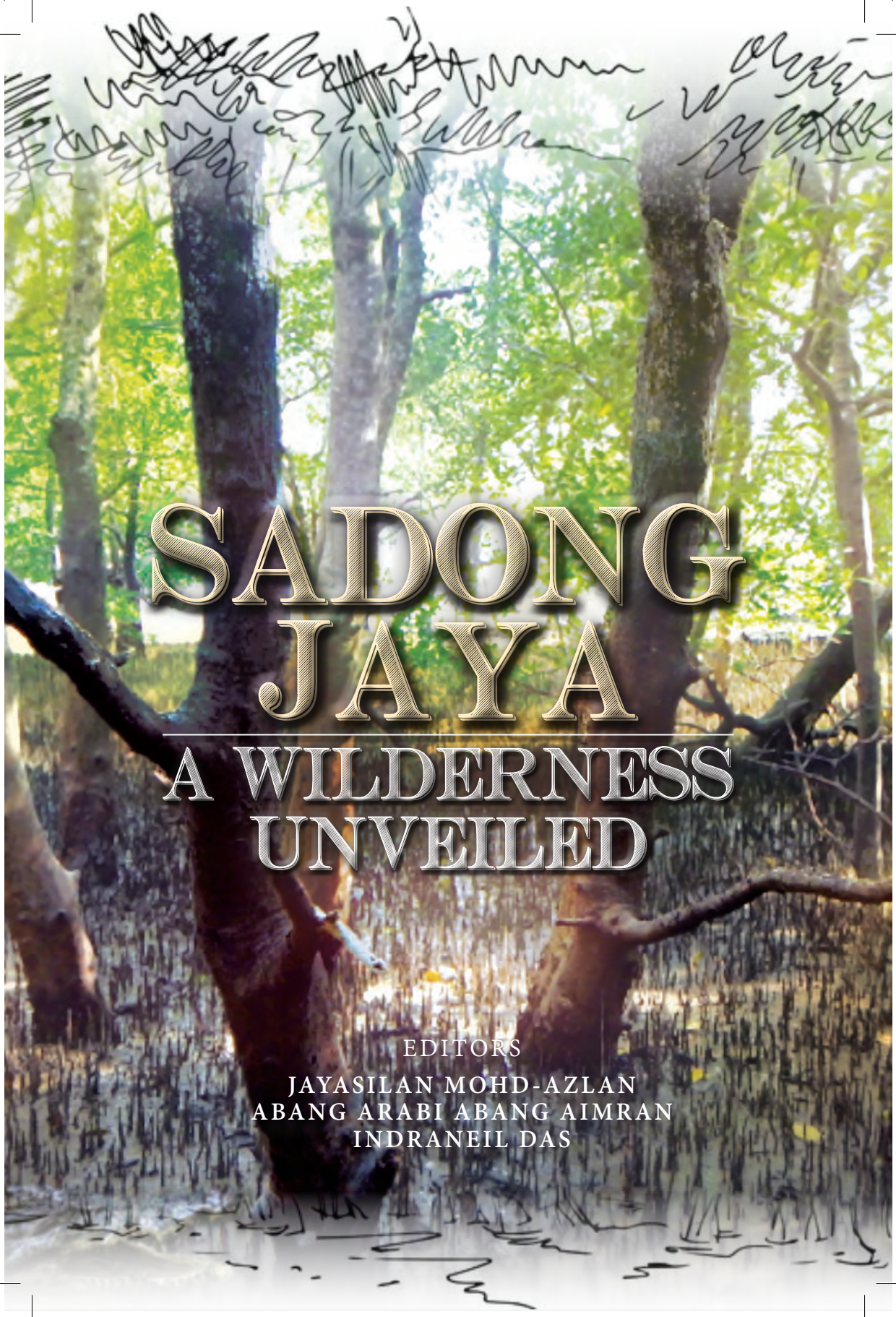
SADONG JAYA
A WILDERNESS UNVEILED
EDITORS
JAYASILAN MOHD-AZLAN
ABANG ARABI ABANG AIMRAN
INDRANEIL DAS

