushes the soil inside the cell by their legs and use their abdomen to give shape to the nest. The female spent maximum time inside the nest during whole process of nest building, occasionally comes out to do inspections and constructed three to five cells within one nest. In the *Sceliphron madraspatanum* wasps the female had constructed one cell and filled it up with spiders and sealed it after egg-laying. The observations recorded that both wasps are parasitoid by nature they raised their young ones on the diet of paralysed spiderlings and complete its life cycle in the nest. Each cell is sealed off from adjoining eggs with mud or pellets. This complete sealing off cells from each other is most probably done to avoid competition between young ones for sufficient food. The shape, size, number of cells in the nest and numbers of eggs vary within one species. This behavioral studies are not only useful for the ethological aspects but also useful for the species recognition. Till now a meagre work has been done on behavioral aspect globally and the present study will provide data for future analysis in behavioral and taxonomical studies.

Keywords: Nesting behavior, *Pison punctifrons, Sceliphron madraspatanum.*

INTRODUCTION

The Superfamily Apoidea of Hymenoptera has been composed of two important groups Apiformes and Spheciformes; bees come under Apiformes, wasps in Spheciformes. The Spheciformes (Apoid wasps) forms a large part of the aculeate Hymenoptera. Apoid wasps closely related to the wasps also have bees like characters, and are placed with them in the superfamily Apoidea. Apoid wasps are morphologically, behaviorally, and ecologically diverse group of insects those are common in many habitats (O'neill, 2008). Like bees and ants of Hymenoptera, wasps are also important part of the insect fauna of the world. Wasp are pollinator of many wild and cultivated plant species and are part of other important services to ecosystem. The biodiversity of these insects threatened by increasing habitat degradation, habitat fragmentation and agricultural intensification that includes the loss of natural and semi natural habitats and extensive monoculture practices. They balance the ecosystem as they feed on the other small creatures and being eaten by birds, lizards, ants and other living organisms. However, we still have a very little information regarding apoid wasp's species behavior and on their life-spans.

The present study was conducted on two parasitoid solitary-venomous apoid wasps species i.e. Pison punctifrons Shuckard, 1838 and Sceliphron madraspatanum (Fabricius, 1781) to study the behavioral patterns, land approaches and their requirements to form nest. Perusal of literature had revealed meagre information on Apoid wasp's studies. However, the efforts were made to study available information on Apoid wasps conducted throughout the different parts of the World by Goulet and Huber (1993), Michener (2000); Melo Gar (1999) worked on the phylogenetic relationship of Sphoid wasps and behavioral patterns; Evans and O'Neill (1988) did the study on the behavior of North American beewolves

with respect to their parasitoid behavior. In India previously work on this group has been done by Bingham, (1897).

MATERIAL AND METHODS

The study was conducted in the combined campus of Zoological Survey of India, Botanical Survey of India and Anthropological Survey of India (30.345570N, 78.013268E), Dehradun, Uttrakhand, India during October, 2019 to November, 2021. The campus has rich diversity of wild and cultivated plants. There are two types of habitats within this campus; the broad leaves trees, shrubs are in forest habitat and cultivar plants species with in civilized habitat. The nests were only reported near the civilized and within civilized habitat away from rain and sunlight. The behavioral studies completely based on the field observations; the behavioral studies conducted during their breeding months in the pre-monsoon and monsoon season (June-August during 2019-21) when wasps were busy in building their nests and selecting preferable sites for the nest constructions. The observations made during some selective hours between 10am to 03pm, when wasps were active.

The unidentified wasps were caught in the field by using Insect net and after taking photographs, observation and identification of the species, the live individuals were released. The very few selected unidentified individuals of wasps were collected and transferred into insect collection paper packs and were brought to the laboratory and identification of the collected specimens was carried out using identification keys provided by Bingham, (1897). For the identification of specimens, the stereomicroscope Luxeo 4Z was used. After identifications the specimens were preserved in National Zoological Collections of Northern Regional Centre, Zoological Survey of India, Dehradun.

RESULTS

The studies on nesting and hunting behavior of *Pison punctifrons* Shuckard, 1838 and *Sceliphron madraspatanum* (Fabricius, 1781) (Apoidea: Hymenoptera: Insecta) in Dehradun, Uttarakhand, India was conducted during 2019-21.

Pison punctifrons Shuckard, 1838, the adult head and thorax structures are granular and closely punctured; the deep groove present behind the ocelli head (Bingham, 1897). The forewing of *Pison punctifrons* Shuckard, 1838 have three sub-marginal cells, two submarginal cells are larger as compare to the third cell (Fig. 1). Entire body colour is black having silver trichomes patches present on head below the eyes and on the clypeus region as well on the apical margins of abdomen; those are visible when wasp comes in contact with light. The *Pison punctifrons* undergoes complete metamorphosis (holometabolous); having four different phases of post-embryonic developments *i.e.* Egg, Larva (Fig. 3), Pupa (Fig. 4) and an Adult (Fig. 2). The complete transformations from an egg to an adult take place within the nest.

