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COMMUNICATION

A NEW DISTRIBUTION RECORD OF MASON WASP *PISON PUNCTIFRONS* SHUCKARD, 1838 (HYMENOPTERA: SPHECIDAE: LARRINAE) FROM NOIDA, UTTAR PRADESH, INDIA

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A new distribution record of mason wasp *Pison punctifrons* Shuckard, 1838 (Hymenoptera: Sphecidae: Larrinae) from Noida, Uttar Pradesh, India

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Abstract: This paper reports occurrence of mason wasp *Pison punctifrons* Shuckard, 1838 from Noida, Uttar Pradesh, India. This is a new distribution record for the species. This paper examines the nest architecture and prey choices of the wasp and carries the photographic record of a live *P. punctifrons* Shuckard on her nest with prey.

Keywords: Mud-nest, prey choice, range extension.

Editor: Anonymity requested.

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Author contribution: RKS B prepared the conceptual framework for the study, conducted literature survey and prepared the manuscript. ASB conducted the fieldwork including photography and prepared all the illustrations for this note.

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INTRODUCTION

Pison punctifrons Shuckard, 1838 has never been reported before from Noida or its surrounding areas, including Delhi. Existing records for this species in India, as per Pulawski (2015) are only from Bihar (Purnia), West Bengal (Barrackpore as *P. suspiciosum* Smith, 1858, now a synonym of *P. punctifrons* Shuckard), and Uttar Pradesh (Mussoorie as *P. striolatum* Cameron, 1897, now a synonym of *P. punctifrons* Shuckard). Additionally, there is one record of this species from Kerala (Sudheendrakumar 1989).

This Note reports the occurrence of *Pison punctifrons* Shuckard from Noida, Uttar Pradesh, India – a new distribution record. Figure 1 presents the distribution pattern of the species in India. Also there are details of nest and prey of *P. punctifrons* (Image 1). Classification followed here is as per Bohart (1976).

Nesting activities were studied in a single storeyed residential house in sector 33 of Noida, Uttar Pradesh, India. Location coordinates are: 28.589N & 77.354E.

Main field observations were conducted from 03 Sep 2015 to 01 Oct 2015 and again from 08 May 2020 to 06 June 2020. Additional intermittent observations were also made to keep records of the old (inactive) nests in the study area. Daytime high temperature during the study period ranged 32–37 °C in 2015 and 32–45 °C in 2020.

Opportunistic as well as systematic observations were conducted for the study of this wasp. On 03 Sep 2015, a small, black wasp was discovered building tiny barrel shaped clustered mud cells of the nest on the handrails of the stairs just about 1.5m above the ground in the study area. Observations were made and photographs taken. Contents of the last provisioned cell were collected for the identification of the prey. The nest, in general, was not disturbed.

On 08 May 2020 a wasp was spotted again building nest in the study area. Nest building and provisioning activities were observed and photographed / videographed. Contents of the last cell were collected for identification. The wasp that emerged last was also collected for the purpose of identification.

Study area was intermittently searched for old nests during the study period. Old nests were given unique identification numbers. Details of nests (location, type, substrate, number of cells, height from ground) were recorded. Photographs (or sketches) of all the old nests were maintained. Contents of older nests without exit holes were collected for examination. Fully formed wasps were found in one old nest inside a narrow cavity.



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Image 1. *Pison punctifrons* Shuckard at nest with prey.

A basic 100x optical microscope was used for the examination of the wasp including forewing venation. Same setup was used for the identification of the prey (spiders) to the family level. Focus stacking technique was used to photograph wasp and smaller spiders using combination of microscope and digital camera/ mobile phone. Inkscape vector graphics software was used for preparing line diagrams.

Identification of *Pison punctifrons* Shuckard is based on the original descriptions of Indian *Pison* Spinola species by earlier workers. Identification of spiders has been done with the help of (Tikader 1987; Jocqué 2007).

Forewing venation for identification

Of the many variables in *Pison* Spinola, none is more striking than the forewing venation. Wings have three or two submarginal cells, and the two-celled condition is clearly the result of complete reduction of the second cell (Bohart 1976). Arrangement of recurrent veins produces variety of wing patterns. The m-cu crossveins of the forewing have been called the recurrent veins. In wings with three sub-marginal cells the first recurrent vein is received by submarginal cell 1 or 2 or is interstitial. The second recurrent vein is received by submarginal 2 or 3 or is interstitial (Bohart 1976). This wing venation pattern is the most crucial clue to the identification of *Pison* Spinola species.

Pison Spinola species in India with three or two sub-marginal cells

Antropov (1994) reviewed 'agile' group of *Pison* Spinola species (species having forewings with only two sub-marginal cells). So far as Indian species are concerned, this study included *P. pulawskii* Antropov, 1994, *P. erythropus* Kohl, 1884, *P. agile* (Smith, 1869), *P. differens* Turner, 1916, and *P. rothneyi* Cameron, 1897.

