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## Research Article

# Identifying targets for plant conservation in Harapan rainforest, Sumatra

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### Abstract

A short description of how the Harapan Rainforest may have been before logging is given, based upon interviews with the people who conducted surveys prior to timber extraction. This information is used to demonstrate similarity to the forests of the Pasir Mayang and Muara Bungo area, which have been more thoroughly surveyed. The former state is then contrasted with the current condition based upon botanical surveys undertaken in 2008, 2012 and 2013, highlighting both dominant and rare species as well as the need for more comprehensive information on the conservation status of the majority of species. Finally, a number of introduced weedy species are now present whose potential for continued population growth and potential to retard restoration is discussed.

**Key words:** Conservation; botanical survey; restoration; tropical forest; Southeast Asia

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## Introduction

Sumatra is the third largest island in the Malesian Archipelago, after Borneo and New Guinea and the sixth largest in the world. The island is dominated by a series of mountains in its northern part and along its western edge (the highest peak is Mount Kerinci at 3804m). In the centre and along the eastern edge the land is low lying and intersected by numerous rivers. The flora of Sumatra has been neglected in the past: the plant collection density of 22 specimens / 1 km<sup>2</sup> is lower than of New Guinea and Kalimantan [1]. The Sumatran forests are considered to be extremely species rich, on a par with those of the better known forests of the island of Borneo [2]. However, the lowland rainforests, in particular, are under pressure from timber extraction and conversion to oil palm and pulp-wood plantations. These natural forests occupied around 16 million ha in 1900, but only 500,000 ha of rainforest may now remain. This transformation is also driving endangered and charismatic animal species such as the orang-utan, Sumatran tiger and Sumatran rhino towards extinction.

The Royal Botanic Gardens, Kew and Herbarium Bogoriense have been working since 2008 at the Harapan Rainforest site. The main focus of our research has been reforestation and the current floristic diversity and vegetation types present in the area. The Harapan Rainforest lies in the lowlands of East Sumatra and has a tropical climate with seven to nine consecutive wet months and three or less consecutive dry months [2]. In the vegetation map of Sumatra by Laumonier [3], the forests of the Harapan Rainforest area are characterized as dense moist evergreen forest. This forest type has suffered from extensive logging and other human interactions and by 1997 only 3.34% of it was left intact [3].

The Harapan Rainforest is situated in both Jambi and South Sumatra Provinces, and was previously operated under two concession licenses, each with a distinct logging history. However, it is now effectively managed for ecosystem restoration as a single contiguous area. In the Jambi part of the site, the North West ('SPAS') area was first to be logged and has been allowed to recover. From there logging moved anticlockwise through the concession. The logging company ceased operating on the site before reaching the most southern area known as Bukit Meranti. After the departure of the logging company some areas were targeted by intense illegal logging. The South Sumatran concession was logged by a different company, who made two separate cuts of the forest before they also ceased operating on the site. Again some areas were and continue to be affected by illegal logging activities, and the forests were severely damaged by fires (Sorensen, Cahyadin and Sadad *pers. comm.* in [4].

## Methods

The first author visited Harapan Rainforest in 2008, 2012 and 2103, each lasting about 3 weeks and several areas were visited either for plant collecting or for vegetation mapping [4]). In addition informal interviews with staff who conducted the pre-extraction timber surveys at the Harapan Rainforest were done in 2012. Specimens collected were named at Kew and addition plant species information for other sources were compiled in a species list and named updated when needed. The IUCN assessment of each species was recorded when available.

## Results and discussion

From interviews with staff who conducted pre-extraction timber surveys at the Harapan Rainforest, it is believed that the forests across the site were previously more or less uniform in structure and species composition. Dipterocarpaceae species were common, but spread out throughout the landscape. Usually, only a small number of Dipterocarpaceae species were present at any particular site. The most common Dipterocarpaceae canopy tree was *Shorea ovalis* Blume, which was very common, but rarely occurred in patches and was seldom dominant. In the sub canopy there does not seem to have been a dominance of any particular family, apart from some areas occupied by the

distinctive bulian (*Eusideroxylon zwageri*) forest. The co-dominant plant families may have been Lauraceae, Rubiaceae, Sapotaceae and large trees of *Koompassia* and *Durio* were often also present [4]. This description of the pre-logged forest at Harapan, based on interviews, appears to have been similar to that of Pasir Mayang and Muara Bungo in the Tebo district of Jambi Province. A survey of this forest showed that it was highly diverse, structurally complex and dominated by trees belonging to the Dipterocarpaceae, Myrtaceae, Burseraceae and Euphorbiaceae families, without dominance of any one family at the canopy level [3]. Below the canopy the forest was composed of a combination of many families including Annonaceae, Burseraceae, Ebenaceae, Euphorbiaceae, Leguminosae-Mimosoideae, Myristicaceae, Polygalaceae, Rubiaceae, Sapindaceae, Sapotaceae, and Ulmaceae, with fewer Dipterocarpaceae and some palms. A similar type of forest was encountered by Jacobs [5] in the North West of Kota Agung (Lampung Province) at 300-400 m in altitude. This primary forest was also poor in Dipterocarpaceae, but rich in Annonaceae, Euphorbiaceae, Meliaceae and Rubiaceae.

