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## Nesting activity and foraging plants of the golden mining bee *Nomia aurata* Bingham (Halictidae: Hymenoptera)

**Sonu Bharti and Mohammad Sarfaraz Khan**

### Abstract

This research examines the nesting activity and foraging plant of the golden mining bee, *Nomia aurata*, at G.B Pant University of Agriculture and Technology Pantnagar (India). The research investigates the provision collection time, deposition time, nesting activity period and the effect of abiotic factors on these activities. A total of 30 nests were located at 3 different nesting beds during the weekly survey at the Norman E. Borlaug Crop Research Centre and Vegetable Research Centre. Detailed nesting activity of the female of the 3 nests located in the close proximity with each other was recorded. The foraging plants were also documented for the bees. *Nomia* bees, also known as alkali bees, are skilled pollinators of various crops, including alfalfa and onions. They outperform honey bees due to their unique flower opening technique. They also pollinate fruit crops like apples, cherries, and plums. *Nomia* bees engage in generalist foraging behaviour, interacting with wildflower species like composites and umbellifers. The golden mining bee, *Nomia aurata*, is a pivotal pollinator for several plant species, including *dandelions*, *Trifolium* spp, and *Vicia* spp. Throughout the observation period, the bee's foraging habits were catalogued, revealing preferences for a range of plants from different families. Prominently, *Polygonum effusum* emerged as the favoured plant for provisioning, closely followed by *Lysimachia arvensis*.

**Keywords:** Golden mining bees, *Nomia aurata*, alkali bees, skilled pollinator, nesting activity

### Introduction

More than 97% of bee species are solitary, including mason bees, carpenter bees, leafcutter bees, mining bees and sweat bees. Few species, including honey bees, stingless bees and bumblebees, live in colonies. The diversified group of solitary bees known as soil dwelling bees, commonly referred to as ground-nesting bees, construct their nests in sand or dirt (Danforth *et al.*, 2019) [7]. Estimates of the percentage of bee species that build subterranean nests range from 64% to 83% (Cane and Neff, 2011; Harmon-Threatt, 2020) [4, 10]. Soil dwelling bees can be found in many different habitats, including fields, forests, and gardens. They are generally non-aggressive and do not defend their nests like social bees, but may sting if disturbed or threatened. Some common species of soil dwelling bees include the mining bees (Andrenidae), the digger bees (Apidae), and the sweat bees (Halictidae). These bees are typically small to medium-sized and can be identified by their distinctive markings and behaviour. With 4,510 species, the bee family Halictidae is the second-largest in the clade Anthophila (Ascher and Pickering, 2023) [2]. They are referred to as "sweat bees" because many species, especially the smaller ones, are drawn to perspiration. The subfamily in Halictidae Nomiinae subfamily has around 620 species, with the Palearctic and nearby regions being hotspots of species richness (Michener 2007; Pauly 2009; Ascher and Pickering, 2019) [13, 14, 3]. The *Nomia* bees also known as alkali bees, are effective pollinators of various crops, such as alfalfa and onion, and are preferred over honey bees in pollinating alfalfa due to their ability to open flowers without damaging stamens and stigma. *Nomia melanderi* is a productive pollinator of lucerne in different parts of the world (Hackwell, 1967) [9]. *Nomia* bees are also known to visit willow catkins for pollen collection. Bees are attracted to flowers of various fruit trees, such as apple (*Malus domestica*), cherry (*Prunus avium*) and plum (*Prunus domestica*) (Howes, 2013) [11]. *Nomia aurata* Bingham 1897, commonly known as the golden mining bee, is a species of solitary bee under the tribe Nomiini subfamily Nomiinae of family Halictidae. *Nomia aurata* is an early spring bee species. They typically emerge from their nests and start their nesting activities in the early spring months, around March to April, depending on the region and climate.

*Nomia* spp. are generalist foragers and can be observed on a variety of wildflowers, including composites (e.g., daisies and asters), umbellifers (e.g., carrot family), and other flowering plants found in meadows, grasslands, and gardens (Carril and Wilson, 2023) [5]. *Nomia aurata* engage in nest construction and provisioning, they also play a vital role in pollination. As they visit flowers to collect pollen, they inadvertently transfer pollen grains from the male parts (anthers) to the female parts (stigma) of flowers, facilitating pollination and ensuring plant reproduction (Silva *et al.*, 2020) [6]. *Nomia aurata* bees are often seen foraging on dandelions, collecting both pollen and nectar (Embry, 2018) [8]. Some leguminous plants, such as clovers (*Trifolium* spp.) and vetches (*Vicia* spp.) are also visited by *Nomia aurata* bees (Howes, 2013) [11].

