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Morphological Description and Ecological Status of Hawkmoths (Lepidoptera: Sphingidae) in Three Vegetation Types of Mt. Kitanglad, Lirongan, Lantapan, Bukidnon, Philippines

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ABSTRACT: Moths are said to have an important ecological role on the stability of terrestrial environment. In this paper, we listed species moths that were collected in three vegetation types in Mt. Kitanglad namely dipterocarp forest, montane forest and agro ecosystem. Thirty three individuals of hawkmoths were collected, and composed of thirteen species namely: *Acherontia lachesis, Agrius convolvuli, Ambulyx staudingeri, Amplypterus panopus mindanaoensis, Daphnis hypothous, Gnathothlibus erotus erotus, Hippotion brunneum, Hippotion echeclus, Psilogramma menephron, Theretra nessus, Theretra rhesus, Theretra manilae, Theretra sugii* and was described based on the: a) general color of their eyes, thorax, abdomen, and the wings and b) length of the eyes, antennae, hook, proboscis, prothorax, mesothorax, metathorax, forewing, hindwing, legs, eight segments of the abdomen, spine, total body length and wingspread. These morphological descriptions can be the basis of its identification. There are 2 rare endemic species, 2 common endemic species, 2 uncommon or local and 7 are Southeast Asia endemic species of hawkmoths were recorded.

Keywords: Dipterocarp forest, Agro ecosystem, Montane forest, Rare endemic, Common endemic.

I. INTRODUCTION

The Philippines is an archipelagic country in a geographical location in Southeast Asia that endows it with abundant natural resources and one of the 17 megadiversity countries in the world (Fontanilla *et al*., 2012). Sphingidae are family of moths belonging to the order lepidoptera. This lepidopteran species are plant feeding as larvae and nectar feeding as adults (Zahiri *et al*., 2011). They are probably the second largest order in the class insecta (Johnson *et al*., 2019) and with the largest radiation of phytophagous insect containing 155,000 species (Zahiri *et al*., 2011) or approximately 160,000 described species (Kawahara & Breinholt, 2014), which thought to have played a central role in the megaradiation of angiosperm. Hawkmoths also known as sphinx moths or hummingbird moths, belong to the class insecta and like all insect, moths have thorax, abdomen and wings which are densely covered in scales. According to Miller (1997) they are distinguished among moths because of their rapid flying ability and a long proboscis which is the hallmark of this family and also having a narrow forewings and shorter hind wings (Chandra *et al.*, 2013). They are holometabolous insect with very uniform life cycles. They are diurnal, crepuscular or nocturnal (Messenger, 1997). According to the report of Primo *et al*., (2013), they play a vital role in the stability of terrestrial ecosystem as herbivores as well as pollination and reproduction of plant species.

Family sphingidae also plays a role in a variety of research programs in terms of their biology, life histories and morphology (Mohagan *et al*., 2019). Since insects are the largest group of animals, large numbers of sampling techniques are employed. One of the most commonly employed technique to attract night active hawkmoths species is by using light trap which allows sampling and killing most specimens undamaged (Sheikh *et al.*, 2016).

Messenger (1997) stated that there are 203 genera or 205 genera of hawkmoths and it contains about 1,450 species (Singh, 2017) or 1,498 species (Rougerie *et al*., 2014) all over the world with about 117 species occurring in the Philippines and 62 species occurring in the Philippines (Hogenes & Treadaway 1998). 24 are Philippine endemic species and 10 are endemic Philippine subspecies of widely distributed Asian species (Hogenes & Treadaway, 1998). Since Mindanao is the second largest island in the Philippines, according to (Kemal *et al*., 2018), there are 49 moth taxa collected from two mountainous localities of Mt. Kitanglad and Caragan but there is no information on the morphological characteristics of hawkmoths in Mt. Kitanglad that will facilitate the identification of the species.

II. MATERIALS AND METHODS

Entry protocol and establishments of the sampling sites: A permit to conduct the study and collect samples was acquired from the authorities of the selected study sites. A Gratuitous permit (No. R10 2019-14) were also

utilized prior to the conduct of study. The study was carried out across vegetation type of Mt. Kitanglad namely: agro ecosystem, dipterocarp forest, and montaneforest.

Sampling procedures, collection and preservation of specimen samples: Different species of moths were collected across the vegetation types in Mt. Kitanglad. Light trapping technique was used for sampling night flying hawkmoths. The light traps were used for 10 hours from 6pm to 4am. Light traps used 500 watts 12 voltage tungsten bulbs powered from portable generator with source power of 220AC, where there was a white sheet where insects will be trapped. A field notebook was brought to record the data such as weather condition (humidity and temperature), start and finish time, name of location, compass and the date. Identification of the collected moth species was based on morphological structures. The length of the head consists of antennae, proboscis and eyes, the abdomen, and the thorax which is divided into prothorax, mesothorax, and metathorax as well as the forewing and hindwing was measured using a ruler. Measurements were reported in cm. Confirmation of the species identification was done by Dr. Alma B. Mohagan and Sir Dave P. Mohagan, faculty of Biology Department and Museum, Central Mindanao University.

III. RESULTS AND DISCUSSION

1. *Acherontia lachesis* (Fabricus, 1798) (Figs. 1 (a) and (b).

