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**A Note on Insect Diversity of  
Northern Gunung Rara Forest in Sabah,  
with Special Reference to some Bornean  
Endemic and Iconic Species**

**Arthur Y.C. Chung**

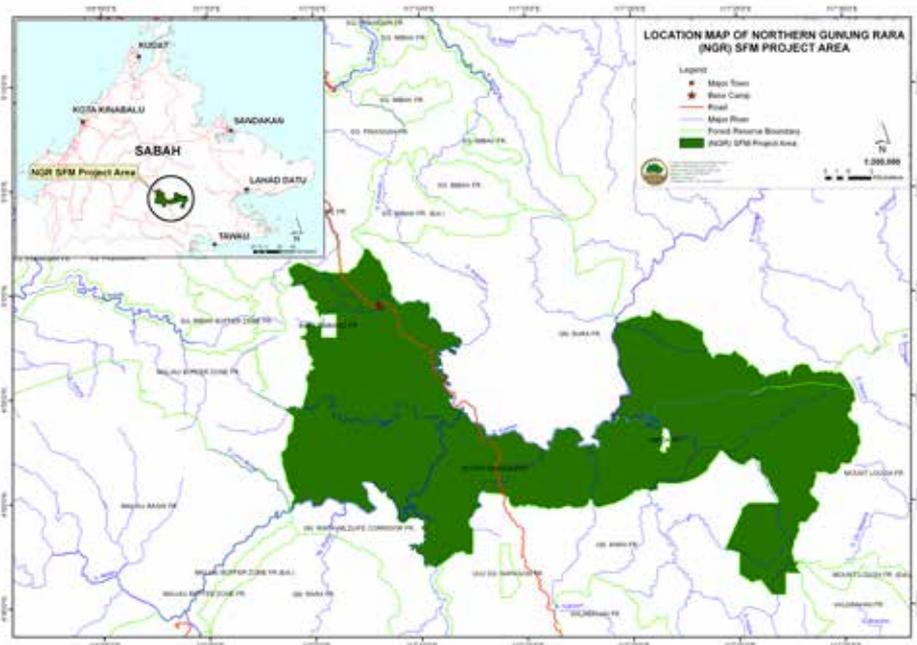
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**ABSTRACT**

An insect diversity survey was carried out from 9th to 14th of March, 2015 in the Northern Gunung Rara-Sustainable Forest Management (NGR-SFM) project area in south central Sabah. As there is no insect survey in the past in the NGR-SFM project area, this pioneer data will serve as baseline information for other research work in future. Insect data recorded during the survey provides salient information to enhance the biodiversity conservation and for formulation of the forest management plan of this area. At least 12 Bornean endemic species were recorded from NGR during this survey. The endemics include beetle, moth, cicada, dragonfly and damselfly species. This information provides input towards recommendations on High Conservation Value Forest (HCVF) of the area. A few iconic and rare species were also recorded. The nocturnal insect species richness and abundance were moderate. This is not surprising because NGR was logged in the past and some of the surveyed sites were degraded. On average, 58 species and 70 individuals were recorded within a one-square-metre. The mean Shannon Index was 3.94 while Simpson Index was 128.81 and Fisher Alpha Index was 191.70. Monitoring, as well as enforcement according to the management plan in this area at a regular basis is important in ensuring that this project area is protected and conserved accordingly.

## INTRODUCTION TO THE STUDY AREA

The Northern Gunung Rara-Sustainable Forest Management (NGR-SFM) project area is managed by the District Forestry Officer of Kalabakan, Sabah Forestry Department. This area comprises (i) Mount Magdalena FR – Class I (55,555 ha), (ii) part of Gunung Rara FR – Class II (5,387 ha) and (iii) two VJRs – Class VI, namely Batu Timbang VJR (261 ha) and Imbok VJR (127 ha). The project area (61,330 ha) is located in the south-eastern part of Sabah (Fig. 1) and falls within Forest Management Units (FMU) No. 23 and No. 24.



