

Inventory of the Order Orthoptera in Institut Teknologi Sumatera

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Abstract:

Orthoptera is always associated with plant vegetation, as these insects are herbivores and rely on plants as their primary food source. Institut Teknologi Sumatera is home to various types of vegetation and plant diversity, both naturally growing and managed for specific purposes. Based on this background, research is needed to inventory and document the species of grasshoppers found at Institut Teknologi Sumatera and understand their distribution and habitat. Data collection on the diversity of the Orthoptera order was carried out at Institut Teknologi Sumatera and identified in the Zoology Laboratory at Institut Teknologi Sumatera. Sampling was conducted using an insect net and the hand sorting method. Observations were conducted in the morning from 07:00 – 10:00 AM WIB and in the afternoon from 03:00 – 05:00 PM WIB. Based on the research conducted at the Institut Teknologi Sumatera, 12 genera were found at four observation station points. At station I, 161 individuals were found; at station II, 204 individuals were found; at station III, 136 individuals were found; and at station IV, 145 individuals were found. 12 genera of the order Orthoptera were found, belonging to four families. The most commonly found family was Acrididae, while the least commonly found families were Gryllidae and Pyrgomorphidae.

Keywords: : Grasshoppers, Orthoptera, Institut Teknologi Sumatera

Introduction

The phylum Arthropoda can be classified into 26 orders, including Orthoptera. The term *Orthoptera* originates from Latin, where *Orthop* means "straight" and *Pteron* means "wing," referring to their straight wings, which is why they are categorized under this order (Saroni & Gustina, 2021). These insects are commonly found in grasslands. Their habitat mainly consists of grassy areas and dry environments such as dry soil, rocky surfaces, and other arid locations (Irwanto & Gusnia, 2021).

Both juvenile and adult insects share the same habitat and food sources. Generally, some insects are phytophagous (plant-eating), while others are zoophagous (predatory), and some even exhibit cannibalistic behavior (Boror, 1992). The life cycle of the order Orthoptera falls into the category of insects with an incomplete metamorphosis. Insects undergoing incomplete metamorphosis develop through stages starting from eggs, then transitioning into nymphs (juvenile insects), and finally becoming adult insects or imago. During the nymph stage, young insects undergo molting, shedding their exoskeleton to grow into adulthood. In the adult stage, their organs fully develop, including their reproductive system and wings (Boror, 1992).

Orthoptera is always associated with plant vegetation, as these insects are herbivores and rely on

plants as their primary food source (Semiun & Mamulak, 2019). Several ecological factors, including rainfall, relative humidity, atmospheric temperature, protection from external predators, and vegetation structure, can influence the diversity of Orthoptera.

According to Prakoso (2017), the abundance and diversity of the order Orthoptera are higher in undisturbed ecosystems compared to disturbed ones. Additionally, Naskrecki (2013) stated that vegetation influences the presence of grasshopper species within an ecosystem. Greater vegetation diversity in a habitat can serve as a rich food source for Orthoptera, promoting increased grasshopper diversity. The abundance of insect species is also determined by their reproductive activity, supported by a suitable environment and sufficient food sources. In tropical regions, insect abundance and reproduction are significantly influenced by seasonal changes (Surahmat et al., 2001), as seasons impact food availability and the survival capacity of insects.

Institut Teknologi Sumatera is home to various types of vegetation and plant diversity, both naturally growing and managed for specific purposes. Based on this background, research is needed to inventory and document the species of Orthoptera found at Institut Teknologi Sumatera and understand their distribution and habitat. The results of this inventory are expected to serve as a foundation for

further research, conservation efforts, and the sustainable utilization of biodiversity in the region.