Materials Examined: Three MSS- no. 1a.kit.1-4-2019, MSS- no. 1b.kit.1-4-2019, MSS- no. 1c.kit.1-4-2019.

Distribution: Montane forest (3 individuals) Hogenes & Treadaway (1998) record of distribution for *A. lachesis* is from many islands of the Philippines including Balabac, Palawan, Mindoro, Luzon, Marinduque, Polillo, Panay, Negros, Cebu, Samar, Leyte and Mindanao. It is also distributed in Eastern Pakistan, Sri Lanka, Laos, Vietnam, Malaysia, Indonesia to Papua New Guinea, India, China to Southern Japan, and has recently become established on the Hawaiian Islands (Pittaway & Kitching, 2019).

Ecological Status: Southeast Asian Endemic (Pittaway & Kitching 2019).

Description: *Acherontia lachesis* was observed in Montane forest only of Mt. Kitanglad located in Lirongan, Lantapan, Bukidnon around 7:00 pm -11:00 pm, January 4, 2019. This species is also known as death's head hawkmoth (Leong & D'Rozario, 2011; Pittaway & Kitching, 2019).

The head was dominantly covered black with yellow vortex. The antennae ranged from 1.4 cm 1.7 cm, compound black eyes 0.2 cm-0.3 cm, proboscis 2.0 cm-2.1 cm. Thorax dominantly colored yellow with black stripes: prothorax (0.8 cm-1.2 cm), mesothorax (0.5 cm) and metathorax (0.4 cm-0.5 cm). The abdomen was dominantly colored black with yellow bands (2.5 cm-2.8 cm). Setae were absent at the anal end. The wingspan was dominantly colored black with yellow band and white stripe at the discal space. The forewing size was 5.2 cm-6.0 cm, hindwing 2.3 cm-3.6 cm of black with yellow at the basal part.

The wingspan is not consistent with the record of Pittaway & Kitching (2019) because Mt. Kitanglad species has shorter wingspan, but they are similar to the forewing description having a white stripe at discal space. The length of the forewing is consistent to the record of Hogenes & Treadaway (1998) but not consistent in the study of Leong & D'Rozario (2011). There is no comparison with morphometrics of the Kitangladsphingids because other authors like Pittaway& Kitching (2019), did not consider the measurements of the parts of head, abdomen, thorax, and hindwing and only wingspread and length of their forewing only were considered in their papers. The proboscis of this species is shorter and robust, this is to facilitate their consumption of honey (Leong & D'Rozario, 2011). The amount and availability of food and water affects the growth of moth that's why they vary in their sizes. *Acherontia lachesis* is similar to *Acherontia styx medusa* but they differ only by the black basal area of the hindwing Hogenes & Treadaway, (1998).

2. *Agrius convolvuli* (Linnaeus, 1758) (Figs. 1 (c) and (d).

Materials Examined: 3, MSS-no. 2a.kit.1-6-2019, MSS-no. 2b.kit.1-3-2019, MSS-no. 2c.kit.1-6-2019.

Distribution: (2) Dipterocarp forest and (1) Agro-ecosystem.

Hogenes & Treadaway (1998) record of distribution for *A. convolvuli* is from the most remote islands and as far north as within polar circle. The species found in the Philippines are from Balabac, Palawan, Mindoro, Luzon, Panay, Negros, Siquijor, Cebu, Bohol, Leyte, Samar, Dinagat, Camiguin de Mindanao, Jolo and Calamian. It is also distributed according to Muller *et al*., (2005) in Israel. It was also reported in Pakistan (Rafi *et al*., 2014). Record of distribution by Pittaway & Kitching (2019) is from China, Taiwan, Mongolia, North Korea, South Korea, Japan and Russia.

Ecological status: Southeast Asia Endemic (Pittaway & Kitching, 2019).

Description:

Agrius convolvuli was observed in Dipterocarp forest and Agro- ecosystem only of Mt. Kitanglad located in Lirongan, Lantapan, Bukidnon around 7:00 pm -12:00 pm, January 3 & 6, 2019 respectively. This species is also known as convolvulus hawkmoth (Pittaway & Kitching, 2019).

The head was dominantly covered gray. The antennae ranged from 1.1 cm -1.9 cm, compound black eyes 0.4 cm-0.5 cm, proboscis 10.2 cm-11.6 cm. Thorax dominantly coloredgray with black spots: prothorax (0.5 cm-0.8 cm), mesothorax (0.3 cm) and metathorax (0.3 cm). The abdomen was dominantly coloredgray dorsal stripe with pink and black bands edged with white on the sides (2.4 cm-3.2 cm). Setae were present at the anal end 0.1 cm. The wingspan was dominantly coloredgray with black bands at orbicular space. The

forewing size was 3.9 cm-4.8 cm, hindwing 2.3 cm-2.8 cm of black and gray bands.

The wingspan of *A. convolvuli* is not consistent with the record of Pittaway & Kitching (2019), species in Kitanglad is smaller compared to their measurement, however; the length of the forewing is consistent to the record of Hogenes & Treadaway (1998). This species cannot be confused with other hawkmoths in the Philippines because of its pink and black bands on its own abdomen. This species is very fast flyers and most abundant in agro- ecosystem. The study of sphingid moths in Kitanglad is more comprehensive in terms of measurement because there is no comparison with the morphometrics with the other authors; they only emphasize the wingspread and length of forewing. According to Muller *et al.* (2005), this species was common in all phyto-geographical zones except deserts. Johnson & Raguso (2016) recorded that these species are the most important pollinators of orchids.