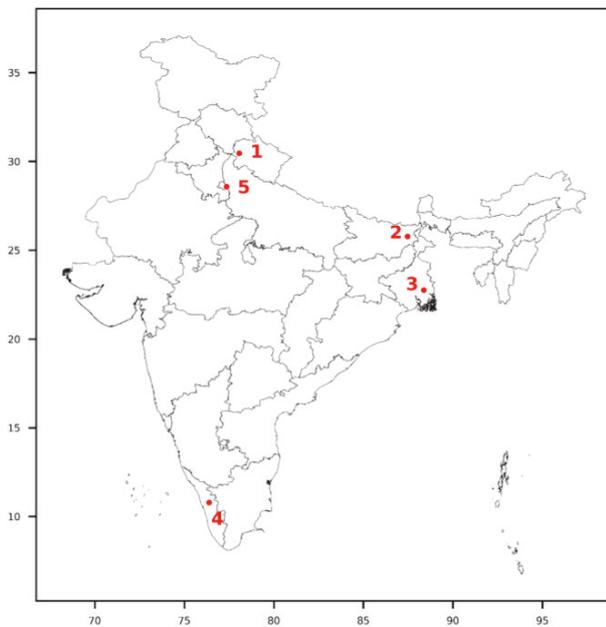


Figure 1. Distribution of *Pison punctifrons* Shuckard in India.

1—Mussoorie (Uttarakhand) | 2—Purnia (Bihar) | 3—Barrackpore (West Bengal) | 4—unidentified location (Kerala) | 5—Noida (Uttar Pradesh).

We used this information for segregating Indian *Pison* Spinola species into two categories: *Pison* Spinola with three sub-marginal cells in the forewing and those with two sub-marginal cells (See Table 1). Bingham (1897) provides descriptions of the Indian *Pison* Spinola species.

As per Table 1, there are only five *Pison* Spinola species found in India with three submarginal cells and this includes one doubtful species namely *Pison fasciatum* Radoszkowski.

Genus *Pseudonysson* Radoszkowski, 1876 is presently a synonym of genus *Pison* Jurine in Spinola, 1808. *Pseudonysson fasciatus* Radoszkowski, 1876 has been synonymized with *Pison fasciatum* (Radoszkowski, 1876) (Bohart 1976).

Turner (1916) writes about *Pison fasciatus* (Radoszkowski, 1876):

“The description is poor, but apparently the species is allied to *Pison algiricum* Kohl, 1898, but with normal antennae. To this species I assign an Indian specimen with some doubt. Hab. S.E. Caucasus; Chapra, Bengal (Mackenzie)”. There is no other information available about this species from any other source. So, ignoring this doubtful species, there are only four *Pison* Spinola species in India with three submarginal cells.

Additional description

Female. Total length 9mm, forewing 6mm, and colour entirely black. Forehead and prothorax thickly punctured

(Image 2). Clypeus with a large protruding median lobe with rounded apical margin, without lateral lobes (Figure 2). Clypeus and the face below the eye incision (notch) densely covered with silvery pubescence. Propodeum at base coarsely and obliquely striated (Image 3). Abdomen smooth and shining. Silvery bands on the apical margins of the abdominal segments become conspicuous in flight, under certain lighting conditions when the wasp approaches nest. Forewings hyaline with darker apical margins. Forewings with three submarginal cells, the second much smaller and petiolated. Veins dark brown. The first recurrent vein (1m-cu) received near the apex of the first submarginal cell, aligning and apparently merging with the crossvein; the second recurrent vein (2m-cu) received at the apex of the second submarginal cell merging with the crossvein (Image 4). Facial details as shown in Figure 2 are based on a composite image obtained using focus stacking technique.

Comparison for identity confirmation

We will now compare the forewing venation details with the description of other workers to confirm identification of the species as *Pison punctifrons* Shuckard.

Forewing venation of Noida *Pison* Spinola species is closer to the description of *Pison suspiciosus* Smith (a synonym of *P. punctifrons* Shuckard) as given by Smith (1858), “The first recurrent nervure received at the apex of the first submarginal cell; the second at the apex of the second submarginal”.

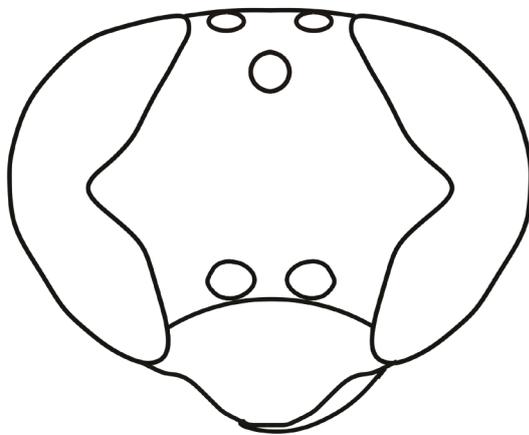
In case of Noida *Pison* Spinola species first recurrent vein is received “near the apex” (not “at the apex”), however this difference needs to be viewed in the light of the descriptions given by Shuckard (1838) for *P. punctifrons* and *P. spinolae*, “...the recurrent nervures inosculating with the transverso-cubitals...”. He further adds that “...this species at first sight much resembles the *P. spinolae* Shuckard, but, upon examination, it is at once distinguished by its very coarse sculpture, and the size of its second submarginal cell”.