Sadong Jaya Drone Shots
by Mohamad Fizl Sidq Ramji

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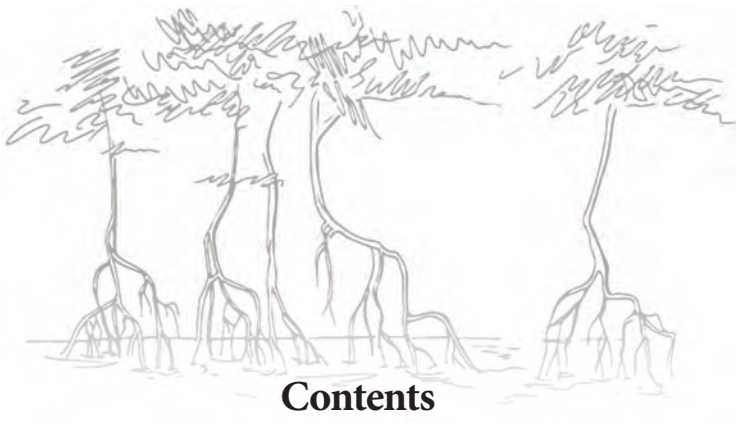


Contents

Foreword

Sarawak's mangrove forests are some of the most endangered habitats, and their continued exploitation for a variety of purposes raises the need for substantial research. Many of us here in Universiti Malaysia Sarawak wade into such forests, in the hopes of generating new, critical knowledge. I would like to commend the efforts by Sarawak Forestry Corporation Sdn. Bhd. for their support in collecting data on the biodiversity of Sadong Jaya Mangroves, which forms the material for the book. The work is also expected to be important for local communities, to aid them better understand, appreciate and perhaps use their resources sustainably, such as an interpretation tool to guide ecotourists and others to the Sadong Jaya Mangroves.

As will be evident to the readership, a variety of approaches have been taken by the authors of this volume. The volume's Editors, J. Mohd-Azlan, Abang Arabi and Indraneil Das emphasize the unusual conservation importance of mangrove forests. Ismail Jusoh present a brief description of the plant diversity. Within the zoological sciences, separate contributions lead by a specialist include investigations on insects by Wan Nuraine; ichthyological communities by Fatimah A'tirah; description of the bird diversity by Mohamad Fizl Sidq Ramji; a description of the frogs and reptiles by Indraneil Das; and the small mammal community by Faisal Ali. The book wraps up with chapters on related social elements, such as use of natural resources by Mohamad Suhaidi, and finally, the ecotourism potential of Sadong Jaya by Dayang Affizah.

I hope, in some small way, this volume will be useful to stakeholders, be it the business sector or the wider public, to whom we remain connected through our common thoughts on biodiversity protection and appreciation for nature.

Prof. Datuk Dr Mohamad Kadim Suaidi
Vice Chancellor, Universiti Malaysia Sarawak

Message

Sarawak is located within one of the world's biodiversity hotspots, and home to a variety of landscapes, that include mangrove forests. Mangrove ecosystems are among the most threatened habitats in the world. An important source of primary productivity, its ecosystem functions and refuge to a diverse biota, the value of such forest types have remained underappreciated in terms of being brought under the formal protected areas system.

Biodiversity is one of the top state agendas, whereby the State of Sarawak, with the establishment of Sarawak Forestry Corporation (Park and Wildlife) is determined to conserve and protect its biodiversity. This project sits in line with the University's niche area of biodiversity and environmental conservation and sustainable community transformation. This book, based on new research by the staff of our two institutions, brings together information on species, their habitats and other aspects of natural history, and the human community's perception on conservation and sustainable use.