**Material and Methods**

Regular field visits were conducted to record the bee visiting on flowering plants during the study period. Foraging of the individual bee on flowers of plant species were considered as

its floral resource and foraging plants. Initially for the few days the activity of the bees was observed for entire day. After the few days of observation of nesting activity of the bee it was seen that the activity of the bees ceases after 1:00 pm. After this the daily observation on the foraging activity of bees were recorded from 7:00 am in the morning till 2: 00 pm in the noon. The period from the initiation of the foraging activity till the completion of the foraging activity in a day was observed and this duration was considered as the duration of foraging. The detailed foraging activity of 3 nests previously marked and numbered viz., 4, 6 and 7 was recorded till the completion of their foraging activity period. The plants on which the bees were found foraging for the provision were collected. The collected plants specimen was identified by the Taxonomist Dr. D.S Rawat, Professor College of Basic Science and Humanities, GBPUAT&T, Pantnagar.

**Results and Discussion**

**Table 1:** Mean time (sec) spent by *N. aurata* females in collection and deposition of provision (based on pooled mean for nest 4, 6, 7)

Date	Collection time by individual female	Mean value	Deposition time by individual female	Mean value
9th March, 2023	149.25+186.26+166.71	167.40	164.62+162.34+243.6	190.18
10th March, 2023	148.90+167.03+166.46	160.79	123.71+113.81+263.84	167.12
11th March, 2023	126.34+192.75+237.75	185.61	158.51+125.06+224.36	169.31
12th March, 2023	118.92+168.83+236.26	174.67	259.88+300.58+303.83	288.09
13th March, 2023	142.78+195.71+240.25	192.91	242.92+145.66+220.13	202.90
14th March, 2023	120.33+137.35+119.23	125.63	115.5+133.3+143.03	130.61
15th March, 2023	153.80+208	180.90	176.42+198.59	187.50
16th March, 2023	125.8+181.20+118.92	141.97	152.25+299.52+259.89	237.22
17th March, 2023	171.38+138.62+148.90	152.96	132.66+208.43+123.71	154.93
18th March, 2023	185.90+131.25	158.57	173.97+141.74	157.85
19th March, 2023	Rain		Rain	
20th March, 2023	Rain		Rain	
21st March, 2023	Rain		Rain	
22nd March, 2023	170.36+189.97	180.16	182.36+178=180.18	
23rd March, 2023	184.06		141.25	
24th March, 2023	175.53		96.6	
25th March, 2023	143.4		190.86	

On 9<sup>th</sup> of March the mean collection time of *Nomia aurata* was 167.40 sec and the mean deposition time of the female was 190.18 sec. Similarly, on 10<sup>th</sup> of March the mean collection time of the female was 160.17 sec and the mean deposition time of the female was 167.12 sec. On 11<sup>th</sup> of March the mean collection time of *Nomia aurata* was 185.61 sec and the mean deposition time of the female was 169.31 sec. On 12<sup>th</sup> of March the mean collection time of *Nomia aurata* was 174.67 sec and the mean deposition time of the female was 288.09 sec. On 13<sup>th</sup> of March the mean collection time of *Nomia aurata* was 192.91 sec and the mean deposition time of the female was 202.90 sec. On 14<sup>th</sup> of March the mean collection time of *Nomia aurata* was 125.63 sec and the mean deposition time of the female was 130.61 sec. On 15<sup>th</sup> of March the mean collection time of *Nomia aurata* was 180.90 sec and the mean deposition time of the female was 187.50 sec. on 15<sup>th</sup> of March no activity was recorded in the nest 6. On 16<sup>th</sup> of March the mean collection

time of *Nomia aurata* was 141.97 sec and the mean deposition time of the female was 237.22 sec. On 17<sup>th</sup> of March the mean collection time of *Nomia aurata* was 152.96 sec and the mean deposition time of the female was 154.93 sec. The activity of the bees in the nest 4 stopped after 17<sup>th</sup> of March. On 18<sup>th</sup> of March the mean collection time of *Nomia aurata* was 158.57 sec and the mean deposition time of the female was 157.85 sec. On 19<sup>th</sup> 20<sup>th</sup> and 21<sup>st</sup> of March the activity was not recorded due to rain. On 22<sup>nd</sup> of March the mean collection time of *Nomia aurata* was 180.16 sec and the mean deposition time of the female was 180.18 sec. On 23<sup>rd</sup> of March the mean collection time of *Nomia aurata* was 184.06 sec and the mean deposition time of the female was 141.25 sec. On 24<sup>th</sup> of March the mean collection time of *Nomia aurata* was 175.53 sec and the mean deposition time of the female was 96.6 sec. On 25<sup>th</sup> of March the mean collection time of *Nomia aurata* was 143.40 sec and the mean deposition time of the female was 190.86 sec.

