



## DIVERSITY AND FORAGING BEHAVIOUR OF INSECT POLLINATORS IN CUCUMBER

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### ABSTRACT

This study aims to identify the diversity of pollinating bees, measure the activity of pollinating bee visits, and measure the role of pollinating bees in fruit formation in cucumber *Cucumis sativus*. The pollinator species with the highest to lowest abundance were *Xylocopa confusa* (464 individuals, 35.83%), *Ceratina cognata* (356 individuals, 27.49%), *Apis cyrtandrae* (251 individuals, 19.38%), *Megachile unbripenis* (56 individuals, 4.32%), *Apis cerana* (44 individuals, 3.40%), *Megachile fulvifrons* (38 individuals, 2.93%), *Apis burnensis* (36 individuals, 2.78%), *Megachile conjuncta* (20 individuals, 1.54%), *Xylocopa latipes* (20 individuals, 1.54%), and *Xylocopa caerulea* (10 individuals, 0.77%). Total species and individuals were highest in the morning from 07.00-09.00 WITA (10 species, 548 individuals), which decreased in the afternoon (9 species, 480 individuals) and became the least in the afternoon from 13.00-16.00 WITA (8 species, 267 individuals).

**Key words:** Apidae, carpenter bee, Central Sulawesi, conservation, diversity, identification, Indonesia, insect, pollination, taxonomy, population dynamics

Bees play an important role in pollination ecology. The number of bee species worldwide is estimated at 16,000 (Bhowmik et al., 2021). Social bees have a higher level than solitary bees and there are caste divisions. Solitary bees interact between individuals in one hive. Solitary bee nests are made by the female mother who then feeds on her larvae, but usually the mother leaves the nest before the larvae mature (Ghanshyam Kachhawa et al., 2020). Bees belong to the order Hymenoptera, in the superfamily Apoidea. Apis bees in the Apidae family (subfamily Apinae) are examples of social bees that act as pollinators. Some horticultural crops are autopolinated (self-pollinated), so the role of pollinating bees in increasing agricultural production and habitat is less considered. A decrease in the population of pollinating bees around agricultural land will result in a decrease in the frequency of visits to flowers. Pollination by bees contributes significantly to fruit production (Mandal and Mandal, 2015). Plants assisted by bee pollination have increased fruit size and number of seeds/ fruit. Cucumber is one of the agricultural crops that require pollination for fruit formation. Bees are natural agents that do not cost money to help the pollination process. Several studies reported the types of pollinating bees and their effect on plant fruit formation. *Bombus terrestris* L was reported as a bee producing heavier fruit weight (Painkra, 2018). This study aims to identify the diversity of pollinating bees, measure the activity visits, and measure the role in fruit formation in cucumber.

### MATERIALS AND METHODS

The research was conducted in the Organic Farmland, Sigi Regency, Central Sulawesi, Indonesia (1°07'13"S 120°09'30"E). Pollinating bee biodiversity was observed for 30 days on 200 flowering cucumber plants using the scan sampling method. Bee diversity observations were made at three time periods, namely 07.00-09.00, 10.00-12.00, and 13:00-16:00 WITA when the weather was sunny or not raining. The number of species and individuals of bees visiting the cucumber flowers were recorded. During observations, pollinators visiting the crop were collected, preserved in 70% ethanol and identified with available taxonomic keys. Calculation of diversity indices, species richness was done with Shannon-Weiner diversity 'H' index (Ghanshyam Kachhawa et al., 2020).

### RESULTS AND DISCUSSION

Pollinating bees observed on cucumber plants consisted of 10 species, namely *Megachile conjuncta*, *M. fulvifrons*, *M. unbripenis*, *X. confusa*, *X. latipes*, *X. caerulea*, *C. cognata*, *Amegilla cyrtandrae*, *A. burnensis* and *Apis cerana*. Three pollinator bee species were found in high abundance, namely *X. confusa* (345 individuals), *A. cyrtandrae* (115 individuals), and *C. cognata* (90 individuals). The species pollinating cucumber plants with the highest

to lowest abundance were *X. confusa* (464 individuals, 35.83%), *C. cognata* (356 individuals, 27.49%), *A. cyrtandrae* (251 individuals, 19.38%), *M. unbripennis* (56 individuals, 4.32%), *A. cerana* (44 individuals, 3.40%), *M. fulvifrons* (38 individuals, 2.93%), *A. burnensis* (36 individuals, 2.78%), *M. conjuncta* (20 individuals, 1.54%), *X. latipes* (20 individuals, 1.54%), and *X. caerulea* (10 individuals, 0.77%). Total species and individuals were highest in the morning from 07.00-09.00 WITA (10 species, 548 individuals), decreased in the afternoon (9 species, 480 individuals) and least in the afternoon from 13.00-16.00 WITA (8 species, 267 individuals). Furthermore, the similarity of pollinator bee species in the morning, afternoon and evening showed the similarity of visitor bees between time periods ranged from 84-94% and the highest similarity occurred in the afternoon - afternoon (94%)...

Environmental factors affect the local distribution of bees in foraging, reproduction and molting activities (Ranjitha et al., 2019). Light intensity is positively correlated with the number of individuals and species. Bee flight activity is reduced at low temperatures and high humidity (Sharma et al., 2019). At low temperatures, the number of foraging bees also decreases. Yogapriya et al. (2019) also reported an increase in the number of solitary bees in coffee plantations, with increasing light intensity. However, the number of species and number of individuals were negatively correlated with wind speed. Visitation activity can be a measure of insect effectiveness pollinators and many characters, such as the number of hairs on the body, and pollen basket as a place to store pollen (Painkra, 2018). Before exploiting the food source, bees have the ability to learn to handle flowers in order to optimally obtain pollen and nectar. *X. confusa* and *A. cyrtandrae* bees collect pollen by vibrating the pupa tube, while *C. cognata* collect pollen by inserting their proboscis into the pupa tube. Some pollinating bees were reported to vibrate the pupa to take pollen, such as *A. chlorocyanea* on tomato flowers in Australia (Bhowmik et al., 2017), *X. ordinaria* on *Solanum curvispinum* flowers in Brazil (Bhowmik et

al., 2017), *Hylaeus* on tomato flowers in Bogor (Mandal and Mandal, 2015). Buzz pollination behavior results in a greater number of pollen drops in a shorter time. Species that are not capable of producing vibrations will insert their proboscis into the pedicel tube or tear and chew the corolla to get the pollen, thus requiring a shorter time (Nemeth and Szekeley, 2000). obtain the pollen, thus requiring a longer time. The difference in the efficiency of pollen release in flowers is one of the reasons why flowers with pedicel tubes are commonly visited by buzzing bees (Mandal and Mandal, 2015).

#### AUTHOR CONTRIBUTION STATEMENT

Contributed in data analysis (MM, IMB, FD) and Field surveys (MT).

#### CONFLICT OF INTEREST

No conflict of interest.

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(Manuscript Received: July, 2024; Revised: August, 2024;

Accepted: August, 2024; Online Published: September, 2024)

Online First in [www.entosocindia.org](http://www.entosocindia.org) and [indianentomology.org](http://indianentomology.org) Ref. No. e24370