Shuckard (1838) describes *P. spinolae* as follows, “... the petiolated submarginal cell very minute, and receiving the two recurrent nervures at the inosculating points of its transverse cubitals”. As per Shuckard, arrangement of recurrent veins is identical in *P. punctifrons* and *P. spinolae*.

Forewing venation of *P. spinolae* is shown in Figure 3 based on the illustration given by Harris (1994). The arrangement of recurrent veins of *P. spinolae* is exactly same as that of Noida *Pison* Spinola species. First recurrent vein received near the apex of the first

Table 1. *Pison Spinola* species in India as per Pulawski (2015). Species with two sub-marginal cells segregated as per Antropov (1994).

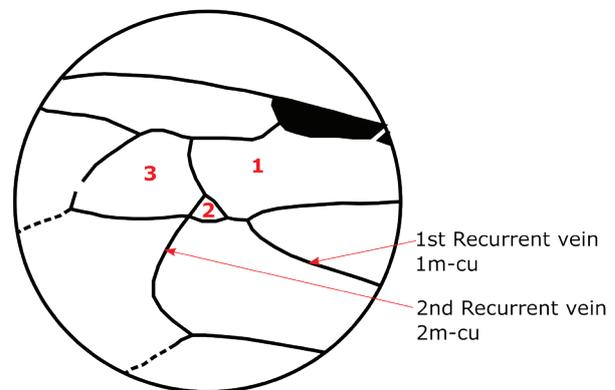
A. <i>Pison Spinola</i> species with three sub-marginal cells:					
	Name	Authority	Synonyms	Authority	Geographic Location
1.	<i>P. argentatum</i>	Shuckard, 1838	<i>P. fuscipalpe</i>	Cameron, 1901	Bombay, Bangalore
2.	<i>P. fasciatum</i>	(Radoszkowski, 1876)			India (?)
3.	<i>P. orientale</i>	Cameron, 1897			Barrackpore
4.	<i>P. punctifrons</i>	Shuckard, 1838	- <i>P. suspiciosum</i> <i>P. striolatum</i>	- F. Smith, 1858 Cameron, 1897	Purnia, Kerala (no specific location) Barrackpore Mussoorie
5.	<i>P. rugosum</i>	F. Smith, 1856	- <i>Pisonitus rugosus</i> <i>P. appendiculatum</i>	- F. Smith, 1869 Cameron, 1897	Barrackpore
B. <i>Pison Spinola</i> species with two sub-marginal cells:					
6.	<i>P. agile</i>	(F. Smith, 1869)	<i>P. koreense</i>		Southern India, Sri Lanka
7.	<i>P. differens</i>	R. Turner, 1916			Assam, Shillong
8.	<i>P. erythropus</i>	Kohl, 1884	<i>Parapison rufipes</i>	F. Smith, 1869	Uttar Pradesh: Mainpuri.
9.	<i>P. oblitteratum</i>	F. Smith, 1858			Kumaun, northern India
10.	<i>P. pulawskii</i>	Antropov, 1994			Rajasthan: Udaipur
11.	<i>P. rothneyi</i>	Cameron, 1897	<i>P. crassicorne</i>	Cameron, 1897	Barrackpore



1mm

Pison punctifrons Shuckard, 1838. ♀

Figure 2. Facial details of female *Pison punctifrons* Shuckard.



Pison spinolae

Forewing venation (Part)

1= 1st submarginal cell

2= 2nd submarginal cell

3= 3rd submarginal cell

Figure 3. Forewing venation (Part) of *Pison spinolae* Shuckard (based on Harris 1994)

submarginal cell and the second recurrent vein received at the apex of the second submarginal cell. This confirms the identification of the wasp as *P. punctifrons* Shuckard.

Darker apical margin of the forewing and arrangement of recurrent veins are sufficient keys to differentiate *P. punctifrons* from other *Pison* species of India with three submarginal cells.

In case of *P. argentatum* the first recurrent vein is received towards the apex of the first submarginal cell, and the second recurrent vein received about the middle of the second submarginal cell (Shuckard 1838).

In case of *P. orientale* Cameron, the recurrent veins are received shortly in front of the transverse cubital (Cameron 1897).

In case of *P. rugosum* Smith, the first recurrent vein is received towards the apex of the first submarginal cell, and the second recurrent vein received about the middle of the second submarginal cell (Smith 1856). This description of the forewing venation is similar to that of *P. argentatum* and additional features need to be included in the identification key.