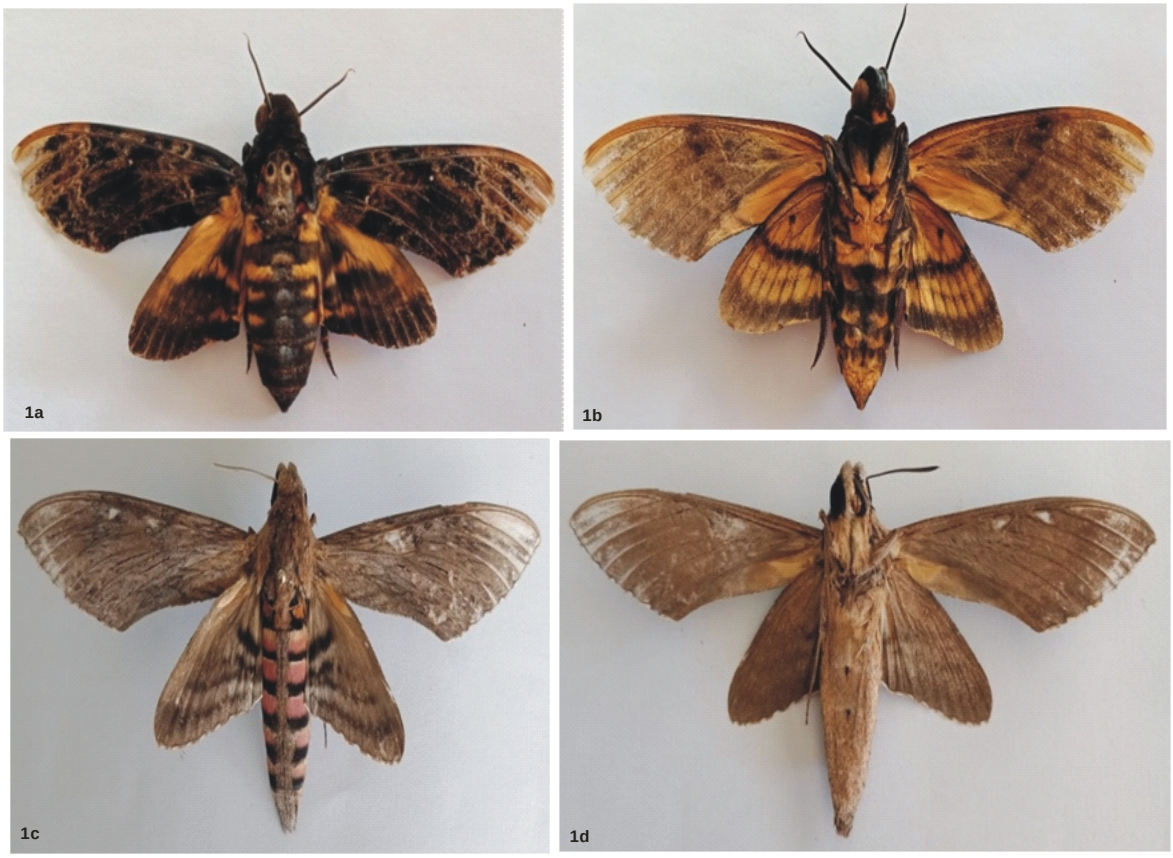

Fig. 1. *Acherontia lachesis* (a): Dorsal, (b) Ventral, (Fabricus, 1798), *Agrius convolvuli* (c) Dorsal, (d) Ventral, (Linnaeus, 1758).

3. *Ambulyx staudingeri* (Rothschild, 1894) (Figs. 2 (a) and (b).

Materials Examined: 3, MSS-no. 3a.kit.1-4-2019, MSS-no.3b.kit.1-4-2019, MSS-no. 3c.kit.1-6-2019

Distribution: (1) Montane forest and (2) Agro-ecosystem

Hogenes & Treadaway (1998) record of distribution for *A.staudingery* is from Sulu Archipelago, especially on Jolo and Islands of the Tawi-tawi group, Mindoro, Luzon, Polillo, Marinduque, Sibuyan, Panay, Masbate, Negros, Siquijor, Cebu, Bohol, Samar, Leyte, Mindanao, Jolo, Tawitawi and SangaSanga.

Ecological status: Rare Endemic (Hogenes & Treadaway 1998)

Description:

Ambulyx staudingeri was observed in Montane forest and Agro- ecosystem only of Mt. Kitanglad located in Lirongan, Lantapan, Bukidnon around 7:00 pm -11:00 pm, January 4 & 6, 2019.

The head was dominantly covered brown. The antennae ranged from 1.9 cm-2.2 cm, compound dark brown eyes 0.3 cm-0.4 cm, proboscis 3.1 cm-3.2 cm. Thorax dominantly colored red orange: prothorax (0.7 cm-1.9 cm), mesothorax (0.3 cm-0.4 cm) and metathorax (0.3 cm-0.4 cm). The abdomen was dominantly colored red orange with dark brown lines at the center (2.5 cm-3.0 cm). Setae were present at the anal end 0.1 cm. The wingspan was dominantly colored brown with black circle near the base. The forewing size was 5.6 cm-6.3 cm, hindwing 3.5 cm-3.6 cm of black and red orange bands.