#### *Rare forest type (bulian forests)*

Bulian forests are a unique feature of the forests in the Jambi area. The species itself (*Eusideroxylon zwageri* Teijsm. & Binn.), which is known as bulian or Borneo ironwood is known from Sumatra, Borneo and the Philippines. In other parts of its range the species may occur as a sub-dominant or an occasional species, although there are some reports that Bulian forests also occur in Borneo (Slik pers. com.). These forests are one of a few natural forests in lowland Sumatra consisting of only one dominant species [2] and are now very rare due to the extensive harvesting of the mature trees. At the Harapan rainforest site, three bulian forests are known. The first site is the northwest corner, which has been logged within the past decades and is in the process of re-growing through a combination of resprouting from old stumps and some enrichment planting. The second site is upriver from Bato on the Kapas River in the centre of the forest. This site had also been logged by the previous concessionaire and again more recently by illegal loggers. The third site is in the southern part of Harapan Rainforest which has not yet been visited by the authors or other Harapan Rainforest staff (Pirnanda pers. com.). Given that these forests are generally restricted to the Jambi area and are under severe threat from illegal logging activities and conversion to oil palm plantations, the conservation of these forests must be one of the key Harapan Rainforest conservation priorities.

#### *Rare species*

At present no extensive floristic survey of the site has been carried out and only about 600 species are recorded from various sources [4], of these only a tiny minority have been assigned an IUCN redlist status [6]. Those that are listed are mainly Dipterocarpaceae species. *Dipterocarpus hasseltii* Blume; *Hopea mengerawan* Miq.; *H. sangal* Korth.; *Shorea acuminata* Dyer and one Myrtaceae (*Syzygium ampliflorum* (Koord. & Valeton) Amshoff) are all assessed as Critically Endangered. While several other Dipterocarpaceae species (*Anisoptera marginata* Korth.; *Shorea bracteolata* Dyer; *S. leprosula* Miq.; *S. pauciflora* King; *S. teysmanniana* Dyer ex Brandis and *Vatica pauciflora* (Korth.) Blume) are assessed as Endangered; and a series of species from various families are classified either as vulnerable (*Dyera polyphylla* (Miq.) Steenis (Apocynaceae); *Canarium ovatum* Engl (Burseraceae); *Dacryodes elmeri* H.J.Lam (Burseraceae); *Dipterocarpus retuses* Blume (Dipterocarpaceae); *Eusideroxylon zwageri* (Lauraceae); *Aquilaria malaccensis* Lamk. (Thymelaeaceae); *Gonystylus bancanus* (Miq.) Kurz; *Gonystylus macrophyllus* (Miq.) A. Shaw) (Thymelaeaceae) or conservation dependent (*Koompassia malaccensis* Benth. (Leguminosae) & *Baccaurea polyneura* Hook.f. (Phyllanthaceae)). The over representation of Dipterocarpaceae in the IUCN list results from greater knowledge of these species, a comprehensive attempt to get them IUCN listed and a significant range contraction due to logging and conversion of forest in the recent past. However, there are many species in the Harapan Rainforest which are not listed, but are surely in need of protection. A good example is the Jambi Province endemic genus *Emblemantha urnulata* Stone (Primulaceae). A small population of this species was found in flower and fruit in 2008 and subsequently it has been seen sterile at various areas across the site. Before 2008 it was only known from two old herbarium specimens [7]. Given the lack

of detailed botanical knowledge of the Harapan Rainforest and which plants are rare or under threat, it is essential that a full floristic survey is conducted and that all species are assessed using the IUCN criteria.

### *Introduced weeds*

A number of species of bamboo could become a major ecological problem at the Harapan Rainforest site. There are many well-established populations, which seem to be invading open areas. At the moment it is unclear how many species of bamboo are present but they are reported to be native to Sumatra (Elizabeth Widjaja *pers. com.*). The main ecological concern is with a 'leaning' species which appears to be able to invade open vegetation very easily and can quickly overtake an area. It can also survive in the shade of mature stands of trees. There appears to be a very low establishment rate for other plants species in areas dominated by these bamboos. From discussions with local people, it appears that this bamboo became more prominent after the fires of 1997, at least within the South Sumatra Province [4].

*Bellucia pentamera* Naudin is a species of Melastomataceae native to South America, introduced to Indonesia in the early part of the 20<sup>th</sup> century via Bogor Botanic Gardens [8]. It is now one of the most commonly encountered species in many of the Harapan Rainforest sites. In some areas it forms the dominant canopy species in association with *Macaranga gigantea* Müll. Arg. and almost defines young secondary vegetation. It grows very well in young secondary vegetation, becoming less dominant in mid- to older-secondary vegetation and is almost absent in 'good' old secondary forests [4]. It is unclear if this is the result of being out-competed by the successional vegetation or that it finds it more difficult to invade older, more established vegetation types. This species has been reported to have become invasive in some well established plots in Kalimantan in the last few years (Cam Webb *pers. com.*). It is unclear at the moment whether this species will be a long term conservation problem at the Harapan Rainforest site and, as such, more ecological work is needed.

A plantation of introduced species of *Acacia* is present in the southern part of the Harapan Rainforest. Several species of *Acacia* which have been used in similar plantations across Southeast Asia have become weedy. In the Harapan Rainforest site itself *Acacia* trees and seedlings were encountered in several areas [4] and this could develop into long term conservation problem, although currently the situation does not seem serious.

### **Implication for conservation**

- Harapan Rainforest most likely represents an example of a once widespread lowland forest which has now almost disappeared. The protection of the site is a global priority if this forest type is not to be lost entirely.
- The Bulian forests are under severe threat from illegal logging and conversion to oil palm plantation. The conservation of this forest type must be one of the key conservation priorities for Harapan Rainforest.
- Given the lack of detailed botanical knowledge of the Harapan Rainforest and which plants are rare under threat, it is essential that a full floristic survey is conducted and that species are assessed using the IUCN criteria.
- More work is needed to understand ecology of the introduced weeds in order to assess whether they will become a long term barrier to the restoration of the site.

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