Material and Methods

Data collection on the diversity of the Orthoptera order was carried out at Institut Teknologi Sumatera and identified in the Zoology Laboratory at Institut Teknologi Sumatera in January until March 2022. Purposive sampling is a sampling technique based on specific considerations. The primary goal of purposive sampling is to obtain logically selected samples that can be considered representative of the population being studied (Yudharta et al., 2021). Sampling process was conducted by 3 collectors of each station using insect net and the hand collection method. Observations were conducted in the morning from 07:00 – 10:00 AM WIB and in the afternoon from 03:00 – 05:00 PM WIB (Semun & Mamulak, 2019). These observations were conducted at four locations around Institut Teknologi Sumatera (Figure 1). At these four locations, one dense vegetation was observed: the vegetation around Buildings E and F (Station I - 5°21'43"S 105°18'54"E). The open habitats include the Institut Teknologi Sumatera Botanical Garden – Kebun Raya (Station II - 5°22'16"S 105°18'41"E), Embung A (Station III - 5°21'32"S 105°18'36"E), and the area around Asrama TPB (Dormitory) Institut Teknologi Sumatera (Station IV - 5°21'34"S 105°19'05"E). This was done to compare the three open and one dense vegetation area. Microclimates during observation (temperature dan humidity) of each station were measured using thermohygrometer.



Figure 1. Map of the research locations

The specimens obtained were placed in 70% alcohol, which serves to kill the specimens, and then left to air dry. The specimens were pinned using a needle #2 at the posterior pronotum, just to the right of the body's midline. They were then placed on a mounting board to position the insect. The mounting board is cork, which allows the needles to be inserted deeply. These needles adjust the legs and antennae and stabilize the specimen during drying. Drying was carried out using an oven for 3 days at 50°C. Once the specimens were dry, they were placed in a collection box (Boror, 1992).

The preserved samples will be counted and identified based on their genus. Insect identification is carried out up to the genus level using references from GBIF.org database and Boror (1992). Data collection and identification of insect species are made by observing the morphological characteristics of the Orthoptera order, such as the color of the abdomen, wing color, skin color, and thorax color. After the samples are observed, the object manually measured and photographed using smartphone camera (Irwanto & Gusnia, 2021). Primary data management involves processing data analyzed up to the genus level. All preserved sample collection stored in Zoology Laboratory of Institut Teknologi Sumatera.

Results and Discussion

Based on the research conducted at the four observation stations in Institut Teknologi Sumatera, 12 genera of Orthoptera found, belonging to four families. The most commonly found family was **Acrididae**, while the least were **Gryllidae** and **Pyrgomorphidae** (Table 1).

Differences in vegetation type and composition greatly affect the abundance of species that can live in it, where Orthoptera are also affected by this. In this study, the types of Orthoptera obtained were almost the same at all observation stations, both in areas that had denser vegetation (Station I), and in areas that were more open and experienced periodic pruning (Stations II, III, IV). Research conducted in areas with denser vegetation, in the Wan Abdurahman Gunung Betung Botanical Forest Park Lampung, found more Orthoptera species, i.e. 30 species from 6 families (Acrididae, Eumastacidae, Tettrigidae, Tettigonidae, Gryllidae and Gryllotalpidae) (Nismah and Anasta, 2009).

Table 1. Orthoptera species observed on Research Stations at Institut Teknologi Sumatera

No	Famili	Genus	Station			
			I	II	III	IV
1	Acrididae	<i>Acrida</i>	✓	✓	✓	✓
2		<i>Anacridium</i>	✓	✓	✓	✓
3		<i>Caryanda</i>	✓	-	✓	-
4		<i>Gastrimargus</i>	✓	✓	✓	✓
5		<i>Oxya</i>	✓	✓	✓	✓
6		<i>Phlaeoba</i>	-	✓	✓	✓
7		<i>Teratodes</i>	✓	✓	✓	✓
8		<i>Trilophidia</i>	✓	✓	✓	✓
9	Gryllidae	<i>Anaxipha</i>	✓	-	-	-
10	Pyrgomorphidae	<i>Atractomorpha</i>	✓	✓	✓	✓
11	Tettigoniidae	<i>Conocephalus</i>	✓	✓	✓	✓
12		<i>Neoconocephalus</i>	✓	✓	✓	✓

Key Characteristics of Genera from the Order Orthoptera Found at ITERA

The order Orthoptera found at four observation stations includes 12 genera: *Teratodes*, *Acrida*, *Atractomorpha*, *Anacridium*, *Gastrimargus*, *Caryanda*, *Neoconocephalus*, *Conocephalus*, *Trilophidia*, *Oxya*, *Phlaeoba* and *Anaxipha*.