The forewing length of *A. staudingeri* is consistent with the record of Hogenes & Treadaway (1998). There is no comparison with the morphometrics of the Kitangladsphingids because other authors only focused

on the measurement of the forewing, other parts such as parts of the head, thorax, abdomen was not considered in their papers. *A. staudingeri* is similar to *A. tattina*

4. *Amplypterus panopus mindanaoensis* (Cramer, 1779) (Figs. 2 (c) and (d).

Materials Examined: 3, MSS-no. 4a.kit.1-4-2019, MSS-no.4b.kit.1-4-2019, MSS-no. 4c.kit.1-6-2019

Distribution: (1) Montane forest and (2) Agro-ecosystem

Hogenes & Treadaway (1998) record of distribution for *A. panopus mindanaoensis* was described from Luzon, Panay and Mindanao. It is widely distributed in the Philippines.

Ecological status: Common Endemic (Hogenes & Treadaway 1998).

Description:

Amplypetrus panopus mindanaoensis was observed in Montane forest and Agro- ecosystem only of Mt. Kitanglad located in Lirongan, Lantapan, Bukidnon around 7:00 pm -11:00 pm, January 4 & 6, 2019 respectively. This species is also known as mango hawkmoth (Pittaway & Kitching, 2019).

The dorsal head was dominantly covered black, while the ventral part dominantly covered with heavy orange. The antennae ranged from 1.9 cm 2.0 cm, compound dark brown eyes 0.4 cm, proboscis 3.1 cm-3.4 cm. Thorax dominantly colored black (dorsal) and heavy orange (ventral): prothorax (0.6 cm), mesothorax (0.3 cm-0.4 cm) and metathorax (0.2 cm-0.3 cm). The abdomen was dominantly colored orange with dark gray lines, (2.0 cm-2.2 cm). Setae were present at the anal end 0.3 cm. The wingspan was banded with black and dark brown at post discal space and black base. The forewing size was 5.2 cm-6.4 cm, hindwing 3.2 cm-3.5 cm of black at the postdiscal space with black and light brown stripes, white basal space, pinkdiscal space.

The wingspan is not consistent with the record of Pittaway & Kitching (2019). Kitanglad species is smaller however the length of their forewing is consistent having a pink band. *A. panopus mindanaoensis* in Kitanglad is much darker compared to other species studied. This species is an example of protective coloring. The bands are divided into 3 stripes. The study of Pittaway & Kitching (2019) shows that this species has never been feeding at flowers and during daytime it allows itself to be handled but at night it is an active flier. The forewing length of *A. panopus mindanaoensis* is consistent with the record of Hogenes & Treadaway (1998). Other authors did not consider the measurements of the parts of head, abdomen, thorax, and hindwing. The amount and availability of food and water affects the growth of moth that's why they vary in their sizes.

Fig. 2. *Ambulyx staudingeri* (a) Dorsal, (b) Ventral, (Rothschild 1894), *Amplypterus panopus mindanaoensis* (c) Dorsal (d) Ventral, (Cramer, 1779).

5. *Daphnis hypothous* (Cramer, 1779) (Figs. 3 (a) and (b).

Materials Examined: 3, MSS-no. 5a.kit.1-6-2019, MSS-no.5b.kit.1-5-2019, MSS-no. 5c.kit.1-6-2019

Distribution: (3) Agro- ecosystem

Hogenes & Treadaway (1998) record of distribution for *D. hypothous* is known from Ryukyu Islands and Taiwan, Southeast Asia, West-wards to the Middle East and from Sri Lanka, the Greater and Lesser Sunda islands, the Philippines, Sulawesi and North and South Moluccas to Tanimbar. It is also distributed in India, Nepal, Bhutan, Myanmar, China, Thailand, and Indonesia (Pittaway & Kitching 2019).

Ecological status: Southeast Asia Endemic (Pittaway & Kitching 2019).

Description:

Daphnis hypothous was observed in Agro- ecosystem only of Mt. Kitanglad located in Lirongan, Lantapan, Bukidnon around 7:00 pm -11:00 pm, January 5 & 6, 2019. This species is also known as jade hawkmoth (Pittaway & Kitching 2019).

The head was dominantly colored white. The antennae ranged from 1.7 cm 1.8 cm, compound red orange eyes 0.4 cm-0.5 cm, proboscis 4.8 cm-5.0 cm. Thorax dominantly colored white: prothorax (0.6 cm-0.7 cm), mesothorax (0.4 cm) and metathorax (0.4 cm). The abdomen was dominantly colored black with white bands (Dorsal), red orange with white line (Ventral) (2.5 cm-3.0 cm). Setae were present at the anal end, 0.3 cm. The wingspan was dominantly colored green at the basal space with white antemedial band (dorsal). The forewing size was 4.7 cm-5.6 cm with a white spot at the apex, hindwing 3.1 cm-3.3 cm of orange with white stripes.

