# The butterflies of Borneo's Upper Barito Watershed: A preliminary checklist and remarks on the importance of community managed forests in sustaining diversity

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**Abstrak**

Hutan hujan tropis di daerah perbukitan dan pegunungan Kalimantan Tengah merupakan tempat yang didiami oleh keanekeragaman hayati dengan tingkat yang sangat tinggi, diantaranya bahkan merupakan spesies endemik dan terancam punah. Akan tetapi daerah ini lebih banyak dieksplorasi oleh industri ekstraktif dibandingkan oleh ilmuwan. Untuk membangun suatu sistem pangkalan data keanekaragaman hayati di wilayah Murung Raya, Kalimantan tengah, Indonesia, dilakukanlah survei terhadap keanekaragaman kupu-kupu pada musim kemarau 2011. Daftar jenis yang ditampilkan dalam tulisan ini merupakan yang pertama untuk daerah sungai Murung. Penelitian lebih jauh perlu dilakukan pada musim-musim dan daerah lainnya untuk bisa memahami secara menyeluruh daerah sebaran kupu-kupu. Tidak hanya itu, sehubungan dengan perubahan lansekap secara besar-besaran pada daerah ini, hasil sementara penelitian ini mengindikasikan pentingnya hutan-hutan yang dikelola masyarakat lokal sebagai refugium untuk kelestarian keanekaragaman hayati

**Abstract**

The hill and montane rainforests of central Borneo harbour high levels of biodiversity, including many threatened and endemic species. However, this region has been explored far more by extractive industry than scientists. To establish a baseline for biodiversity in the Murung Raya region of Central Kalimantan, Indonesia, butterflies were surveyed during the dry season of 2011. Species lists presented here are the first of their kind for the upper reaches of the Murung River. Further study is necessary from additional seasons and localities to form a comprehensive understanding of the region's butterfly fauna. Nevertheless, amidst ongoing landscape-wide change to this region, our preliminary results indicate the value of community-managed forests as refugia for sustaining biodiversity.

**Keywords**: Borneo, butterflies, biodiversity, conservation, ecology, Kalimantan

## Introduction

Situated within the Sundaland Biodiversity Hotspot (Myers et al., 2000), the island of Borneo was long recognised for its vast swaths of jungles teeming with a rich diversity of life. At the core of the island, hill and montane rainforests rise up from the surrounding lowlands, which support high levels of endemism, particularly amongst insects (Beck and Chey, 2008). Borneo is home to approximately 1,000 known species of butterflies (Otsuka, 1988); as with much of the island's biodiversity, the foundation of our knowledge regarding the ecology of these species was generated from a wealth of studies conducted in the Malaysian states of Sabah and Sarawak (i.e. Beck et al., 1997; Beck & Schulze, 2000; Benedick et al., 2006; Cleary, 2004; Cleary & Mooers, 2004; Hamer et al., 2003; Hamer et al., 2005; Hamer et al., 2006; Häuser et al., 1997; Hill et al., 2001; Schulze et al., 2001; Tangah et al., 2004; Wilott et al., 2000). However, in recent

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years, Lepidoptera studies have started to become more prevalent in parts of Kalimantan (Houlihan et al., 2012; Houlihan et al, 2013; Purwanto et al., 2015; Marchant et al., 2015). Nevertheless, many remote highland regions across Kalimantan, likely to harbour a multitude of new arthropod taxa, remain scientifically unexplored.

The Upper Barito watershed in the northern Murung Raya district of Central Kalimantan remains minimally studied, especially in terms of arthropod diversity; to the best of our knowledge, a butterfly survey conducted by Walpole & Sheldon at Project Barito Ulu in 1992 is the only previous butterfly assessment conducted within this region (1993, 1999). On the first expedition of the Barito River Initiative for Nature Conservation & Communities (BRINCC) in 2011, surveys were conducted to investigate butterfly diversity in undisturbed tropical rainforest and community managed forest [Bahasa Indonesia: "*hutan desa*"] (Cheyne et al., 2012). Species lists presented here represent the first documentation of butterfly diversity along the upper Murung River and its Burak River tributary.