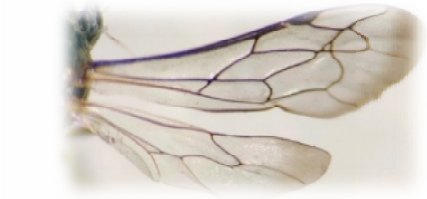

Fig. 1. Wings of *Pison punctifrons.*

Fig. 2. Lateral view of *Pison punctifron.*

Fig. 3. Larva of *Pison punctifrons.*

Fig. 4. Pupa of *Pison punctifrons.*

Sceliphron madraspatanum (Fabricius, 1781), the adult head finely and closely punctured. Clypeus black in colour and sides of the face in front covered with a short fine silver hair; a spot on the apex of the scape of the antennae, bases of the femora, and of the tibiae of the posterior legs, and the petiole of the abdomen, yellow; wings hyaline and iridescent, with a brownish tint. Front pronotum, mesonotum, and median segment finely and transversely, and scutellum and post scutellum longitudinally striated (Bingham, 1897).

A. Nest-Construction and Architecture

Both species of wasps have constructed their nests in pre and early monsoon period in the safest places away from rain and sunlight. Newly built as well as old empty nest were also studied to understand the patterns of nest formation, nest location, shape and size. These species of wasps form mud-nests structures over the solid surfaces of walls, under old broken round-shaped electrical plate, designs and cracks on walls, under the stairs, buildings corners and metal surfaces like stairs railing and corridors almirah. Wasps carry moist soil with their mandibles, jaws and forelegs to the nest site and fix it to the solid surfaces. Wasps have been also reported doing repairing of the damaged nest. Maximum nest construction has been done by wasps in sunny or cloudy time of the day and during rains there were very few or no activities reported.

Pison punctifrons Shuckard, 1838 pushes the soil inside the cell by their legs and use their abdomen to give shape to the nest. The female spent maximum time inside the nest during whole process of nest building and occasionally comes out to do inspections. *Pison punctifrons* constructed three to five cells within one nest (Fig. 5). The shape, size, number of cells and numbers of eggs vary within one species. Variation has been reported in the shape of cells and number of compartments within one nest. From the study sites total five *Pison punctifrons* nests and two *Sceliphron madraspatanum* nests were reported. Out of five nests of *Pison punctifrons* two of them were almost isotropic and rests were oval (grape) shaped (Fig. 6). In one nest three cells were joined like bunch of grapes and of nests were distributed individually.

Fig. 5. *Pison punctifrons* nest.

Some nests were founded with having only two-three cells. The walls of nest are 0.5cm-1cm thick, the thickness varies with in the same nest. Each cell in the nest has around two compartments and female laid one egg in each compartment. In this study only one nest reported from the site where two pupae emerged out from one compartment. So, it is an approximation that a *Pison punctifrons* Shuckard, 1838 female can lays around 4-5 eggs with the average of one egg in one compartment of the cell if nest have 4 compartments. Number of eggs relates with the number of cells and compartment in the nest. After egg-laying female seal her nest with muddy- pellets and no opening were left there in the nest. The offspring come out by removing these pellets from entrance opening of the cell. One nest in study site was reported along with different female behavior; female deposited her eggs and for short time spans she lived in the upper most cells almost for two days. Without depositing any egg in that cells she left the nest with an empty cell or open entrance and never come back, further no such activity has been seen.

Fig. 6. Oval shaped nest of *Pison punctifrons*.

In case *of Sceliphron madraspatanum* (Fig. 7, 8) wasps the female had constructed one cell and filled it up with spiders and sealed it after egg-laying. There were three nests under the study; only one nest was built with over-lapping cells like a multi storied building comprising of 39 cells giving it a “capsule” like appearance. The anterior part of nest consisted of three rows with seven columns and posterior part had two rows with nine columns. An incomplete nest was present besides the above mentioned nest but it is not clear whether both the nests were built by the same individual or not. From anterior part hatching started while female was engaged in building of nest in the posterior part. Construction at the posterior end and hatching from anterior end were observed to be a simultaneous process. There was one individual reported in each cell.

Fig. 7. *Sceliphron madraspatanum* nest under construction.

Fig. 8. Complete nest of *Sceliphron madraspatanum.*

B. Prey Capture and Handling

Pison punctifrons Shuckard, 1838 and *Sceliphron madraspatanum* Fabricius, 1781 wasps are parasitoid by nature they raised their young ones on the diet of paralysed spiderlings (Fig. 9, 10). They can paralysed all other insects and arachnidan. In this study we found that adult females paralysed the spiders by their stings and then carry spiders to their nest; then they laid their eggs on paralysed spiders and form a closed nest over their live bodies. The paralysed spiders do not decompose, they remain alive and fresh then after hatching from the egg, larva feeds upon the spiders and emerged as pupa, later come-out as an adult. *Pison* and *Sceliphron* complete their transformation (from egg to an adult) within their nests. Both species formed their nests in mid of summer season; when moisture and diversity of other floral and faunal resources is on peak. These species constructs their mud nests in sheltered situations like in hollows, mostly near the spider's habitat, many spiders-and-egg cells will be placed adjacent to one another and a nesting structure formed. Each cell is sealed off from adjoining eggs with mud or pellets. This complete sealing off cells from each other is most probably done to avoid competition between young ones for sufficient food.

Fig. 9. Magnified image of *Sceliphron madraspatanum* larva feeding on spider.

Fig. 10. Spiders collected from *Pison punctifrons* nests.

The present study was done on these two parasitoid wasps to study the behavioral patterns, land approaches and their requirements to form nest. This behavioral studies are not only useful for the ethological aspects but also useful for the species recognition. Parasitoid wasps are the different groups among all other venomous organisms. Commonly venom used for predation and defense, but female parasitoid wasps use their venom to manipulate the metabolism, development, and growth of other arthropods for their own reproductive needs. Till now a very few work has been done on behavior aspect of wasps globally and the present study will provide information for future analysis in behavioral and taxonomical studies.

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