**Fig. 1.** Location of Northern Gunung Rara (NGR) SFM project area.

The project area consists of primarily mixed dipterocarp forests that have been heavily influenced by human activities in the past.

The project area is important for the following purposes:

- i. Valuable treasure of genes, species and representative ecosystem.
- ii. Key habitat and connectivity for endangered Orang-utan, Bornean Clouded Leopard, Sumatran Rhinoceros and Pygmy Elephant.
- iii. An ecological and crucial wildlife corridor of global significance linking the world renowned Danum Valley FR, Imbak Canyon FR and the Maliau Basin FR which are important conservation areas.
- iv. Watershed for the Kuamut River.
- v. Source of scientific information.

- vi. Ecosystems well adapted to natural impacts.
- vii. Natural reference to managed forests.
- viii. Critical to local communities' traditional cultural identity.

This study was conducted from 9th to 14th of March, 2015. The expedition camp was based at the Batu Timbang Field Outpost (N 04° 59' 27.0" E 117° 08' 04.4" at 219 m a.s.l.), adjacent to Sg. Lanap, beside the Imbak-Luasong gravelled road.

The objective of this study was to provide up-to-date data on the insect fauna of Northern Gunung Rara SFM area. This information will be incorporated for the preparation of the High Conservation Value (HCV) Report for NGR. Due to the very limited time to prepare this insect report, it is not the intention of this survey to prepare an exhaustive list of insects found within this area but rather to focus on selected insect groups, focusing on the interesting, iconic and endemic species.

## MATERIALS & METHODS

Light trap was used to sample nocturnal insects while sweep nets and forceps were used to sample diurnal insects.

### Light trap

The trap consists of a vertical white sheet (2 X 2 m) illuminated by a 250W mercury-lithium bulb. It was powered by a 12V 100 AH battery. The trap was set up at different locations facing the forested area, from 7:00 to 8:30 p.m. A GPS (Model: Garmin GPSMAP 60CSx) was used to determine the coordinates of each sampling site. Temperature and humidity were taken with a digital hygrometer from Extech Instruments (model no. 445702).

To evaluate diversity of the sampling area, insect species and individuals ( $\geq 5$  mm) within the 1 X 1 m square of the white cloth were enumerated from 8:00 to 8:30 pm. This is a rapid biodiversity assessment method because by the end of the sampling time, species and individual numbers can be obtained, and the data

**Table 1.** Light-trapping at different locations within the NGR-SFM project area.

Sampling site	Coordinates	Elevation (m)	Temp. (°C)	Humidity (%)	Sampling date	Remarks
A	N04°59'26.4" E117°08'35.5"	254	23.0	80	10 March	Clear sky with stars but no moon light.
B	N04°58'25.9" E117°08'57.9"	197	23.0	83	11 March	Clear sky with stars but no moon light.
C	N04°59'36.6" E117°08'52.2"	204	22.0	80	12 March	Clear sky with stars but no moon light.

can be used to calculate diversity indices. This method is simple, fast and can be carried out by non-insect specialist. To avoid compounding human error, the same staff was assigned to count the species and individual numbers throughout the sampling period, and also for other sampling sites. Light-trapping sites are shown in Table 1.

### Sweep net and manual collection

Sweep nets were used to collect flying insects while other insects were sampled using fine forceps. Butterflies were put in triangle papers while other specimens were put in vials with 75% ethanol solution. Sampling was conducted by trekking along the forested trails, riverine areas and along the road. Details of the daytime sampling sites are listed in Table 2.

**Table 2.** Daytime sampling sites in NGR-SFM project area.

Sampling site	Starting point coordinates	Elevation (m)
1 (Sg. Imbok of Imbok Forest Reserve)	N04°50'58.3" E117°22'19.8"	168-184 m
2 (Sg. Katak in PSP1)	N04°58'20.7" E117°08'56.2"	200-253 m
3 (Trail to Bt. Timbang Forest Reserve)	N04°59'07.7" E117°06'52.6"	231-254 m
4 (Sg. Lanap)	N04°59'38.4" E117°08'08.1"	216-234 m

### Insect specimens and identification

In this survey, focus was given to certain insect groups, i.e., butterflies, moths, beetles, dragonflies and damselflies. Only interesting, iconic and endemic insect species were sampled, as to minimize the workload at the laboratory in preparing the specimens for identification. Photographs were taken with DSLR Nikon D800E and Coolpix S8100 cameras to facilitate identification. Common insects were not sampled but photographs were taken for record purposes.