The wingspan of *D. hypothous* is not consistent with the record of Pittaway & Kitching (2019), however, the length of the forewing is consistent in the record of Hogenes & Treadaway (1998). This species can be distinguished from the other species by a white spot at the forewing apex. According to Pittaway & Kitching (2019), that in Metro Manila (Philippines) this synanthropic has been reported as being active by daybreak and during rainy weather, when it has been observed to drink from water puddles next to roads. This species has also no comparison in terms of measurement due to some authors only considered the measurements of the wingspan and length of the forewing only. They did not include the morphology of the head, thorax and abdomen.

6. *Gnathothlibus erotus erotus* (Cramer, 1777) (Figs. 3 (c) and (d).

Materials Examined: 1, MSS-no. 6. kit.1-5-2019

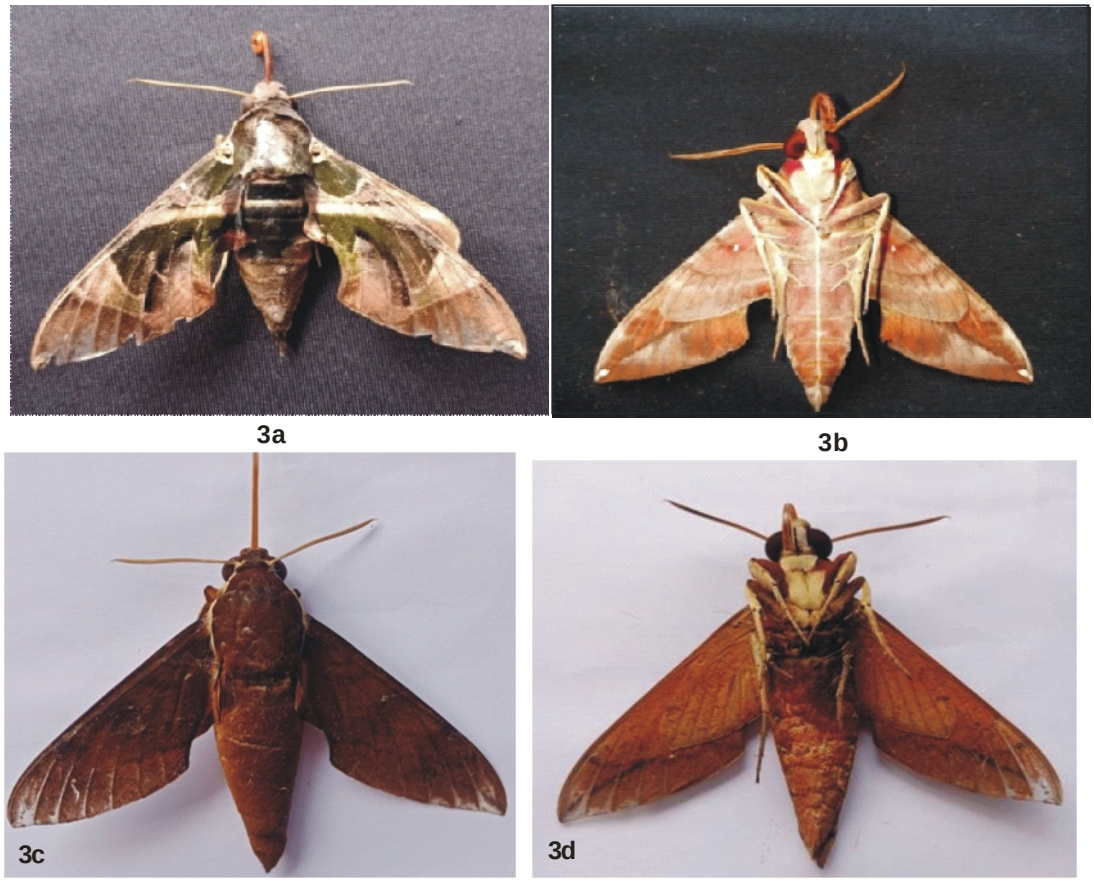

Fig. 3. *Daphnis hypothous* (a) Dorsal (b) Ventral, (Cramer, 1779), *Gnathothlibus erotus erotus* (c) Dorsal (d) Ventral, (Cramer 1777).

Distribution: (1) Dipterocarp forest

Hogenes & Treadaway (1998) record of distribution for *G. erotus erotus* is from Sri Lanka, Andaman, Thailand, Nicobar Islands, Malacca, Sundaland to Sumbawa and Sumba, Sulawesi and the Philippines. It was also recorded in SE Mindanao (Palau Island) and Palawan and Balabac (Inoue, 1996).

Ecological status: Southeast Asia Endemic (Hogenes & Treadaway 1998).

Description:

Gnathothlibus erotus erotus was observed in Dipterocarp forest only of Mt. Kitanglad located in Lirongan, Lantapan, Bukidnon around 1:00 am -4:00 am, January 5, 2019.

The head was dominantly colored dark brown with white lines on both sides. The antennae 1.7 cm, compound black eyes 0.3 cm, proboscis 4.7 cm. Thorax dominantly colored red orange (dorsal), dominantly white (ventral): prothorax (0.5 cm), mesothorax (0.3 cm) and metathorax (2.0 cm). The abdomen was dominantly covered with heavy red orange (3.3 cm). Setae were present at the anal end, 0.1 cm. The wingspan was dominantly colored red orange with black orbicular spot at discal space. The forewing size was 4.2 cm, hindwing 2.5 cm of heavy orange with black spots (ventral).