1. Genus *Teratodes*

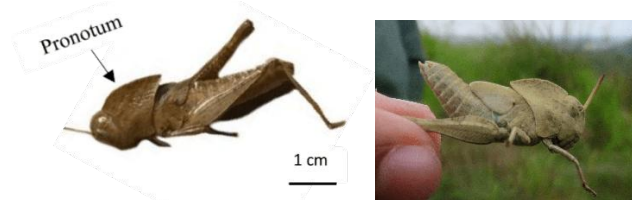


Figure 2. Left: Orthoptera species from *Teratodes* (Personal documentation, 2022), Right: *Teratodes monticollis* (Gray, 1832) (GBIF-iNaturalist, 2023)

In the genus *Teratodes*, the pronotum has a hood-like structure slightly higher than the rest of the body. Its antennae are short and yellowish-brown in colour. The body of this genus exhibits green, yellow, and brown hues. The pronotum is highly compressed, forming a tall peak, with the front part curving over the head into a single point. The middle section also forms a high peak, and its rough-textured exoskeleton covers half the length of the abdomen. The hind femur has small, sharp spines on the upper part (Shishodia et al., 2010). This genus is known for being a voracious leaf eater. The typical habitat of *Teratodes* includes

shrubs and tree foliage. This genus is commonly found in the Oriental and Australian regions.

2. Genus *Acrida*

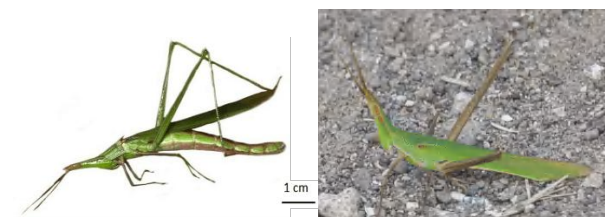


Figure 3. Left: Orthoptera species from *Acrida* (Personal documentation, 2022), Right: *Acrida willemsei* (Dirsh, 1954) (GBIF-iNaturalist, 2017)

The morphology of the genus *Acrida* features a slender body, short antennae, and body coloration that varies depending on the species—green, yellow, brown, or green with brown patterns. When the wings are spread, the hind wings are wider than the forewings. The hind femur is smooth, without serrations, and the ovipositor valves are never serrated or spiny. The body length of this genus ranges from 4.5–5.5 cm (males) to 1.5–7.5 cm (females). This genus prefers dry and hot environments, typically living in grassy areas. Some species can change their coloration and patterns to match the plants they inhabit in response to environmental conditions. Their wings appear red (Kumar & Usmani, 2015). The *Acrida* genus consists of plant-eating (phytophagous) species active during the day. It is commonly found in the Oriental region, often in wooded areas and coastal forests that are not densely vegetated (Kumar & Usmani; n.d., 2014).

3. Genus *Atractomorpha*



Figure 4. Left: Orthoptera species from *Atractomorpha* (Personal documentation, 2022), Right: *Atractomorpha lata* (Mochulsky, 1866) (GBIF-iNaturalist, 2025)

The head of this genus is characterized by a forward-projecting, elongated triangular shape when viewed from behind, with a rounded top. Its antennae

are flat and resemble a dagger. The body appears boat-like due to its broad abdomen. The *Atractomorpha* genus has a chewing-biting mouthpart, making it a pest that reduces the quantity and quality of crops. This genus rarely flies, has a short jumping range, and is not aggressive (Sari et al., 2018). It exhibits polymorphism, meaning it can change body colour from green to brown as environmental temperatures rise. *Atractomorpha* inhabits plantations and rice fields, where it acts as a pest. Males grow to about 2 cm long, while females reach 3.5 cm. This genus is found in the Oriental region, including Indonesia, Japan (including the Ryukyu Islands), the Korean Peninsula, and China (Sari et al., 2018).