Nest location and architecture

All nests are located in absolutely sheltered positions away from the sun or rain; in the semi-covered areas of the house which include verandah, underside of the staircase, or courtyards. Substrate of the nest is a plastered wall, wood or steel. Junction of two walls or a corner of the junction of three walls (e.g., interior corner of a square niche in the wall); grooves and cavities in the wooden windows are preferred locations. No nest is found in the middle of a smooth wall or a ceiling unless a cracking plaster creates some sort of groove or uneven surface.

Well defined horizontal or vertical linear grooves in the wooden window panels are often used as a nesting site. Raised wooden beadings on doors and windows or putty around the glass panes also provide similar junction of two surfaces and therefore offer good nest sites.

Nest is a cluster of tiny mud cells. Three types of nests were recorded in the study area:

1. Type 1 – Free standing nests which vaguely look like a small bunch of tiny grapes (Image 5). Completed nest is fully visible.

2. Type 2 – Nests inside pre-existing grooves. In this case direction of the groove; whether horizontal or vertical decides the progression of the nest and final nest looks quite linear in shape (Image 6). Completed nest is partially visible.

3. Type 3 – Nests inside holes or cavities in the wooden windows (Image 7). Completed nest is not easily visible.

All three types of nests were found in close proximity to each other. Types 1 and 3 nests were attributed to *Pison punctifrons* by identifying the adult wasps associated with these nests. Type 2 nests were attributed to the same wasp on the basis of the pupal cases found in the cells which were identical to the pupal cases found in Types 1 and 2 nests. Individual cells of the Type 2 nest were also similar to the cells of Types 1 and 3 nests.

Basic unit of the nest is a fragile barrel shaped $\frac{1}{2}$ mm thick mud cell, 9mm long with an external diameter of 5mm in the middle and 3mm at both the ends. Though this is generally true for Type 1 nests, Type 2 nests built in

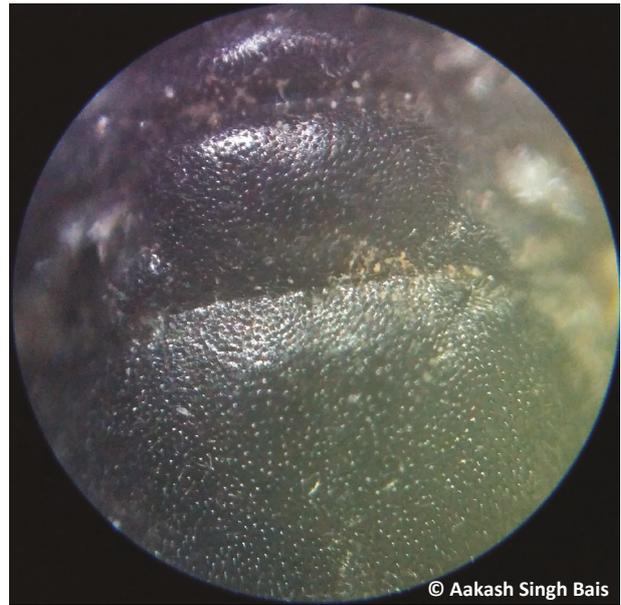


Image 2. *Pison punctifrons* Shuckard. Punctured pronotum and mesoscutum.

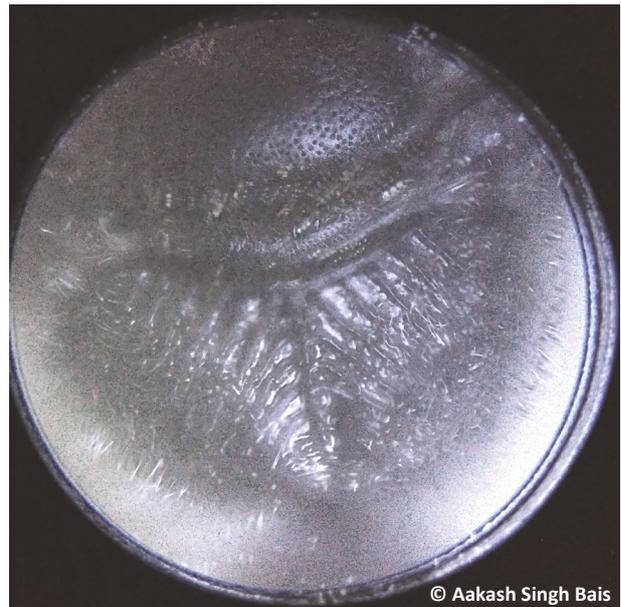


Image 3. *Pison punctifrons* Shuckard. Propodeum.