**Table 2:** Impact of abiotic factors on nesting activity of *N. aurata* female based on pooled mean data for (nest 4,6 and 7)

Nesting Parameters	Abiotic factors				
	Temperature (max) °C	Temperature (min) °C	RH%	Rainfall (mm)	Sunshine hours
Collection	0.503*	-0.023NS	-0.338NS	-0.672**	0.729**
Deposition	0.638**	-0.251NS	-0.834NS	-0.573*	0.670**
Outgoing trips	0.656**	-0.69NS	-0.477NS	-0.575*	0.753**
Incoming trips	0.656**	-0.73NS	-0.475NS	-0.580*	0.755**

When overall mean collection time was correlated with the maximum temperature, the *N. aurata* bees had the significant relationship with the temperature, means the activity of the bees increased when the temperature increased. The bees had the negative nonsignificant relationship with the RH. There was a negative significant relationship with the rainfall, means when the rainfall occurred the activity of the bees decreased. Similarly, the bee had the highly significant relationship with the sunshine hours, means as the sunshine hours increased the activity of the bees increased. Similarly, there was a significant positive relationship with the deposition time. The bee had negative non-significant

relationship with the RH and deposition time. The bees had the negative significant relationship with the rainfall, means the deposition time was less during rainfall. The outgoing and incoming trips had the significant positive relationship with the maximum temperature, sunshine hours and rainfall but the relationship with rainfall is negatively significant, means with increase in temperature and sunshine hours the number of incoming and outgoing trips increased in highly significant manner but with rainfall it decreased. The outgoing and incoming trips had the negative non-significant relationship with the RH. All the parameters were having negative non-significant relationship with the minimum temperature.

**Table 3:** Foraging plants of the *Nomia aurata*

S.no	Foraging plants	Family	Habit	Resource	Flower type/Flower colour	use
1.	<i>Medicago polymorpha</i>	Fabaceae	H, a	FR	Z, Y	M, V
2.	<i>Lysimachia arvensis</i>	Primulaceae	H, a	FR	A, B	M
3.	<i>Polygonum effusum</i>	Polygonaceae	H, a	FR	A, P	M, F
4.	<i>Parthenium hysterophorus</i>	Asteraceae	S, ss, a, b, p	FR	A, W	M
5.	<i>Polypogon monspeliensis</i>	Poaceae	H, a	FR	Z, PY	M
6.	<i>Gamochaeta pensylvanica</i>	Asteraceae	H, a	FR	A, G	M, V

H= herb; S= shrub; ss; subshrub; a= annual; b=biennial; p= perennial; FR= flower reward; Z=zygomorphic; A= actinomorphic; Y= yellow; B= blue; P= purple; W= white; PY= pale yellow; G= green M= medicinal uses; V= vegetable; F= food.

The *Nomia* bees visit different weed plant species for collection of provision (pollen and nectar). The weed plant species visited by the *Nomia* bees for provision were investigated. The *Nomia* bees visited 6 different weed plants for collection of their provision. The bees visited the 2 plants of Asteraceae family, 1 plant of Fabaceae, 1 plant of Primulaceae, 1 plant of Polygonaceae, and 1 plant of Poaceae. From the family Asteraceae weed plant species were *Gamochaeta pensylvanica* and *Parthenium hysterophorus*, from the family Polygonaceae *Polygonum effusum* was used for the collection of provision, from Fabaceae *Medicago polymorpha* was used for collection of provision, from Primulaceae *Lysimachia arvensis* was used for the collection of provision and from the family Poaceae *Polypogon monspeliensis* was used for the collection of provision. The bee visited the flowers with different colour. The most preferred flower for the collection of provision was *Polygonum effusum* followed by *Lysimachia arvensis*. The flower colour of *Polygonum effusum* was purple and the flower colour of *L. arvensis* was blue. *Medicago polymorpha* and *Polypogon monspeliensis* have zygomorphic flowers whereas rest all the weed plants were having actinomorphic flower. Out of the 6 foraging weed plants, 5 species were of herbaceous nature and the *Parthenium hysterophorus* belong to the category of shrub or sub shrub. Except for *P. hysterophorus*, all the weed plant species were annual. *Medicago polymorpha* is weed plant of Mediterranean origin but it is found throughout the world. They are associated with the agriculture field. Being the member of family Fabaceae, they are also capable of fixing the atmospheric nitrogen. They are edible and are consumed as vegetable in China (Ren *et al.*, 2022) [15]. They are used in the treatment of skin plagues, dysentery, rheumatic pains and wounds. *Lysimachia arvensis* is the weed of agriculture crop. In India they are commonly seen in the wheat field and other rabi crops. They have anti-inflammatory, antimicrobial property, antimycotic and antileishmanitic and antiviral property so they are used for medicinal purpose (Yasmeen *et al.*, 2020) [16]. *Polygonum effusum* is a road side weed. They are indigenous weed species. In few countries they are used as food. In India few

