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Notes on the large carpenter bees, genus *Xylocopa* Linnaeus, 1758 (Hymenoptera: Apidae) from Sagar Island, India

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Abstract

Island ecosystems are very unique to study the native biodiversity and several studies have indicated the regional fauna are at great risk of decline globally. Sundarban harbours one of the largest mangrove forests in the world and have been declared as UNESCO world heritage site. Regional documentation of bee fauna is a practical way of addressing the Eltonian shortfall in India. The paper is based on freshly collected samples of large carpenter bees from Sagar Island, West Bengal. Two species namely *Xylocopa* (*Koptortosoma*) *aestuans* (Linnaeus, 1758) and *Xylocopa (Ctenoxylocopa) fenestrata* (Fabricius, 1798*)* were encountered in field and collected subsequently. Diagnostic characters, global distribution and floral linkages of both species are augmented herein from the study site.

Keywords: Wild bees, conservation, floral association, mangrove ecosystem, pollinator, Sundarban.

1. Introduction

From the huge and robust (13-33 mm long) Xylocopini to the petite and slender (3-13 mm) Allodapini, Ceratinini, and Manueliini, the subfamily Xylocopinae contains bees that are quite different in size and appearance (Michener 2007). A single genus, *Xylocopa* Latreille, which is generally known as large carpenter bees because it often builds its nest in dead wood, with the exception of members of the subgenus *Proxylocopa*, which builds its nest in the ground, represents the tribe Xylocopini (Hurd and Moure 1963). The genus most likely originated in the Oriental-Palearctic region, and the subgenera's current distribution, which is primarily in tropical and subtropical climates with sporadic occurrences in temperate regions, is largely the consequence of independent dispersal events (Hurd and Moure, 1963; Leys and Hogendoorn, 2008). One of the most varied groups of solitary bees in the world, large carpenter bees have 377 identified species worldwide; India is represented by 11 subgenera belonging to 28 species; There are 62 species in the subgenus *Koptortosoma* worldwide, with 2 species found in India whereas *Ctenoxylocopa* is known by 8 species globally with 2 species from the country (Ascher and Pickering, 2023).

Due to their involvement in foraging on various flowers and year-round presence, carpenter bees make up a significant percentage of Indian wildlife. Males exclusively consume nectar, while females gather pollen and nectar to raise their brood (Raju and Rao, 2006). Bees and flowers have a mutualistic relationship whereby the bees obtain nectar as a food source and, as a result, pollinate the flowers, which is crucial for the sexual development of plants. Also, by travelling far distances, floral resources determine foraging behaviour (either oligolectic or polylectic) and foraging range. Carpenter bees are widely known for collecting both nectar and pollen from a variety of flowers that include both male and female species (Bhaskara and Subba, 1994; Kumar, 2000; Zafar, 2005).

Due to its buzz pollination, generalist floral visitation, long length of availability, and capacity to pollinate flowers under enclosed greenhouse cultivation, carpenter bees are becoming more and more important (Kaeser, 2010; Abrol, 2012). Their commercial use in association with regional cultural believes (Ghosh et al., 2017) encourage the identification of indigenous species, the development of rearing programmes, the relocation of breeding populations to greenhouse or nearby open-field crops, as well as their preservation in the wild to ensure the survival of their species and natural use in open-field crop pollination (Zafar, 2005; Kaeser, 2010; Abrol, 2012). With these factors in mind, we collected carpenter bees that were readily

available for identification and the availability of various species of floral plant life to further facilitate their planning for their commercialization activities.

2. Materials & methods

The study was conducted in Sagar Island, a part of the Sundarban deltaic complex. The Island falls under the district S- 24 parganas of West Bengal, India. Total six unique study locations were surveyed (Fig. 1). Opportunistic sweep netting was employed to catch large carpenter bees. Agronomic crops, vegetable and flowering plants in kitchen gardens, among other habitats, were all surveyed. The surveys were commenced bi-monthly from March to November in 2018 in a clear sunny weather which is suitable for bee foraging. Random transect walks were employed and bee visitation on flowers were recorded without disturbing them and after that bees were collected by insect nets and immediately euthanized in a killing jar (ethyl acetate fume). The specimens were then brought back to laboratory and methodically stretched, pinned and put in insect wooden box. To safeguard the collection from ants and other insects, naphthalene balls were mounted and Coopex® powder was distributed within the boxes. By utilising several identification keys, such as those developed by Bingham (1897), Maa (1938), Michener (2007) and Prashantha & Belavadi (2017). The study map is prepared by using QGIS v.2.4.0.