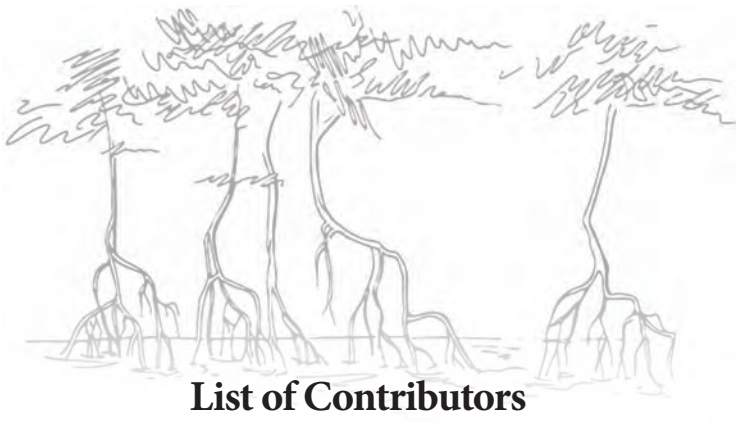
Identifying the distribution, densities and habitat use of plant and animal species in mangrove forests are often seen as a challenge. Nevertheless, these data are essential for understanding their ecology, and in facilitating management of such critical ecosystems.

The faunal studies include, insects, fishes, frogs, reptiles, birds, bats, rodents, shrews and primates. Information on how anthropological activities interrelate with biodiversity is highlighted, and is shown to be a component of biodiversity function whereby the dependence of humans on natural resources and mangrove landscapes remain entwined.

This book is intended for local stakeholders, management authorities, naturalists, researchers and for the general public. It is hoped that nature enthusiasts and those who are interested in tropical biodiversity will find this book beneficial. Finally, we hope that this book will contribute to increasing the knowledge and awareness of our national heritage.

Prof. Dr Wan Hashim Wan Ibrahim
Deputy Vice Chancellor, Research and Innovation, UNIMAS

Mr[illegible]vald Braken Tisen
Deputy CEO, Sarawak Forestry Corporation (Park and Wildlife)



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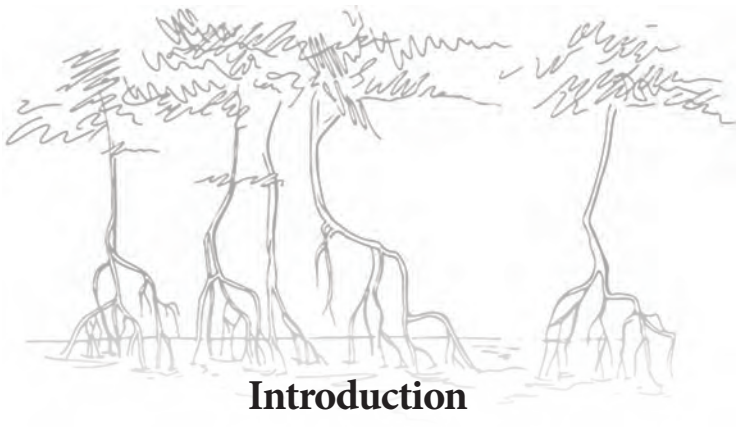

Introduction

Jayasilan Mohd-Azlan, Lisa Lok Choy Hong and Indraneil Das

Littoral and alluvial forests are primarily formed along coastlines or riversides that stretch along shores and riverbanks in south-east Asia. The depauperate biodiversity in littoral and alluvial forests, with lower species richness counts compared to other forest types (Ashton *et al.,* 2003*)* have been of considerable interest, given the vital role played by wetlands as well as their impacts on global warming and flash flood (Yule, 2010). Mangrove forests constitute some of the most threatened habitat in the world, besides being areas of important primary productivity and demonstrate important ecosystem functions, also harbouring a specialised biota. Generally, mangroves characterise sheltered tropical and subtropical coastlines, and mangrove forests contribute 1% of the landscape in Sarawak, with an area 0.09 million hectares. Mangroves, as wetland ecosystems are of substantial economic significance due to their nutrient productivity, as well as ecological function (Ashton and Macintosh, 2002). Nutrient dynamics in the ecosystem are associated with tidal sea water, that transmit to coastal areas and surrounding estuaries (Das 2017; Osland *et al.,* 2017). Mangroves have unique function and structure characteristics. The ecosystem characteristics include relatively simple food webs containing a combination of marine and terrestrial species; nursery grounds and breeding sites for mammals, reptiles and birds; and accumulation sites for sediment, some contaminants, carbon and nutrients. Mangroves also support diversity of unique flora, and fauna as well as serving as breeding and a feeding ground for fish and shellfish (Hwanhlem *et al.,* 2014; Lee *et al.,* 2014). Furthermore, food chains within such ecosystems contribute significantly to the recruitment of adult marine fishes (Sandilyan and Katherisan, 2012).