The aims of this study were to:

- Conduct a preliminary assessment of the butterfly diversity along the Murung River, a tributary to the Barito;
- Investigate the species richness of butterflies within *hutan desa* (community forest), compared to undisturbed dipterocarp forest;
- Develop baselines for future research concerning the utility of biodiversity monitoring programmes led by Indonesian researchers within Central Kalimantan.

## Methods

*Butterfly Trapping*

Sampling was conducted at two sites during the dry season months of July and August, 2011 – one community forest (*hutan desa*) adjacent to Tumbang Tujang on the Murung River (Hoeing et al., 2015 - this issue) and one forest site on the Burak River, a tributary of the Murung, which was undisturbed in 2011 (exact location to remain undisclosed as coal exploration and mining operations increase in the area). Butterflies were sampled systematically using fruit-baited traps, and opportunistically with hand-nets outside of these sampling areas, so as to supplement species lists while avoiding interference with analyses of trap data. A total of 18 traps were baited with fermenting bananas, which were replenished daily between 0800-1200hrs when traps were monitored. Traps were placed 1.5m above ground in the understory and greater than 100m apart at each site, with half (n=9) distributed along a prominent ridge (250-400m a.s.l.) and half along a stream in the ridge's adjacent valley (225-300m a.s.l.). Fruit-baited traps and other entomological collecting equipment for the 2011 BRINCC Expedition were sponsored to PRH from BioQuip Products, Inc., which were later donated to the Orangutan Tropical Peatland Project (OuTrop) for the establishment of a long-term butterfly monitoring programme in Central Kalimantan (Purwanto et al., 2015; Marchant et al., 2015). Butterflies were identified according to D'Abrera (1982; 1985; 1986) and Otsuka (1988).

*Community Diversity*

Due to the different abundances in each assemblage, expected species accumulation curves were constructed using the Mao Tau estimator of sample-based rarefaction and rescaled by individuals to provide a direct comparison of species richness (Randomizations=50; Bootstrapped 200 times) (Magurran, 2004; Barlow et al., 2007; Colwell, 2011). These statistics were calculated using EstimateS (Version 8.2.0).

## Results

Butterflies were surveyed for a total of 20 (*hutan desa*) and 15 (undisturbed) consecutive days (15 July - 3 August & 11-25 August, 2011 respectively), recording a total of 77 taxa. Species accumulation curves constructed from bait-trap data did not reach asymptotes during sampling periods (Fig. 1), suggesting that continued sampling was necessary to accurately extrapolate species richness. The list presented here (Table 1) is tentative and additions will be made when specimens from the Lycaenidae and Hesperidae families are identified at the McGuire Center for Lepidoptera & Biodiversity of the Florida Museum of Natural History.

## Discussion

In regions of rapid habitat loss and degradation, comprehensive long-term surveys are often unrealistic. Indonesia is currently the world leader in annual deforestation (Gaveau et al., 2014), and Murung Raya