The length of the forewing for *G. erotus erotus* is consistent according to the record of Hogenes & Treadaway (1998). They did not include the morphology of the head, thorax and abdomen. Record of this species from the Philippines (Inoue, 1996; Inoue *et al.*, 1997; Jensen, 1973) was based on the misidentification.

7. *Hippotion brunneum* (Semper, 1896) (Figs. 4 (a) and (b).

Materials Examined: 3, MSS-no. 7a.kit.1-4-2019, MSS-no.7b.kit.1-4-2019, MSS-no. 7c.kit.1-6-2019

Distribution: (1) Montane forest and (2) Agro-ecosystem

Hogenes & Treadaway (1998) record of distribution for *H. brunneum* is from Philippines, Sulawesi, the Moluccas and New Guinea.

Ecological status: Rare Endemic (Hogenes & Treadaway 1998).

Description: *Hippotion brunneum* was observed in Montane forest and Agro- ecosystem only of Mt. Kitanglad located in Lirongan, Lantapan, Bukidnon around 7:00 pm -11:00 pm, January 4 & 6, 2019.

The head was dominantly covered black with white dorsal line. The antennae ranged from 1.1 cm to 1.3 cm, compound black eyes 0.4 cm, proboscis 4.0 cm-4.9 cm. Thorax dominantly colored black with white dorsal line: prothorax (0.5 cm), mesothorax (0.3 cm) and metathorax (0.3 cm). The abdomen was dominantly colored black with white dorsal lines; dominantly gray (ventral) (1.5 cm-1.8 cm). Setae were present at the anal end, 0.1 cm. The wingspan was dominantly banded with black color at the discal space. The forewing size was 2.6 cm-3.1 cm, hindwing 1.5 cm-1.8 cm of red orange at discal space, black at post discal space.

The length of the forewing of *H. brunneum* is consistent with the record of (Hogenes & Treadaway (1998). It has a beautiful white dorsal line on the thorax and abdomen. In the Philippines this cannot be confused with other hawkmoths. There is no comparison with morphometric of the Kitangladsphingids because other authors like Hogenes & Treadaway (1998) did not consider the measurements of the parts of head, abdomen, thorax and hindwing and only length of their forewing were considered in their papers.

8. *Hippotion echeclus* (Moore, 1858) (Figs. 4 (c) and (d).

Materials Examined: 3, MSS-no. 8a.kit.1-6-2019, MSS-no.8b.kit.1-6-2019, MSS-no. 8c.kit.1-6-2019

Distribution: Agro-ecosystem

Hogenes & Treadaway (1998) record of distribution for *H.echeclus*is from India to Thailand and Malacca, The Greater Sunda Islands, Bali, Lombok, Sumba and Flores, and from Sulawesi.

Ecological status: Southeast Asia Endemic Hogenes & Treadaway (1998)

Description

Hippotion echeclus was observed in Agro- ecosystem only of Mt. Kitanglad located in Lirongan, Lantapan, Bukidnon around 7:00 pm -11:00 pm, January 6, 2019. This species is also known as raffle's striated hawkmoth Pittaway & Kitching (2019).

The head was dominantly dark green with white lines on the palpus, beneath the eye. The antennae ranged from 0.8 cm 1.1 cm, compound dark green eyes with black at the center 0.3 cm, proboscis 3.0 cm-3.2 cm. Thorax dominantly colored dirty white (ventral), yellow with ash green: prothorax (0.2 cm-0.4 cm), mesothorax (0.3 cm) and metathorax (0.2 cm). The abdomen was dominantly colored yellow with black spots (dorsal), dirty white with black spots (ventral) (1.8 cm-2.0 cm). Setae were present at the anal end 0.1 cm. The wingspan has a white basal space, dark yellow median line with black orbicular spot. The forewing size was 2.8 cm-3.2 cm, hindwing 1.7 cm-1.9 cm.

The length of the forewing of *H. echeclus* is consistent with the record of Hogenes & Treadaway (1998), but not consistent with that of Pittaway & Kitching (2019) in terms of wingspan. This species can be distinguished from the similar *H. echeclus*, *H. rosetta* and *H. boerhaviae* by the white line on the palpus beneath the eye. This species has also no comparison in terms of measurement due to some authors only considered the measurements of the wingspan and length of the forewing. The amount and availability of food and water affects the growth of moth; that's why they vary in their sizes.

Fig. 4. *Hippotion brunneum* (a) Dorsal, (b) Ventral (Semper, 1896), *Hippotion echeclus* (c) Dorsal, (d) Ventral) (Moore, 1858).

9. *Psilogramma menephron* (Cramer, 1780) (Figs. 5 (a) and (b).

Materials Examined: 3, MSS-no. 9a.kit.1-5-2019, MSS-no.9b.kit.1-6-2019, MSS-no. 9c.kit.1-6-2019

Distribution: (3) Agro-ecosystem

Hogenes and Treadaway (1998) record of distribution for *P. menephron* is from N. India, Nepal and S. China through continental S. E. Asia to Vietnam and from the greater and lesser Sunda Islands through Sulawesi, the Philippines and Taiwan.

Ecological status: Southeast Asia Endemic Pittaway & Kitching (1998).