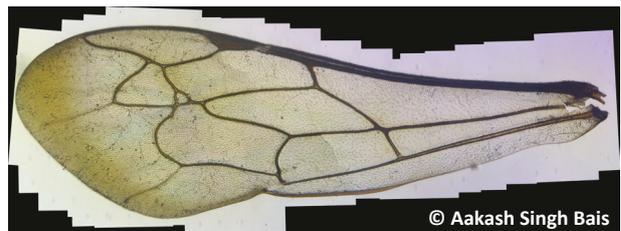


Image 4. Left forewing venation of *Pison punctifrons* Shuckard.

pre-existing narrow grooves were found to be of longer length. For example, two Type 2 nests built in 4 x 4 mm linear vertical groove in the wooden window were found to be having longer cells. First nest (Type 2) contained three cells of 12mm and one cell of 16mm (Image 6a,b). Second nest (Type 2) had two cells of 12mm and one cell of 16mm.

The substrate is not lined and thus becomes a part of the cell. Any cracks in the substrate are repaired by filling them with mud. Two adjoining cells built on the original substrate are independent and do not share a common partition wall. Cell construction begins from the bottom of the barrel and ends at the top 3mm opening which is closed immediately after provisioning of the cell is completed and egg laid.

During the study period (2015–2020), 21 nests were built in the study area. Details of these old inactive (and also active nests under observation) were collected. Nest type, substrate, height from the ground and number of cells for each nest were recorded. Out of total 21 nests 10 were Type 2 (48%), eight Type 1 (38%), and three Type 3 (14%). Substrate for the 11 nests was cement plaster (52%), eight were built on wood (38%), and one each on metal and glass putty (5% each). All nests were located 1.2–3.35 m above the ground level. Frequency distribution plot of number of cells vs number of nests is presented in Figure 4.

While recording old nests in the study area, one cluster of mud cells was found just inside a window latch hole, 15mm diameter and 20mm deep, in the top element of a wooden window frame. This was a Type 3 nest (Image 7). It contained a cluster of five mud cells. Architecture of this partly hidden nest was discovered by sequentially breaking the nest cells using a wooden toothpick and separately collecting the contents of each cell in a dish. Breaking sequence followed 5-4-3-2-1. Pencil torch was used to illuminate the interior portion of the cavity. Mental images formed during the process were used to immediately draw the rough sketch showing arrangement of the nest cells.

One intact pupa was found in each of the two exterior cells (Cell 4 and 5). Three interior cells 1, 2, & 3, which were fully or partly blocked by the two exterior cells returned perfectly formed but dead adult wasps, one in each cell. It is tentatively suggested that probably these adult wasps could never find a passage to get out of the cells because of the obstruction created by the exterior cells.

Active nest observations

On 08 May 2020 at 13.15h a *Pison punctifrons* wasp



Image 5. *Pison punctifrons* Shuckard nest. Type 1.

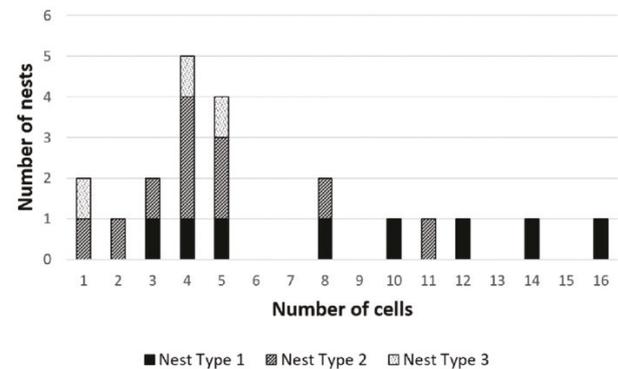


Figure 4. Frequency distribution plot. Number of cells vs number of nests.

was spotted at the nest, building the third cell of the nest. This was a Type 1 nest. At 13.30h the cell was closed. Before closing the nest, the wasp was seen inserting her abdomen inside the cell as if pushing the contents to make room for more spiders. But we soon realized that the wasp actually deposited the egg, as soon after, mud was brought and the opening was sealed. Immediately after sealing the cell she began building the 4th cell from where she ended the last cell, i.e., from the end