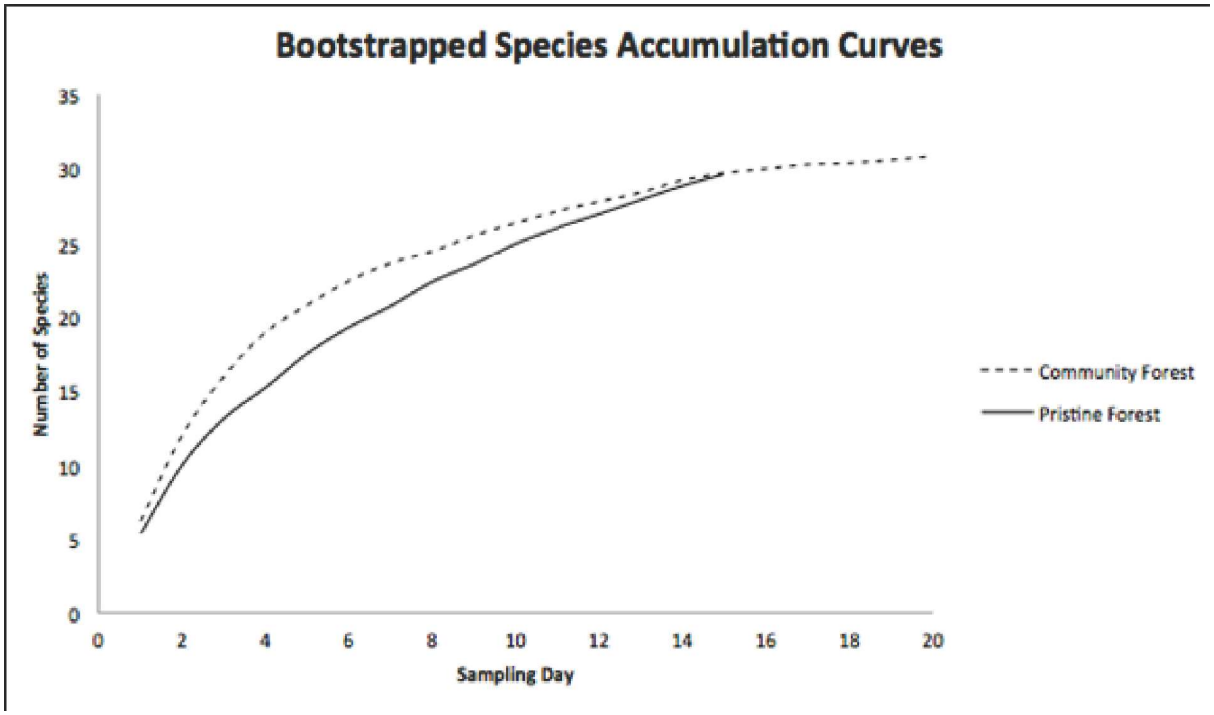


**Figure 1.** Butterfly species accumulation curves for fruit-baited traps in undisturbed forest and community forest.

is one of the country's final frontiers for extracting coal, gold, diamonds, rubies, timber, and more recently, gaharu trees for perfume. Preliminary surveys here highlight the impressive diversity within community-managed forests and consequently, their importance in harbouring butterfly diversity.

In larger datasets that still experience undersampling for certain assemblages, Shannon's entropy (eHbc) can be calculated to provide a bias-controlled comparison of the effective number of species (Beck & Schwanghart, 2010; Beck et al., 2011; Houlihan et al., 2013). From additional work in Central Kalimantan, we have learned how drastically butterfly communities can fluctuate within a year, with respect to seasonality (Marchant et al., 2015). Thus, here we simply present a preliminary list of butterflies that will be informative for future biodiversity surveys in the hill forests of central Borneo.

These results serve as baseline data for an area that is on the verge of imminent and permanent environmental change. More research investigating the life histories of these Bornean butterflies is critical to understanding how converted landscapes will impact host plant relationships, and which plant species are of highest conservation priority with respect to sustaining butterfly diversity. Our results suggest that community managed forests are capable of supporting high levels of biodiversity. Legal recognition of customary land tenure and community owned forest is increasing in Indonesia following rulings by the constitutional court (Bettinger et al. 2014). Protection of community forests could potentially become crucial as havens of biodiversity and support the livelihoods of numerous communities along the Murung River (Colchester, 1994; Curran et al., 2004; Dixon and Sherman, 1990; Porter-Bolland et al., 2012; Wilkie et al., 2006). Generalist butterflies may fare better than less mobile organisms during the course of fragmentation (Houlihan et al., 2013), but connectivity between forested islands managed by local communities is critical to prevent a widespread biodiversity collapse.