Description

Psilogramma menephron was observed in Agro-ecosystem only of Mt. Kitanglad located in Lirongan, Lantapan, Bukidnon around 8:00 pm -9:00 pm, January 5 & 6, 2019. This species is also known as privet hawkmoth or large brown hawkmoth Pittaway & Kitching (2019).

The head was dominantly covered with black color. The antennae were 1.7 cm, compound black eye 0.2 cm - 0.3 cm, proboscis 8.1 cm-8.9 cm. Thorax dominantly coloredgray: prothorax (0.6 cm-0.8 cm), mesothorax (0.4 cm-0.5 cm) and metathorax (0.3 cm). The abdomen was dominantly black with gray bands (1.8 cm-2.0 cm). Setae were present at the anal end 0.2 cm. The wingspan has black and white stripes at the outer margin with gray, black and white spots. The forewing size was 5.1 cm-5.2 cm, hindwing 2.8 cm-3.0 cm of dominantly gray with yellow basal part.

The length of the forewing of *P. menephron* is not consistent with the record of Hogenes & Treadaway (1998). In the Philippines, this species is very variable but always much more variegated with light grey and white. Their body sizes vary with each other, availability and amount of food affects their growth. There is no comparison with morphometrics of the Kitangladsphingids because other authors like Pittaway & Kitching (2019), did not consider the measurements of the parts of head, abdomen, thorax and hindwing and only wingspread and length of their forewing were considered in their papers.

10. *Theretra manilae* (Clark, 1922) (Figs. 5 (c) and (d).

Materials Examined: 1, MSS-no. 10. kit. 1-6-2019

Distribution: (1) Agro-ecosystem

Hogenes & Treadaway (1998) record of distribution for *T. manilae* is from Sulawesi and Philippines.

Ecological status: Endemic uncommon or local (Hogenes & Treadaway 1998).

Description

Theretra manilae was observed in Agro- ecosystem only of Mt. Kitanglad located in Lirongan, Lantapan, Bukidnon around 7:00 pm -11:00 pm, January 6, 2019.

The head was dominantly black with white line above the eyes. The antennae was 1.3 cm, compound dark brown eyes 0.3 cm, proboscis 5.1 cm. Thorax dominantly shaded green with black band (dorsal), white shaded with orange (ventral): prothorax (0.5 cm), mesothorax (0.3 cm) and metathorax (0.2 cm). The abdomen shaded green with black line (dorsal), white shaded with orange and black spots (2.0 cm) (ventral). Setae were absent at the anal end. The wingspan dominantly colored green with black orbicular spot (dorsal), orange with black spots (ventral). The forewing size was 3.4 cm, hindwing 2.1 cm of dominantly colored orange with black spots.

The length of the forewing for *Theretra manilae* is not consistent according to the record of Hogenes & Treadaway (1998). This species can be recognized by its green ground color with silver stripes on the tegulae. Other information from different authors like Hogenes & Treadaway (1998) and Pittaway & Kitching (2019) about the measurements of its body parts as well as its color was not found.

Fig. 5. *Psilogramma menephron* (5a: Dorsal, 5b: Ventral) (Cramer, 1780), *Theretra manilae* (5c: Dorsal, 5d: Ventral) (Clark, 1922).

11. *Theretra nessus* (Drury, 1773) (Figs. 6 (a) and (b).

Materials Examined: 3, MSS-no. 11a.kit.1-4-2019, MSS-no.11b.kit.1-5-2019, MSS-no. 11c.kit.1-5-2019

Distribution: (1) Agro- ecosystem, (1) Montane forest and (1) Dipterocarp forest

Hogenes and Treadaway (1998) record of distribution for *T. nessus* is from Sri Lanka, India and Nepal, through Southeast Asian continent to China to Japan and Taiwan, Eastern Australia and Loyalty islands. In the Philippines it is known from many islands. It is also distributed in Bhutan, Myanmar, Thailand, Korea, Malaysia, Singapore, Indonesia, N Australia and New Caledonia (Pittaway & Kitching 2019).

Ecological status: Southeast Asia Endemic (Pittaway & Kitching (2019).

Description

Theretra nessus was observed in Agro- ecosystem, Montane forest and Dipterocarp forest only of Mt. Kitanglad located in Lirongan, Lantapan, Bukidnon around, 8:00pm -9:00pm, 7:00 pm -11:00 pm, 1:00 am - 4:00 am respectively, January 5 & 6, 2019. This species is also known as yam hawkmoth Pittaway & Kitching (2019).

The head was dominantly covered with green, white dorsal line above the eye. The antennae ranged from 0.8 cm-1.9 cm, compound greenish eyes 0.5 cm, proboscis 5.2 cm -6.0 cm. Thorax dominantly green with black dorsal spot: prothorax (0.6 cm-0.7 cm), mesothorax (0.3 cm -0.4 cm) and metathorax (0.4 cm-0.5 cm). The abdomen was green with gold stripes on the side (2.0 cm-3.5 cm). Setae were present at the anal end 0.3 cm -0.6 cm. The wingspan dominantly light brown at discal space, dark green at basal space with black orbicular spot. The forewing size was 4.8 cm-5.4 cm, hindwing 2.3 cm-3.2 cm with white basal and post discal space, and black discal. The length of the forewing for *Theretra nessus* is consistent in the record of Hogenes & Treadaway (1998). The wingspread is also consistent according to the record of Pittaway & Kitching (2019). This species is easily distinguished by its gold stripes in abdomen. There is no comparison with morphometrics of the Kitangladsphingids because other authors like Hogenes & Treadaway (1998) did not consider the measurements of the parts of head, abdomen, thorax, and hindwing and only length of their forewing were considered in their papers. The amount and availability of food and water affects the growth of moth that's why they vary in their sizes.

