Kolokium Penyelidikan INTAN 2021

Firefly (Coleoptera: Lampyridae) Diversity and Distribution in Malaysia: Ecological Explanations and Conservation Requirements

Dr. Nada Badruddin

Institut Penyelidikan Perhutanan Malaysia (FRIM)

Problem Statement

- Despite the growing interest to determine the drivers behind high biodiversity observed in the tropical forests, many taxa are understudied including the fireflies.
- There is limited information on the impact of logging in the tropics on the diversity and species of low abundance or difficult to study taxa.
- There is a need for a rapid assessment of species diversity of multiple habitats in a shorter temporal scale for tropical forest fireflies.

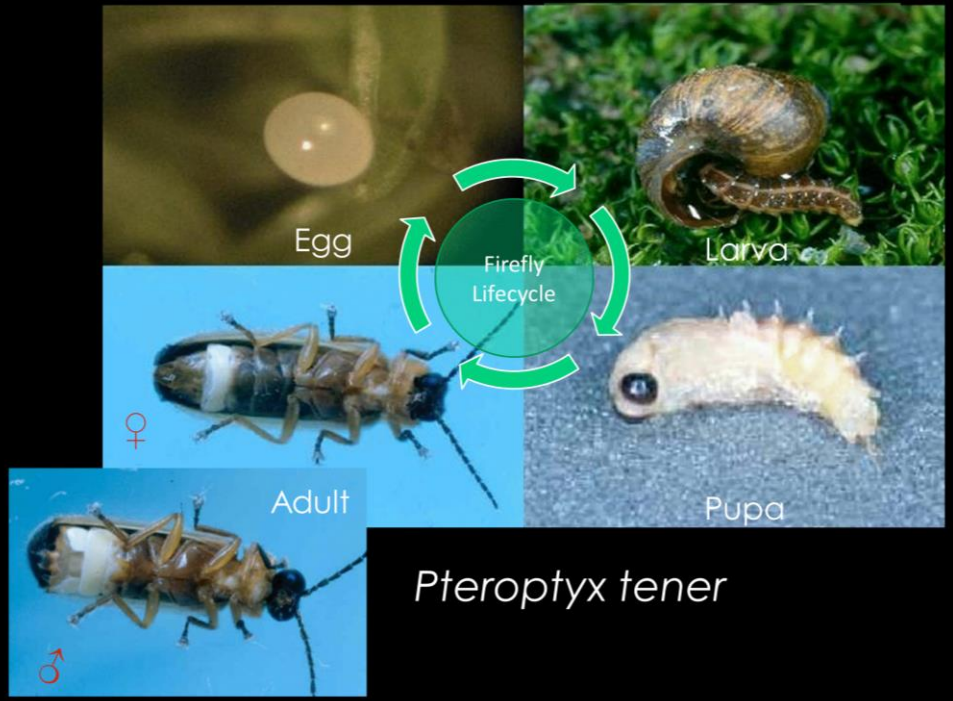
Objectives

- To identify the habitat characteristics that moderate species richness and diversity of the Malaysian inland fireflies.
- To identify the possible effects of logging history and associated changes in habitat variables on species richness and diversity of Malaysian inland fireflies.
- To assess beta diversity of the fireflies among five forest types across elevational gradients.

Introduction

- Fireflies
  - In Malaysia
- Logged forest and species recovery
  - Logging and fireflies
- Species across elevations
  - Biodiversity study across elevations
  - Fireflies across elevations

Fireflies



Pteroptyx tener

Fireflies in Malaysia

- Grouped by their light displaying behaviour:
  - Solitary fireflies
  - Congregating fireflies
- Information of fireflies in Malaysia are mainly focussed on the congregating fireflies.
- The solitary fireflies are not well studied:
  - presence in difficult terrain,
  - occurrence in low number,
  - have solitary behavior, therefore may of less appeal to the public.

Logging and fireflies

- Alteration of forest from logging:
  - Larger canopy gaps.
  - Increase light penetration to the ground.
  - Increasing soil temperature.
  - Decrease leaf litter availability.
  - Increasing growth of understorey plant.

- Possible impacts on fireflies:
  - Increase of light penetration (night light).
  - Increase in soil temperature may affect the microhabitats of the firefly larvae; their prey snails and the flightless firefly females.
  - Decrease in leaf litter may affect the nutrient availability of the prey snails.
  - Increase in height and density of understorey plants may influence the adult firefly mating success.

Biodiversity study across elevations

- Compact environmental and geographical variation:
  - provides a platform to understand biodiversity patterns and its drivers more rapidly.
  - Allows rapid assessment of organism diversity in various habitats.
- Rapid assessment is particularly important for an understudied taxa with minimal species richness and distribution data.