Specimens were identified based on the FRC Entomology Collection and various reference materials, e.g. Otsuka (1988 & 2001) for butterflies; Holloway (1983, 1985, 1986, 1988, 1989, 1993, 1996a, 1997, 1998a & b, 1999, 2001, 2003, 2005, 2008, 2009 & 2011), Robinson *et al.* (1994) and Sutton *et al.* (2015) for moths; Fujita (2010), Makihara (1999) and Tung (1983) for beetles; Orr (2003) and Tang *et al.* (2010) for dragonflies and damselflies. Some other insects were identified based on Hill and Abang (2005). Dr Steven Bosuang assisted in the identification of a few beetle species while Datuk C.L. Chan identified the stick insect and Dr Rory Dow identified a dragonfly species.

## Data analysis

Nocturnal insect diversity was measured using various indices, including Shannon-Wiener, Simpson and Fisher Alpha. Shannon is among the most widely used diversity index in ecological studies and it often increases as both richness and evenness of the community increases. Simpson is more sensitive towards dominant species within the community while Fisher Alpha is commonly used for moth diversity. All data were analysed using Species Diversity & Richness (SDR) version 4.1.2 software developed by Seaby and Henderson (2007).

## RESULTS & DISCUSSION

### Overall insect diversity

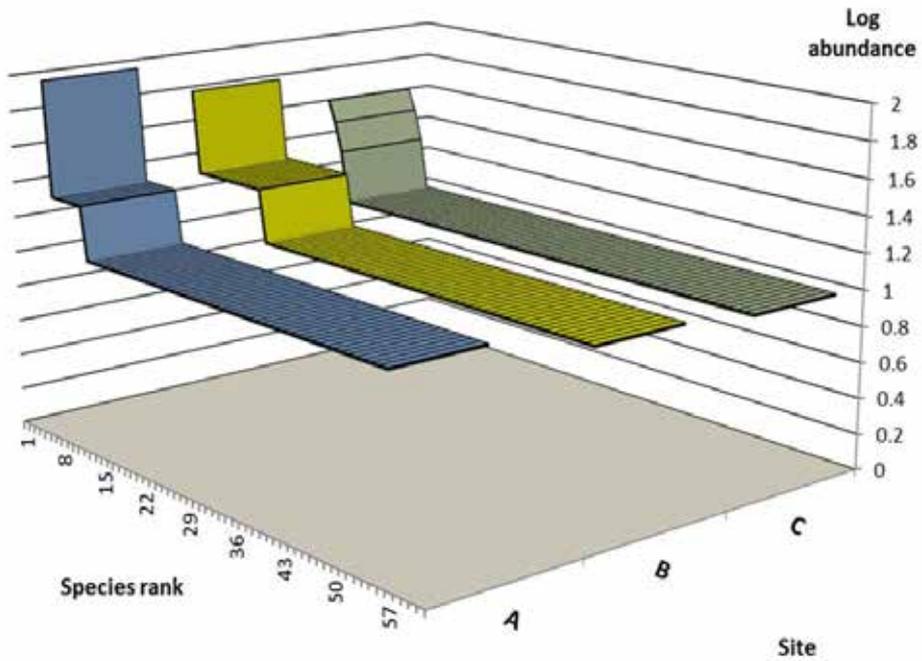
The nocturnal insect species richness and abundance were moderate, as shown in Table 3. On average, only 58 species and 70 individuals were recorded within a one-square-metre. The mean Shannon Index was 3.94 while Simpson Index was 128.81 and Fisher Alpha Index was 191.70. During light-trapping, the temperature was between 22°C and 23°C with humidity between 80 and 83% (Table 1). The distribution of insect species from the light-trapping sites is reflected in the species-rank abundance curves in Figure 2. Overall, the distribution of species was quite even throughout the sampling although the number of species was moderate. This is reflected in the Shannon Index, with value more than 3.0 in all sampling sites. The species with the highest individuals was 9, as recorded in Site A and 6 in Site B. Chung *et al.* (2015) provided the list of insects sampled from NGR-SFM project area during the survey.