Fig. 6. *Theretra nessus* (a) Dorsal (b) Ventral, (Drury, 1773), *Theretra rhesus* (c) Dorsal (d) Ventral, (Boisduval, 1875), *Theretra sugii* (e) Dorsal, (f) Ventral) (Cadiou, 1995).

12. *Theretra rhesus* (Boisduval, 1875) (Figs. 6 (c) and (d).

Materials Examined: 1, MSS-No. 12. Kit.1-6-2019

Distribution: (1) Agro- Ecosystem

Hogenes & Treadaway (1998) record of distribution For *T. rhesus* is from Sumatra, Java, Bali, Peninsular Malaysia, Borneo, Sulawesi and The Philippines. It is also distributed in Indonesia and Taiwan (Pittaway & Kitching, 2019).

Ecological Status: Endemic Common (Hogenes &Treadaway, 1998).

Description

Theretra rhesus Was Observed In Agro- Ecosystem Only Of Mt. Kitanglad Located In Lirongan, Lantapan, Bukidnon Around 7:00 Pm -11:00 Pm, January 6, 2019. The Head Was Covered Dark Green With Black Vortex (Dorsal), White (Ventral). The Antennae Were 1.6 Cm, Compound Dark Green Eyes With Black At The Center 0.4 Cm, Proboscis 2.7 Cm. Thorax Dominantly White With Black Spots (Ventral), Brown (Dorsal): Prothorax (0.5 Cm), Mesothorax (0.3 Cm) And Metathorax (0.2 Cm). The Abdomen Was Dominantly Brown With 2 Green Line (Dorsal), White With Black Spots (2.0 Cm) (Ventral). Setae Were Absent At The Anal End. The Wingspan Dominantly Light Brown With Black Orbicular Spots, With 6 Oblique Postmedial. The Forewing Size Was 3.3 Cm, Hindwing 2.2 Cm Of White With Black Spots (Ventral).

The Length of the Forewing for *Theretra rhesus* Is Not Consistent to the Record of Hogenes & Treadaway (1998). This Species Has 6 Oblique Postmedial Lines. The Study Of Sphingid Moths In Kitanglad Is More Comprehensive In Terms of Measurement Because There Is No Comparison With The Morphometric with the other Authors; They Only Emphasize The Wingspread and Length of Forewing.

13. *Theretra sugii* (Cadiou, 1995) (Figs. 6 (e) and (f).

Materials Examined: 3, MSS-no. 13a.kit.1-4-2019, MSS-no.13b.kit.1-4-2019, MSS-no. 13c.kit.1-3-2019

Distribution: (2) Dipterocarp forest and (1) Montane forest

Hogenes & Treadaway (1998) record of distribution for *T. sugii* is from Philippines only and currently only known from Mindanao.

Ecological status: Endemic uncommon or local (Hogenes & Treadaway 1998).

Description

Theretra sugii was observed in Dipterocarp forest and Montane forest only of Mt. Kitanglad located in Lirongan, Lantapan, Bukidnon around 7:00 pm -11:00 pm, January 3 & 4, 2019.

The head was dominantly black with white line at sides (dorsal), orange (ventral). The antennae ranged from 1.2 cm -1.6 cm, compound dark orange eyes 0.3 cm-0.4 cm, proboscis 3.7 cm-4.4 cm. Thorax heavy orange: prothorax (0.3 cm-0.5 cm), mesothorax (0.3 cm-0.4 cm) and metathorax (0.3 cm). The abdomen heavy red orange with black spots (2.0 cm-2.6 cm). Setae were present at the anal end, 0.1 cm-0.2 cm. The wingspan was dominantly heavy orange with black post medial line, black discal dot. The forewing size was 3.9 cm-4.3 cm, hindwing 2.0 cm-2.3 cm of heavy orange with black spots.

The length of the forewing is consistent to the record of Hogenes & Treadaway (1998). The study of sphingid moths in Kitanglad is more comprehensive in terms of measurement because there is no comparison with the morphometric with the other authors; they only emphasize the length of forewing. Species growth depends on the food that they eat and the availability for water and other nutrients. The amount and availability of food and water affects the growth of moth that's why they vary in their sizes. This species can be distinguished with the other by its falcate apex, line and discal dot at the forewing is much heavier.

IV. CONCLUSION

A total of thirteen species of hawkmoths belonging to nine genera namely: *Acherontia*, *Agrius*, *Ambulyx*, *Amplypterus*, *Daphnis*, *Gnathothlibus*, *Hippotion*, *Psilogramma* and *Theretra* were collected on three vegetation types of Mt Kitanglad namely: montane forest, dipterocarp forest and agro ecosystem. Morphological characteristics that separate genera is in terms of size and color patterns, however for the species level is the presence of spots, dots or bands, color patterns on wings and size. There are 2 rare endemic species, 2 common endemic species, 2 uncommon or local and 7 are Southeast Asia endemic species of hawkmoths were recorded in the study.

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