4. Genus *Anacridium*



Figure 5. Left: Orthoptera species from *Anacridium* (Personal documentation, 2022), Right: *Anacridium deschauenseei* Rehn, 1941 ((GBIF-iNaturalist, 2021)

The *Anacridium* genus is characterized by its grey, brown, or olive colouration, with relatively short and sturdy antennae. Adult males grow to a length of 3.0–5.6 cm, while females reach 4.6–7.0 cm. This genus is active from late afternoon until early morning and is challenging to find during the morning and daytime (Dima, 2023). It is usually found on the ground surface. Most species in this genus are folivores, feeding only on the leaves of certain plants, and they are solitary. The *Anacridium* genus is widely distributed in the Oriental region (Ivković et al., 2016).

5. Genus *Gastrimargus*



Figure 6. Left: Orthoptera species from *Gastrimargus* (Personal documentation, 2022), Right: *Gastrimargus marmoratus* (Thunberg, 1815) (GBIF-iNaturalist, 2020)

The *Gastrimargus* genus is characterized by eyes with black and white vertical stripes, a greyish tibia, and a reddish lower hind femur. It is usually found near shrubs in warm and dry habitats. Adult

Gastrimargus individuals have a greyish-brown body colour, while nymphs are typically green or yellowish (Ma et al., 2009). The distribution of the *Gastrimargus* genus includes countries in the Oriental and Ethiopian regions (Baker & Dysart, 1992).

6. Genus *Caryanda*

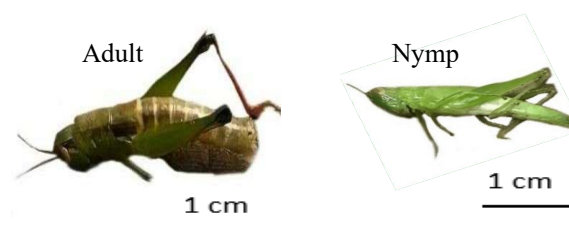


Figure 7. Above: Orthoptera species from *Caryanda* (Personal documentation, 2022), Below: *Caryanda spuria* (Stål, 1861) (GBIF-iNaturalist, 2024)

In this genus, the female's body is larger than the male's. The genus has a slender and medium-sized body. The head is shorter than the pronotum, with large, elongated eyes. It lacks hind wings, and the forewings are also short. The body is generally yellowish-green with black markings on the back of the head, a yellow-green colour, and a yellow face. The hind tarsi are short, not longer than half of the hind tibia, with a conical-shaped cerci (Storozhenko, 2021). The female's body length is larger than the male's, with males measuring 1.9–2.5 cm and females 2.7–3 cm. The *Caryanda* genus comprises 88 species in the Oriental region, including the Eastern Palearctic, China, Indonesia, and the Afrotropical region (Storozhenko, 2021).

7. Genus *Neoconocephalus*

In the genus *Neoconocephalus*, the wings are usually as long as the body. The face is cone-shaped with a pointed tip. Females in this genus have a very long ovipositor, which exceeds their body length. This genus has green and brown coloration. It can be identified by its size and shape, with black-colored eyes. Most species in this genus can be distinguished by their characteristic cone shape and the black

coloration at the tip of their mouth. Their habitat includes grassy areas, shrubs, marshes, and sometimes cornfields. Adult individuals primarily feed on grass seeds, while nymphs consume grass flowers (Snyder et al., 2009). This genus is commonly found in Oriental, Nearctic, and Ethiopian regions.

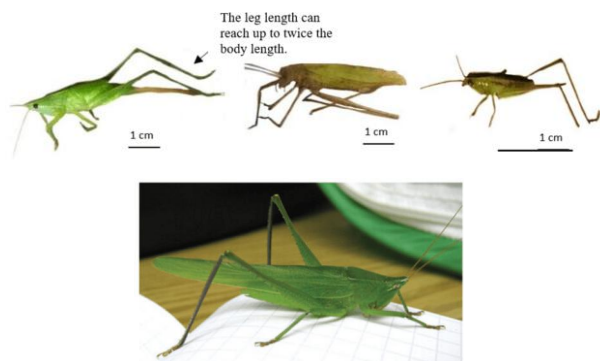


Figure 8. Above: Orthoptera species from *Neoconocephalus* (Personal documentation, 2022), Below: *Neoconocephalus affinis* (Palisot de Beauvois, 1805) (Hofstede, et.al., 2020)