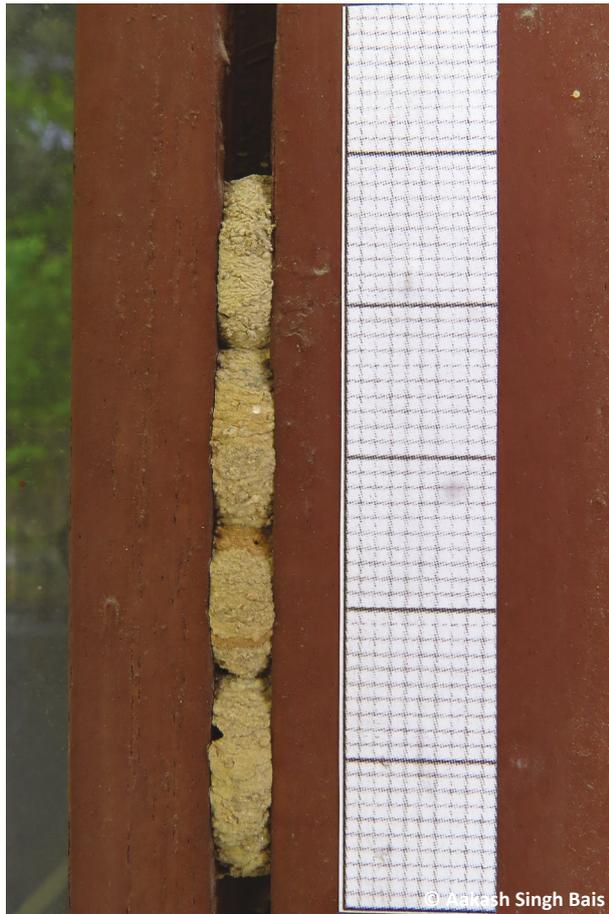


Image 6a. *Pison punctifrons* Shuckard nest. Type 2. Front view.

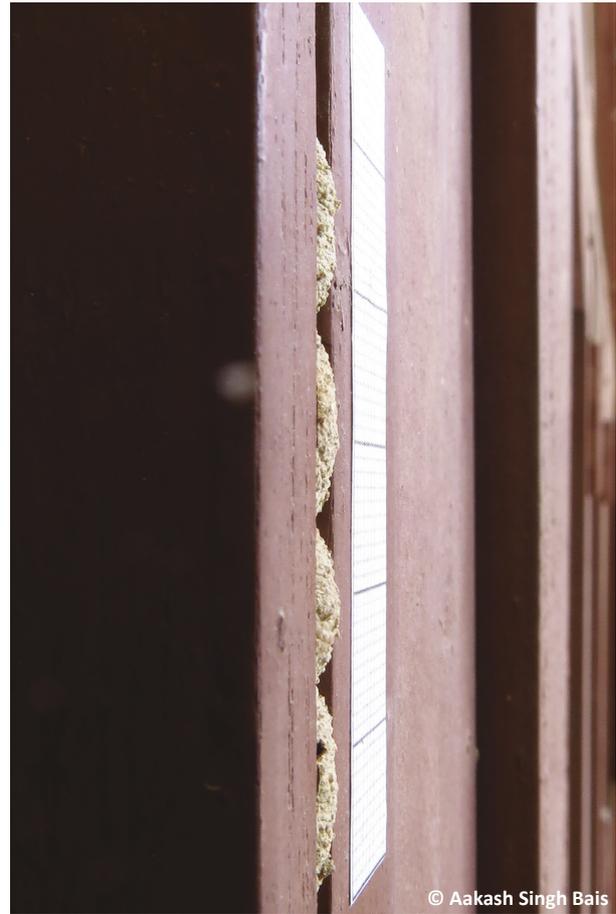


Image 6b. Same *Pison punctifrons* Shuckard nest. Type 2. Side view.

cap of the 3rd cell. Construction of the 4th cell began at 13.38h and the same was completed in 70 minutes. The wasp made 18 trips to bring the mud pallets for this cell. Nineteenth, the last visit to the nest was at 14.37h for the final inspection before provisioning began. At 15.00h the first spider was brought to the cell. At 15.40h we closed the field work for the day.

Next day on 09 May 2020, she continued provisioning the same cell 4 and finally closed it at 13.34h. The egg was most probably laid at 13.00h. Immediately after closing cell 4, construction of cell 5 began. At 16.45h when the field work ended for the day, cell number 5 was still under construction.

Next day on 10 May 2020 no activity was seen, the wasp did not visit the nest. Rains followed a dust storm at 11.45h. Fifth cell was still open and without any spider. Weather remained cloudy for the rest of the day and the wasp was never seen around the nest. Next day on 11 May 2020, the wasp did not arrive at the nest till 13.30h and assuming that no more cells would be added, we collected the contents of the last sealed cell

4 for examination leaving behind sealed cells 1, 2, & 3. Empty cell 5 also needed to be removed for this. Wasps from cells 1, 2, & 3 emerged on 06 June 2020. Wasp from cell 3 was collected for identification.

The building process

Cell construction begins from the bottom of the barrel. Having laid the base, wall of the barrel is raised in multiple segments. The wasp precariously holds the substrate or previously laid segment of the barrel wall to raise it further by depositing and spreading wet mud paste, brought in the shape of a pallet. The wasp spends much time inside the cell while construction is in progress and only occasionally visits the outer surface for inspection. Inside of the cell is rendered smooth while outside remains rough.

While building nest cell the wasp produces high frequency sound by vibrating her wings. Recorded sound frequencies ranged 4–11 kHz with maximum amplitude at 6072 Hz.