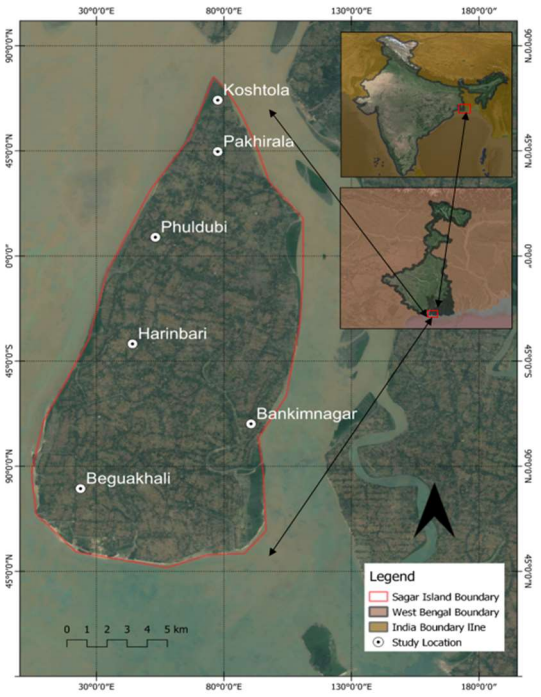

Fig. 1. Map of study site with individual locality records in Sagar Island, West Bengal.

3. Results

Order: **HYMENOPTERA**

Family: **APIDAE**

Subfamily: **XYLOCOPINAE**

Tribe: **XYLOCOPINI**

Genus: **XYLOCOPA LATREILLE, 1802**

a. *Xylocopa* (*Koptortosoma*) *aestuans* (Linnaeus, 1758) (Fig.2 A–D)

1758. *Apis aestuans,* Linne*, Sy.sl. Nat.* (lOth edit.) I, p. 57U, No. 37, ♀

Diagnosis: Body length (18.4±1.9 mm). Head comparatively broader than long; sub circular outline; sturdily convex as in frontal view with higher occipital area. Punctations in clypeus dense; prominent medially impunctate line on clypeus; mesonotum disc medially non punctate and smooth. Face with black plumose hairs; pubescence in vertex, occiput and gena black; mesosomal dorsum compactly covered with yellow pubescence concealing primary integument; pubescence in tergites black, erect and comparatively longer the closely allied species (*X. pubescence*). Scape distinctly larger than flagellomeres. Wings dark with purple effulgence. Metasomal tergal segments structurally bigger and elongated.

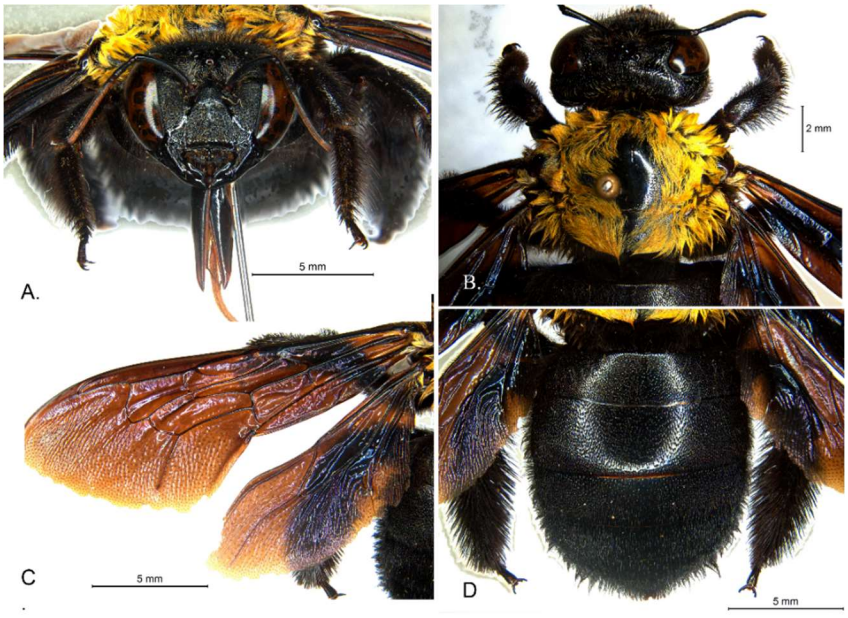

Fig. 2. ♀ *Xylocopa* (*Koptortosoma*) *aestuans* (Linnaeus, 1758) A Face in ventral view, B mesasoma in dorsal view, C Wing in dorasal view, D mesasoma in dorsal view.