Fireflies across elevations

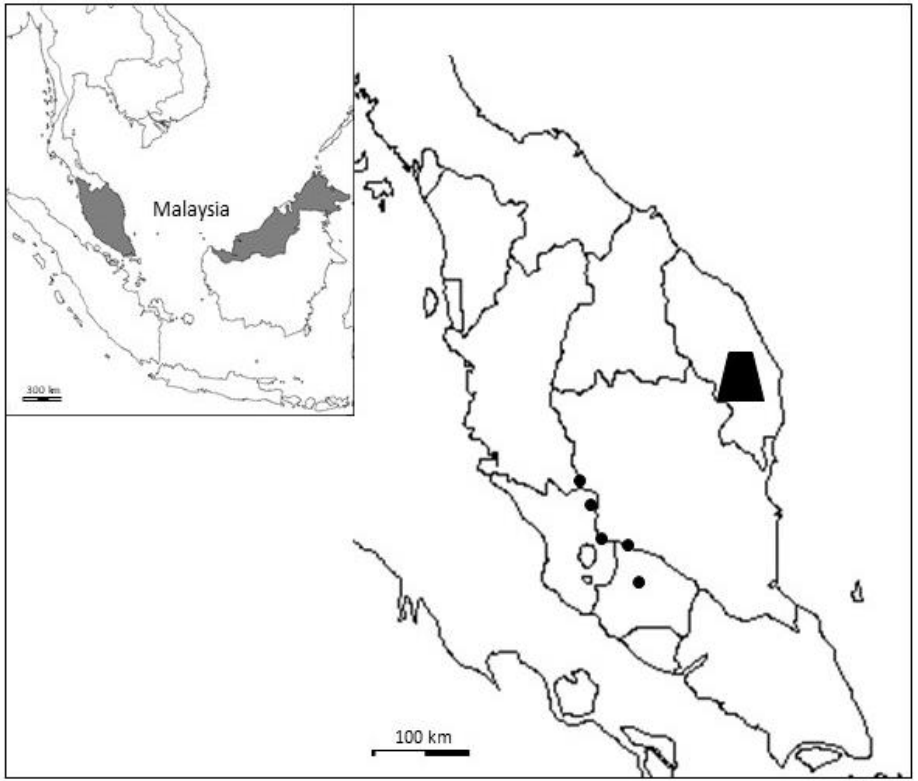
- More information fireflies in the low elevational habitats.
- Limited firefly species information along and at high elevations.
- Influence of elevation towards firefly diversity:
  - Temperature
  - Availability of specific niches

Research Approach

- Study areas
- Sampling and recording
  - Firefly
  - Habitat characteristics
- Data analysis
  - Firefly identification
  - Statistical analysis

Study areas

- Dungun Timber Complex:
  - 229 transects (100 m in length) were sampled from compartments in 7 large forest blocks representing logged once, logged twice and unlogged.
- Mountains in the west coast section of the Banjaran Titiwangsa:
  - 110 transects (80 m in length) positioned between 200 m and 1,900 m a.s.l were sampled from 5 mountains representing 5 elevational forest types.



Sampling and recording

- Firefly specimens:
  - Adult (Nocturnal fireflies)
  - Larva (Nocturnal and diurnal fireflies)
- Habitat characteristics
  - Leaf litter depth
  - Canopy closure
  - Height of understorey plants
  - Presence of water bodies*
  - Proximity to primary forests*

*For post-logged study

Data analysis

- Beta diversity analysis.
- Firefly diversity-habitat characteristics relationships analysis.
- Effect-size analysis of:
  - habitat characteristics
  - forest age since logging
  - elevational forest type
- Firefly diversity in once vs. twice logged forest.

Findings: Fireflies across elevations

- The fireflies were found to be distributed within certain elevational ranges.

Findings: Beta-diversity

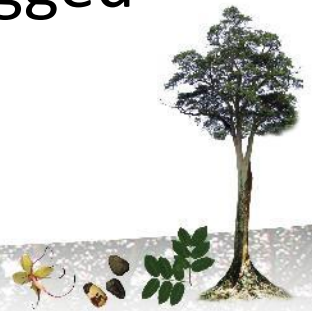
- Associated with forest type rather than mountain identity.

Findings: Effect sizes

- Habitat characteristics:
  - Canopy closure and leaf litter depth were found to have large effect size on firefly species richness in both logged forests and in forest across elevations.
  - The effects of distance to primary forests, canopy closure and leaf litter depth were significant on firefly species richness in logged forests.

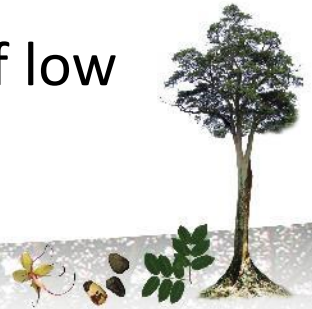
Findings: Firefly diversity in once vs. twice logged forests

- The effect of time since logging on firefly species richness varied by logging rotation.
- Species richness of fireflies in once-logged forests was estimated at 12.78 species and in twice-logged forests to be 7.16 species.



Implication of Findings

- Improvement to the firefly species information in Malaysia.
- Discovery of new species.
- Better understanding of logging regime influence on low abundance taxa.
- Improve understanding of habitat characteristics influencing the firefly community.
- Influence of habitat alteration towards sustainability of low abundance taxa.



Implication to Governmental Policy

- The importance of further understanding of the status and trend of our country's natural heritage via documentation and assessments.
- Possible need to review the logging system to enhance sustainability of biodiversity.
- Protection area for the fireflies (a flagship species)

Thank you