Starr (2004) has described the nesting behaviour

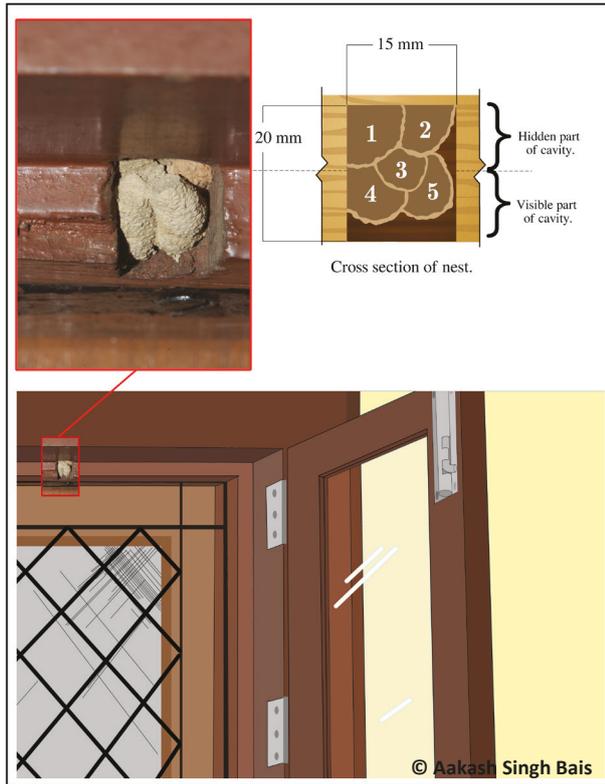


Image 7. *Pison punctifrons* Shuckard nest. Type 3.

of *P. argentatum* and also provided the photographs of the nest. Type of free nests built by *P. argentatum* are different in appearance from those built by *Pison punctifrons*. Nests of the *P. rugosum* as illustrated by Horne (1870) are also different in appearance.

OBSERVATIONS ABOUT THE PREY

Season I (03 September 2015–14 February 2016). The wasp that was spotted on 03 September 2015 completed and sealed four cells by 05 September 2015. After completing the fifth cell, except the top opening, she started bringing small spiders. It took her 10 minutes to 45 minutes to bring one spider to the cell. At 19.30h (on 05 Sep 2015) the wasp was seen resting in the cell, head just protruding out of the cell. Next day on 06 Sep 2015 at 08.00h the wasp was still in the cell, in the same position. At 22.30h also the cell was not yet sealed. Next day on 07 September 2015 the wasp never visited the cell and it remained open. On 01 October 2015 exit holes were observed on two of the cells.

On 14 February 2016 the nest built by this wasp was collected and its contents examined. It had five cells. Three cells were empty with exit holes. One cell returned an intact pupal case. Fifth, the last cell, the top most one, was never sealed after provisioning. It contained

Table 2. Contents of a cell of *Pison punctifrons* Shuckard

	Family	No of spiders
1	Dictynidae	1
2	Oxyopidae	2
3	Salticidae	1
4	Theridiidae	1
5	Thomisidae	4
6	Uloboridae	1
7	Unidentified	1
	Total	11

eight spiders belonging to three families, Oxyopidae: 2, Salticidae: 6, and Theridiidae: 1. It appears that the wasp never completed the provisioning of the last cell nor deposited any egg.

Season II (08 May 2020–11 May 2020)

Contents of the last sealed cell 4 were collected on 10 May 2020 for identification. This cell contained 11 small to very small spiders. Family identification of these spiders is placed in Table 2. The wasp laid the egg dorso-laterally on the abdomen of a crab spider (Thomisidae). See box 8b of Image 8.

Thomisids, the crab spiders, build no webs. They live on plants and foliage. Some species run swiftly and pursue their prey while others wait in ambush inside or underneath a flower to attack and catch the insects visiting the flower for nectar. Salticids, the jumping spiders also do not build webs and actively pursue their prey on plants, foliage, logs, and other substrata. Oxyopids are hunting spiders of the plant and they chase their prey on grass and foliage. Most make little use of webs. Dictynids are very small cribellate orb weavers and make irregular snares in the foliage. Uloborids are also cribellate spiders and make complete or partial orb webs. Spiders of the family Theridiidae build irregular space webs. Going by the number of spiders in a cell from different families (Table 2), it appears that *P. punctifrons* mostly takes prey from those families that build no webs. This is similar to the prey choices made by *P. argentatum* as discovered by other workers (Starr 2004). However, a much larger prey database is required to confirm the same.