Material examined: India: 1♀ West Bengal: S-24 Parganas, Sagar Island 21.82°N, 88.12°E, 7 m, 22.iii.2018, *C. fistula* flower, Coll. D. Ghosh; 2♀: S-24 Parganas, Sagar Island, Kamalpur, 21.71°N, 88.11°E, 5 m, 1,2,5.iv.2018, *C. pepo,* Coll. D. Ghosh; 2♀: S-24 Parganas, Sagar Island, Rudranagar 21.74°N, 88.08°E, 3 m, 13.vi.2018, *S. melongena* flower, Coll. D. Ghosh.
Distribution: Karnataka, Maharashtra, Uttarakhand, West Bengal. *Elsewhere*: Nepal, Pakistan, Saudi Arabia, Malaysia, Singapore, Myanmar, Thailand, Indonesia, Vietnam.
Floral association: Golden shower *(Cassia fistula* L. – family Fabaceae), Common sunflower (*Helianthus annuus* L.– family Asteraceae), Blue snake weed (*Stachytarpheta jamaicensis* (L.) Vahl. – family Verbenaceae), Squash (*Cucurbita pepo* L. – family Cucurbitaceae), Eggplant (*Solanum melongena* L. – family Solanaceae), Tomato (*Solanum* sp. – family Solanaceae), *Eucalyptus* sp. (family– Myrtaceae).

b. *Xylocopa* (*Ctenoxylocopa*) *fenestrata* (**Fabricius**, **1798**) (Fig. 3 A–D)

1798. *Apis fenestrate* Fabricius*, Entomol., Syst. Suppl.* p. 273, No. 3, ♂

Diagnosis: Large body size (20.1±2.2 mm). Integument black; wings with violaceous tints, hyaline basally. Pubescence black. Face flat; space between lateral ocelli with very strong transverse ridge; mandible tridentate and very stout. Punctations in labrum large and of second-degree density (light intensity); second degree punctations on vertex and posterior part of gena. Short frontal carina with basal ½ part weak. Dorsum posteriorly rounded into propodeum. Triangular region of propodeum large, surpassing slightly from centre to end of the latter. Presence of gradulus in metasomal tergum 1–3 with and absent in remaining tergal segments. Submedian process of epipygium runs parallel with each other.

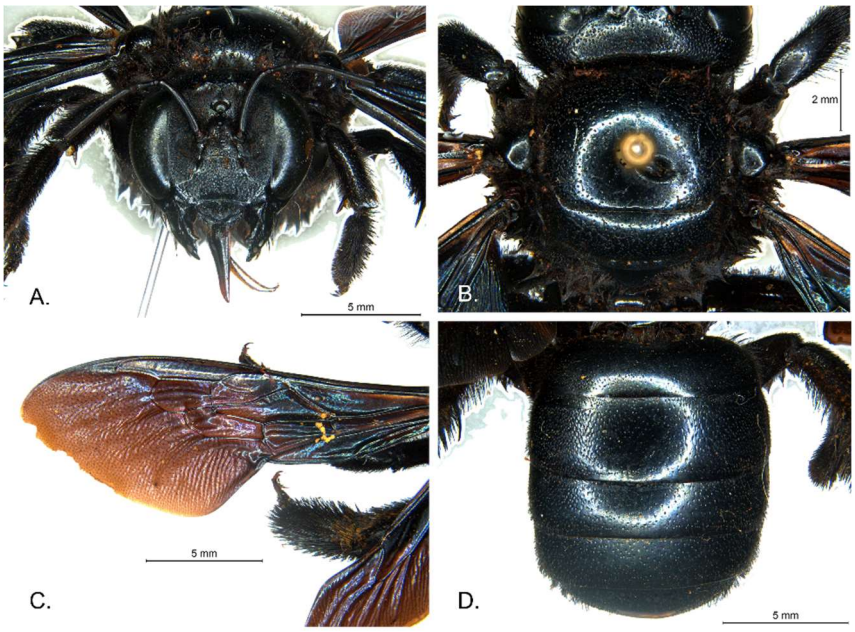

Fig. 3. ♀ *Xylocopa (Ctenoxylocopa) fenestrata* (Fabricius, 1798*)* A Face in ventral view, B mesasoma in dorsal view, C Wing in dorasal view, D mesasoma in dorsal view.