8. Genus *Conocephalus*

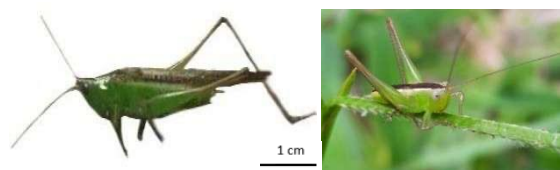


Figure 9. Left: Orthoptera species from *Conocephalus* (Personal documentation, 2022), Right: *Conocephalus maculatus* (Le Guillou, 1841) (GBIF-iNaturalist, 2024)

The characteristics of the genus *Conocephalus* include front and middle femora, which usually lack spines. The body is small to medium-sized (1.3–2.5 cm). The ovipositor is sword-shaped, with smooth edges and small teeth. This genus is diagnosed as having a small body, a shiny appearance, and very long, fragile antennae (H. M. et al., 2015). The genus has green and brown colouration, with brown wings and a brown dorsal stripe. *Conocephalinae* consists of 156 species worldwide. The Pacific species of *Conocephalus* reportedly includes 18 species and subspecies. This genus is found in various open habitats with dense vegetation, grasslands, salt marshes, dry and wet grasslands, roadsides with tall grass, and riverbanks. It is distributed in the Oriental, Australian, and Neotropical regions (Sadiq et al., 2017).

9. Genus *Trilophidia*

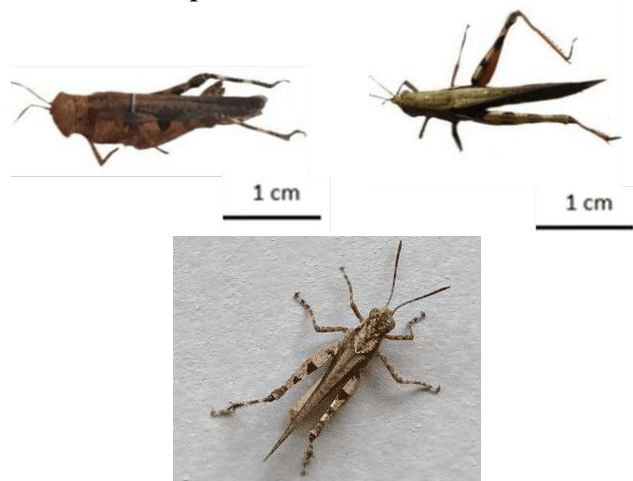


Figure 10. Above: Orthoptera species from *Trilophidia* (Personal documentation, 2022), Below: *Trilophidia annulata* (Thunberg, 1815) (GBIF-iNaturalist, 2024)

Trilophidia has short (filiform) antennae, a pronotum that extends backwards, and a slightly pointed cerci. The subgenital plate curves upward, the hind femur is larger than the tibia, and the tegmina (forewings) is longer than the hind femur. Black stripes can be found on the femur, and the ovipositor is short. The inner surface of the hind femur is larger and elongated at both ends, forming a ring-like appearance (Bai et al., 2016). Some species within this genus are dark brown or dark grey. In its habitat, *Trilophidia* is known as a pest that damages crops. The body length ranges from 1.3 to 3.8 cm. This genus is distributed in the Oriental and Neotropical regions (Bai et al., 2016).

10. Genus *Oxya*

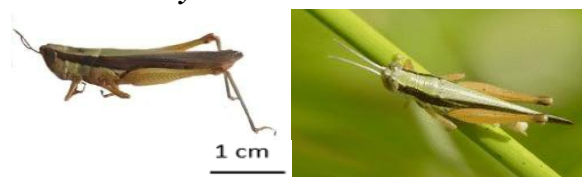


Figure 11. Left: Orthoptera species from *Oxya* (Personal documentation, 2022), Right: *Oxya intricata* (Stål, 1861) (GBIF-iNaturalist, 2023)

The *Oxya* genus consists of grasshoppers characterized by large compound eyes. They are green or brown, with a black stripe running from the eyes to the posterior part of the thorax. Females measure around 3.5 cm, while males measure about 3 cm. They have saltatorial (jumping) legs with yellow femurs and are usually green in colour. Their eyes are oval, and

they have filiform antennae. The frontal ridge is nearly parallel, with fine hairs on their faces. The ovipositor is relatively long and slightly curved. *Oxya* grasshoppers can attack crops during both the rainy and dry seasons. They feed on the edges of leaves, leaving only the leaf veins intact (Soomro & Sultana, 2024). This genus is distributed across Oriental regions (Sultana, 2019).