CONCLUSION

Presence of a little known wasp *Pison punctifrons*

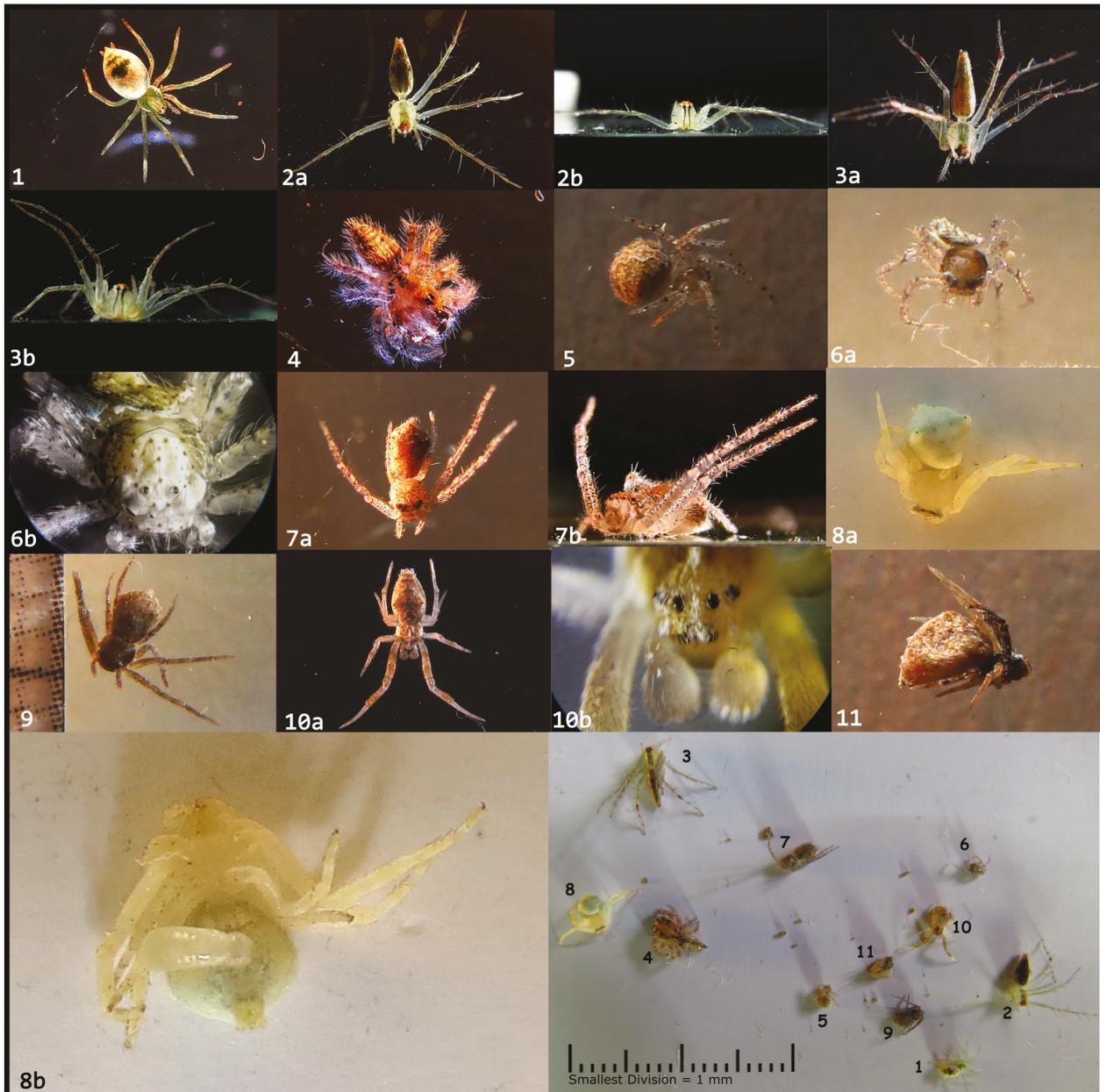


Image 8. Prey contents of one cell of a nest of *Pison punctifrons* Shuckard, 1838.

Key to spider specimens in the index card image at bottom right: 1—Dictynidae | 2, 3—Oxyopidae | 4—Salticidae | 5—Theridiidae | 6, 7, 8, 9—Thomisidae | 10—Uloboridae | 11—Unidentified.

All other magnified images are of the same specimens and share same family identification number. Few specimens have been photographed twice from two different angles to facilitate identification. Such images are labelled 2a, 2b; 3a, 3b etc. © Aakash Singh Bais.

Shuckard in Noida, Uttar Pradesh is established. The nearest historical record is from Mussoorie in Uttarakhand which is about 225km to the north. This historical record from Mussoorie is about 125 years old, when Cameron described *Pison striolatum* in the year 1896 from Mussoorie (Cameron 1896). *Pison striolatum* is presently considered to be a synonym of *Pison punctifrons*. Other historical records of the species from India are also equally old. The last published record for

India is for the year 1989 from Kerala (Sudheendrakumar 1989). Because of limited information available, present status or distribution pattern of *Pison punctifrons* in India is not fully understood.

This wasp builds free standing mud nests and also utilizes pre-existing grooves and cavities. Number of cells per nest vary from one to 16. We do not know what type of nests are built by this wasp in the wild away from the human settlements. Its choice of prey appears to be

small spiders mostly from the families that do not build webs; however, more work on prey choices is required to fully understand the prey preferences of this wasp.

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