Material examined: India: 5♀: West Bengal: S-24 Parganas, Sagar Island, Bamankhali, 21.82°N, 88.12°E, 7 m, 20.iii.2018, from nest in bamboo, Coll. D. Ghosh; 3♀: S-24 Parganas, Sagar Island, Phuldubi, 21.8°N, 88.09°E, 5 m, 2.iv.2018, from nest in *Eucalyptus* sp., Coll. D. Ghosh; 4♀: S-24 Parganas, Sagar Island, Chemaguri, 21.6°N, 88.13°E, 3 m, 13.vi.2018, on air, Coll. D. Ghosh.

Distribution: Arunachal Pradesh, Andhra Pradesh, Assam, Bihar, Chattisgarh, Goa, Haryana, Jharkhand, Jammu & Kashmir, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Odisha, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand and West Bengal. *Elsewhere*: Afghanistan, Bhutan, China, Iraq, Iran, Madagascar, Mauritius, Maldives, Myanmar, Nepal, Pakistan, Sri Lanka, United Arab Emirates.

Floral association: Crown flower (*Calotropis gigantea* (L.) Dryand. – family Apocynaceae), Sea holly (*Acanthus ilicifolius* L.– family Acanthaceae). *Avicennia alba* Blume (family Acanthaceae), *Justicia gendarussa* Burm.f. (family Acanthaceae), Golden shower *(Cassia fistula* L.– family Fabaceae), *Eucalyptus* sp. (family– Myrtaceae), (*Helianthus annuus* L.– family Asteraceae), *Ipomoea* sp. 1 (family– Convolvulaceae).

4. Discussion

Lack of natural pollinators is a major factor in the insufficient pollination of several commercial crops. With the help of honeybees, bumblebees, and solitary bees like *Xylocopa* species, among others, supplemental pollination services are managed (Abrol, 2012). Carpenter bees are common buzz pollinators of many crops, such as almonds (Abrol, 1988), strawberries (Abrol, 1989), oil seed crops (Kapil et al., 1971), cucumbers (Sihag, 1993), sunflowers (Shrivastava and Shrivastava, 1986), peaches, pears, and plums (Kumar et al., 1989), explants (Davidar et al., 2015). Along with commercial crops, Xylocopa bees are also known to be generalist forager on several wild plants like which indicates an important pollinating agent for harbouring the alpha floral diversity (Corlett, 2004; Raju & Rao, 2006).

In order to get nectar from flowers without actually pollinating them, *Xylocopa aestuans* also engage in nectar robbing. Nectar robbing is a practical way to gather nectar from blooms that would otherwise be unsuitable, such as those with small openings for the bee's bulk or those with long penduncles (which are better suited for a butterfly's long probiscis). In addition to harming the plant, this substantially reduces the amount of nectar that may be collected by legal pollination by other bees. Secondary nectar robbers like *Amegilla*, which have mandibles too weak to cut through the substantial flower structures, may also take advantage of the hole made by *Xylocopa*.

Carpenter bee sociality is highly fascinating because various species show diverse but modest levels of sociality. Due of their striking resemblance to the highly eusocial bees in their sister group Apidae, *Xylocopa* bees may provide us with insight into the development of sociality in bees. A nest may be shared by a dominant reproductive female and a guard female who is either young and pre-reproductive or old and no longer reproductive, according to research on the closely related *Xylocopa asteuans*. Daughters or outsiders may seize control of the dominant female, forcing the defeated female into a guard duty while the successful female assumes the reproductive function (Hogendoorn & Velthuis, 1993). Hence, *Xylocopa* bees advocates to be an excellent candidate as model taxon for studying social behavioural dynamics of bees.

They have a lengthy season of activity and are generalist nectar and pollen foragers, which may lessen the need to import alien pollinators (Kaeser, 2010). They make an appealing candidate for crop pollination due to their widespread geographic range, high temperature tolerance, and activity at low illumination levels (Kaeser, 2010; Abrol, 2012).

They were effective pollinators, as evidenced by the preliminary success of their pollination at field and greenhouse crops. With numerous restrictions, it is challenging to develop their captive breeding. Using artificial nesting materials in the wild could encourage them to accept them and reproduce, which could be an alternative of local beekeeping for efficient pollination of tomatoes, melons, blueberries, passion fruit etc.; involvement of native stakeholders play a crucial role in safeguarding local biodiversity in which both commercial and biodiversity avenues can be utilised (Kaeser, 2010; Ghosh et al., 2019). Future studies on involvement of native bee species with local biodiversity and sustainable commercial output regime is imperative as it is our belief by far the most practical way to conserve them as it is absolutely crucial at current light of climate change and global food security issues.

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