11. Genus *Phlaeoba*

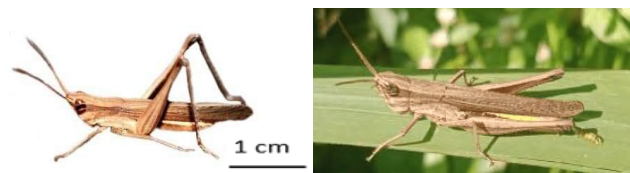


Figure 12. Left: Orthoptera species from *Phlaeoba* (Personal documentation, 2022), Right: *Phlaeoba fumosa* (Serville, 1838) (GBIF-iNaturalist, 2024)

The *Phlaeoba* genus has a cone-shaped head and a narrow, slightly curved cercus with a blunt tip. The abdomen consists of eight oval-shaped ridges, and the tibia is reddish. This genus is generally brown or yellowish-green (Kumar & Usmani, 2019). The antennae are short (filiform), horizontally shaped, and longer than the pronotum. The head is conical, and the eyes are oval-shaped. The wings are fully developed. In males, the cercus is elongated with a narrow, conical angle, while in females, the genital structures have a wider angle with a blunt-ended cercus. The pronotum appears flat or tectiform, with a rounded posterior margin. The body length ranges from 1.5 to 3 cm. This genus is distributed in Oriental and Australian regions. Its habitat includes dry twigs and grassy areas (Hassan, n.d, 2014).

12. Genus *Anaxipha*

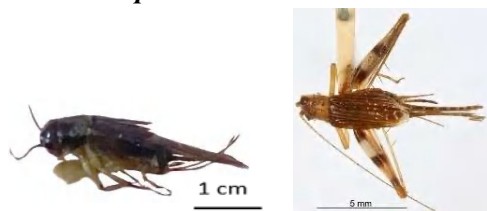


Figure 13. Left: Orthoptera species from *Anaxipha* (Personal documentation, 2022), Right: *Anaxipha* Saussure, 1874 (GBIF-MNHN - Museum national d'Histoire naturelle)

This genus is usually black or dark brown with a brown and yellow, glossy tail. *Anaxipha* has a rounded head, but the back of the head is not rounded.

It has long antennae and a sword-like tail. The pronotum is only slightly longer than the width of its body (Walker & Funk, 2014). In females, the ovipositor is long, whereas in males, the genitalia are short and lack a median process, with a low dorsal cavity. The median ocellus is sometimes visible and sometimes more minor. The pronotum is light yellow except for the posterior edge. The body length of this genus ranges from 2 to 3 cm. Males produce distinctive sounds to attract females. *Anaxipha* is a predator commonly found in rice fields and has the potential to act as a biological control agent against rice leafhopper eggs and small insects such as planthoppers (Karindah et al., 2011). This genus is native to the Oriental, Nearctic, and Ethiopian regions (Morales, 2017).

Conclusion

Based on the research conducted at the Institut Teknologi Sumatera, 12 genera were found at four observation station points. At station I, 161 individuals were found; at station II, 204 individuals were found; at station III, 136 individuals were found; and at station IV, 145 individuals were found. 12 genera of the order Orthoptera were found, belonging to four families. The most commonly found family was **Acrididae**, while the least commonly found families were **Gryllidae** and **Pyrgomorphidae**.

Author Contribution

Gres Maretta: Conceived and designed the experiments and wrote the paper. Angeli Ladynia Sianipar: performed the experiments. Dian Anggria Sari: analyzed and interpreted the data. Andy Darmawan and Jeane Siswitasari Mulyana: Comments and suggestions regarding this analysis.

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Conflict of Interest

The authors have no conflicts of interest to declare

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