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**Table 1.** Species list from Murung Raya. TT = Tumbang Tujang (hutan desa: community forest); SB = Sungai Burak (undisturbed forest).

| | TT | SB | | TT | SB | | TT | SB |
|---|---|---|---|---|---|---|---|---|
| **Nymphalidae** | | | **Morphinae** | | | **Lycaenidae** | | |
| | | | *Amathuxidia amythaon* | X | | *Drupadia ravindra* | X | |
| **Apaturinae** | | | *Faunis kirata* | X | | *Eooxylides tharis* | X | |
| *Euripus nyctelius* | X | | *F. stomphax* | X | | *Pycnophallium (Caleta) elna* | X | |
| | | | *Thaumantis noureddin* | X | | | | |
| **Charaxinae** | | | *Zeuxidia amethystus* | X | X | **Papilionidae** | | |
| *Agatasa calydonia* | X | X | *Z. aurelius* | X | X | *Graphium agamemnon* | X | X |
| *Charaxes (Polyura) athamas* | X | | *Z. doubledayi* | X | X | *G. antiphates* | X | X |
| *C. bernardus* | X | X | | | | *G. bathycles* | X | X |
| *C. borneensis* | X | | **Nymphalinae** | | | *G. codrus* | X | |
| *C. distanti* | X | X | *Kallima buxtoni* | X | X | *G. doson* | X | |
| *C. durnfordi* | X | X | *Kallima spiridiva* | X | | *G. evemon* | X | X |
| *C. fervens?* | | X | *Lexias dirtea* | X | | *G. sarpedon* | X | |
| *C. (Polyura) delphis* | | X | *Lexias pardalis* | X | | *Papilio demolio* | X | |
| *C. solon* | X | X | *Rhinopalpa polynice* | X | X | *Troides brookiana** | X | X |
| *Prothoe franck* | X | X | | | | | | |
| | | | **Pseudergolinae** | | | **Pieridae** | | |
| **Danainae** | | | *Amnosia decora buluana* | X | X | **Pierinae** | | |
| *Eoploea diocletanus* | X | | *Dichoraggia nesimachus* | X | X | *Appias lyncida* | X | |
| *Idea stolli* | X | | | | | *Cepora iudith* | X | |
| | | | **Satyrinae** | | | *Pareronia valeria* | X | |
| **Heliconiinae** | | | *Coelites epiminthia* | X | | *Prioneris cornella* | X | |
| *Cirrochroa satellite* | X | | *Coelites e. euptychioides* | X | X | | | |
| *Terinos clarissa* | | X | *Cupha arias* | X | X | **Coliadinae** | | |
| *Terinos terpander* | X | | *Elymnias sp.* | X | | *Eurema tominia* | X | |
| | | | *Melanitis leda* | X | X | | | |
| **Limenitidinae** | | | *Mycalesis amoena* | X | X | **Riodinidae** | | |
| *Athyma asura* | X | | *M. anapita* | X | X | | | |
| *Athyma pravara pravara* | X | | *M. maianeas* | X | | *Paralaxita haquinus* | | X |
| *Athyma reta* | X | | *M. mnasicles mnasicles* | X | | *P. orphna* | X | |
| *Bassarona dunya* | X | X | *M. oroatis* | X | | *P. telesia* | X | |
| *Dophla evelina* | X | X | *M. orseis borneensis* | X | X | *Taxila haquinus* | X | |
| *Moduza procris* | X | | *M. patiana* | X | | *Zemeros sp.* | X | X |
| *M. p. agnate* | X | | *M. thyateira* | X | X | | | |
| *Neptis magadha* | X | | *Neorina lowii* | X | X | | | |
| *Tanaecia clathrata clathrata* | X | | *Ragadia makuta* | X | X | | | |
| | | | *Ypthima sp.* | X | | | | |

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