**Table 3.** Insect diversity within a one-square-metre, as sampled through light-trapping in the NGR-SFM project area.

No.	Sampling site	Species	Ind.	Shannon	Simpson	Fisher Alpha
1.	A	53	67	3.79	52.64	117.3
2.	B	59	75	3.97	106.7	127.7
3.	C	61	67	4.05	221.1	330.1
	Mean	58±4	70±5	3.94±0.13	128.81±86	191.70±120

### Bornean endemic species

Some Bornean endemic species were recorded from NGR during this brief survey, as listed in Table 4. The endemics include beetle, moth, cicada, dragonfly and damselfly species. This information provides input towards recommendations on High Conservation Value Forest (HCVF) of the area, namely HCV 1.3 (WWF-Malaysia 2009). A few iconic and rare species are also listed in Table 4.



**Fig. 2.** Species-rank abundance curves of the light-trapping sites in the NGR-SFM project area.

**Table 4.** Bornean endemic, iconic and rare insect species from the NGR-SFM project area during the survey.

No.	Species	Author	Order	Family	Status
1	<i>Calomera crespignyi</i>	Bates	Coleoptera	Cicindelidae	Endemic
2	<i>Chalcosoma moellenkampi</i>	Kolbe	Coleoptera	Dynastinae	Endemic
3	<i>Megapomponia merula</i>	Distant	Hemiptera	Cicadidae	Endemic
4	<i>Amata macroflavifer</i>	Holloway	Lepidoptera	Erebidae	Endemic
5	<i>Spilosoma griseabrunnea</i>	Holloway	Lepidoptera	Erebidae	Endemic
6	<i>Lygniodes schoenbergi</i>	Pagenstecher	Lepidoptera	Erebidae	Endemic
7	<i>Trogonoptera brookiana</i>	Wallace	Lepidoptera	Papilionidae	Iconic
8	<i>Troides amphrysus flavicollis</i>	Druce	Lepidoptera	Papilionidae	Iconic
9	<i>Glyphodes militaris</i>	Munroe	Lepidoptera	Crambidae	Endemic
10	<i>Heliocypha biseriata</i>	Selys	Odonata	Chlorocyphidae	Endemic
11	<i>Rhinocypha aurofulgens</i>	Laidlaw	Odonata	Chlorocyphidae	Endemic
12	<i>Rhinocypha cucullata</i>	Selys	Odonata	Chlorocyphidae	Endemic
13	<i>Rhinagrion elopurae</i>	McLachlan	Odonata	Megapodagrionidae	Endemic
14	<i>Macromia corycia</i>	Laidlaw	Odonata	Corduliidae	Endemic
15	<i>Aretoon asperrimus</i>	Redtenbacher	Phasmida	Bacillidae	Rare

### **Butterfly (Lepidoptera)**

Only seven butterfly species were recorded during the survey. However, this does not mean that the species richness of butterflies (and other insect groups) in this area is low. There was no concerted effort to record all butterfly species sighted as the focus of this survey was mainly to record the interesting, iconic and endemic species to be incorporated in the HCV Report. Two iconic butterfly species were sighted during the survey, namely the Rajah Brooke's Birdwing (*Trogonoptera brookiana*) and the Golden Birdwing (*Troides amphrysus flavicollis*). The former species is the national butterfly of Malaysia. Both species are protected under Schedule 2 of the Wildlife Conservation Enactment in Sabah.



**Fig. 3.** A male Golden Birdwing (*Troides amphrysus flavicollis*) sighted beside Sg. Lanap, feeding on the nectar of *Saraca declinata* flowers.