species of *Polygonum* are used as vegetable in the West Bengal and few north eastern states. They are used as expectorant for cough and bronchitis. They are also used as astringent i.e., useful in piles, haemorrhages and diarrhoea. They also possess the antimicrobial property. *Parthenium hysterophorus* is an exotic weed species. They are the noxious weed present in the crop land and the road side habitat. They are utilized as the medicinal plant to treat skin infection, amoebic dysentery and muscular rheumatism in Central America and Caribbean (Kaur *et al.*, 2021) [12]. *Polypogon* is an exotic weed species. They are road side weeds, although they are considered as the problematic weed plant species but they have been used in the treatment of heart palpitations (Ahmad *et al.*, 2022) [1]. *Gamochaeta pensylvanica* is an exotic weed species. They are widely used as vegetable in the form of saag in western Himalayas. It is considered as highly effective against diabetes, high blood pressure, stomach ulcers and diarrhoea.

### Conclusion

For studying the nesting activity of the bees, 3 nests were randomly selected which were in close proximity and whose reading could be recorded simultaneously. The nesting activity of 3 nests viz., 4, 6 and 7, was recorded till their nesting activity was over. The nesting activity of the female in all the nest lasted for different duration. In nest 4 the female was active for 9 days, the female of nest 6 was active for 11 days and the female of nest 7 was active for 17 days. For nest 4 the mean collection time per trip for collection of provision was 138.31±95.38 sec (Mean ± SD) (Median=126.39) and the mean deposition time per trip was 165.79±217.04 sec (Mean ± SD) (Median=70.11). For nest 6 the mean collection time per trip for collection of provision was 191.1±407.70 sec (Mean ± SD) (Median=168.83) and the mean deposition time per trip was 181.15.79±235.60 sec (Mean ± SD) (Median=139.48). For nest 7 the mean collection time per trip for collection of provision was 168.78±151.39 sec (Mean ± SD) (Median=127.71) and the mean deposition time per trip was 184.94±215.62 sec (Mean ± SD) (Median=111.8). For nest 4, the total collection time was 39,355 sec which is equal



to 10.01.52 hrs and the total deposition time was 46,639 sec which is equal to 12.57.19 hrs. For nest 6, the total collection time was 46,540 sec which is equal to 12.58.06 hrs and the total deposition time was 49,157 sec which is equal to 13.41.28 hrs. For nest 7, the total collection time was 66,327 sec which is equal to 18.26.42 hrs and the total deposition time was 70,095 sec which is equal to 19.28.12 hrs. When the overall collection time was correlated with the maximum temperature, the *N. aurata* bees had the significant relationship with the temperature. The bee had the negative non-significant relationship with the minimum temperature and relative humidity. With the rainfall the bee had the highly significant negative relationship. With the sunshine hours the collection time had the highly significant positive relationship. Similar relationship was shown by the bee during the deposition time with all the abiotic factors. Both outgoing and incoming trips had the highly significant relationship with the maximum temperature. With the minimum temperature and RH, the bee had the negative non-significant relationship. With the sunshine hours they had the highly significant positive relationship. With the rainfall the bee had the significant negative significant relationship. The foraging plants were also recorded for the bees. The bee foraged on 6 different plants of different family for its provision viz., *Medicago polymorpha* (Fabaceae), *Lysimachia arvensis* (Primulaceae), *Polygonum effusum* (Polygonaceae), *Parthenium hysterophorus* (Asteraceae), *Polypogon monspeliensis* (Poaceae), *Gamochaeta pensylvanica* (Asteraceae). It was observed that bees mostly preferred *Polygonum effusum* for collection of their provision followed by *Lysimachia arvensis*. On the basis of present studies, it can be concluded that:

- The *Nomia aurata* bees are active from the last week of February till mid-June.
- The *Nomia aurata* bees construct their nests in very close proximity with the weed plant *Polygonum effusum* and they construct their nests in aggregation.
- The foraging period of bees starts from around 8:00 am in the morning and ends at around 2:00 pm.
- Bee generally forages on different plants for provision but the most preferred plant is *Polygonum effusum*.

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