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### **Moth (Lepidoptera)**

Some 18 selected moth species were recorded from this study. At least four endemic species were documented from this survey, namely *Amata macroflavifer*, *Spilosoma griseabrunnea*, *Lygniodes schoenbergi* (All Erebiidae) and *Glyphodes militaris* (Crambidae).



Bornean endemic moths recorded from the NGR-SFM project area during the survey.  
**Fig. 4** (above). *Amata macroflavifer*. **Fig. 5** (below). *Glyphodes militaris*.



Bornean endemic moths recorded from the NGR-SFM project area during the survey. **Fig. 6** (above). *Spilosoma griseabrunnea*. **Fig. 7** (below). *Lygniodes schoenbergi*.

## Beetle (Coleoptera)

Some seven species of macro-beetles (selected) were recorded. *Calomera crespignyi* and *Chalcosoma moellenkampii* are the endemic beetles documented in this brief survey. *C. crespignyi* was sighted along Sg. Imbok and Sg. Lanap while *C. moellenkampii* was attracted to the light trap.



Bornean endemic beetles recorded from the NGR-SFM project area during the survey. **Fig. 8** (above). *Chalcosoma moellenkampii*, male. **Fig. 9** (below). *Calomera crespignyi*.

### Dragonfly & Damselfly (Odonata)

At least 20 Odonata species were recorded during the survey. Four damselfly and one dragonfly species are endemic to Borneo. There could be more because some of the damselflies were only identified up to the genus level, e.g. *Vestalis*. Most of the Odonata species were sampled along Sg. Imbok, Sg. Lanap, Sg. Katak in PSP1 and a river adjacent to the Batu Timbang F.R.



Endemic damselflies recorded during the survey. **Fig. 10** (above left). *Rhinocypha cucullata*. **Fig. 11** (above right). *Heliocypha biseriata*. **Fig. 12** (below left). *Rhinagrion elopurae*. **Fig. 13** (below right). *Rhinocypha aurofulgens*.



**Fig. 14.** *Macromia corycia*, an endemic dragonfly recorded from the NGR-SFM project area during the survey.

### Other insects

Among the interesting insects are the Mantis Fly, *Tuberontha* sp. of the family Mantispidae and a Stick Insect, *Aretaon asperrimus*, which is only found in Luzon of the Philippines and in Borneo. The Giant Cicada, *Megapomponia merula*, that is confined to Borneo, was also recorded during the survey.



**Fig. 15** (above). The Mantis Fly, *Tuberontha* sp. **Fig. 16** (below). The Stick Insect, *Aretaon asperrimus* (female).

## CONCLUSION

As there is no insect survey in the past in the NGR-SFM project area, this pioneer data serve as baseline information for other research work in future. Insect data recorded during the survey provides salient information to enhance the biodiversity conservation of this area. The data will be incorporated in the High Conservation Value (HCV) Report of this project, and also the Forest Management Plan. It is important that the NGR-SFM project area continues to be managed according to the forest management plan. Regular monitoring and enforcement should be carried out to prevent encroachment in this protected area.

## ACKNOWLEDGEMENTS

This scientific expedition was headed by John Sugau and Dr Reuben Nilus of the Forest Research Centre, Sepilok. John L.Y., Roslee Martinis and M.A. Tajuddin Mustapha helped in the field while Nurul Aqidah Ibrahim assisted in the preparation of the insect report. The NGR-SFM project is under the supervision of the Deputy Chief Conservator (Development), En. Fidelis E. Bajau. We thank the DFO of Kalabakan (Adrian Rawlenes) and his staff for logistics and field support. The FRM Division (Valeria Linggok) and Jumri Abd. Hamid of FRC provided the maps. The Chief Conservator of Forests, Datuk Sam Mannan and Deputy Chief Conservator (R&D), Dr Lee Ying Fah, are acknowledged for their support. Dr Rory Dow, Dr Steven Bosuang and Datuk C.L. Chan have kindly identified selected Odonata, Coleoptera and Phasmida species respectively from this survey.

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