Diverse forces may act synergistically on human livelihoods (Brodie et al., 2012) and mangrove forests function as the nursery for shrimps, fishes and maintain marine food web which include endemic and threatened species (Ashton and Macintosh, 2002; Sodhi *et al.*, 2004). Timber resources harvested from mangrove forests fulfill requirements for materials used in building, fuel and remedy (Ashton and Macintosh, 2002). Nonetheless, mangrove forests remain underappreciated as wasteland, for often wrongly assumed to be not sustain high biological diversity, and continue to receive less attention from conservation planners, and consequently, have become the prime choice for land conversion (Posa *et al.*, 2011; Yule, 2010). Further, these habitats tend to provide refugia for innumerable generalist species (Ashton *et al.*, 2003; Hoffmann *et al.*, 2010; Posa *et al.*, 2011).

Little is known on the biodiversity of many mangrove habitats and how local human communities perceive and are dependent on these valuable resources. Ellison and Farnswoth (1996) classified anthropogenic disturbances to mangrove forest into four broad categories with a hierarchy of increasing spatial extent and temporal intensity on biological impacts and recovery: 1) disturbances due to extraction of mangrove flora and fauna, 2) pollution, 3) habitat destruction due to land reclamation, and 4) climate change.

A rapid assessment of the biodiversity and social elements was conducted at the Sadong Jaya Mangroves. Sadong Jaya itself is a small village, located within the Asajaya District in Kota Samarahan Division, Sarawak. The relative distance is approximately 25 km (60 minutes-drive) and 68 km (about 90 minutes-drive) from Kota Samarahan and Kuching, respectively. The Sadong Jaya area is predominantly covered by mangrove forest patches, that edge the coastal rivers and open water. Small-scale agricultural lands (including oil palm plantations, orchard and paddy field) fence the outer forest edge. An extensive mudflat borders the coastal shoreline, between Sungai Semera and Sungai Jemukan, Sadong Jaya.

The total area of the mangrove forest is approximately 111 ha, with Sungai Semera and Sungai Jemukan being the natural drainage outlets. This work comprises the findings from eight specific projects conducted using rapid-assessment techniques to collect information on selected floral and faunal components of Sadong Jaya's biodiversity, with the purpose of developing management plans for the mangrove area and their use of Sadong Jaya.

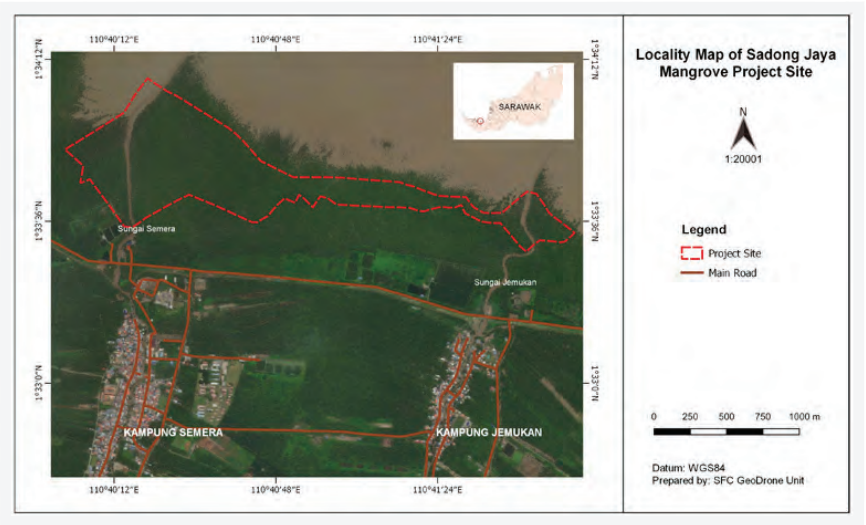

Figure 1.1 Map of the Sadong Jaya Nature Reserve and adjacent areas, in western Sarawak

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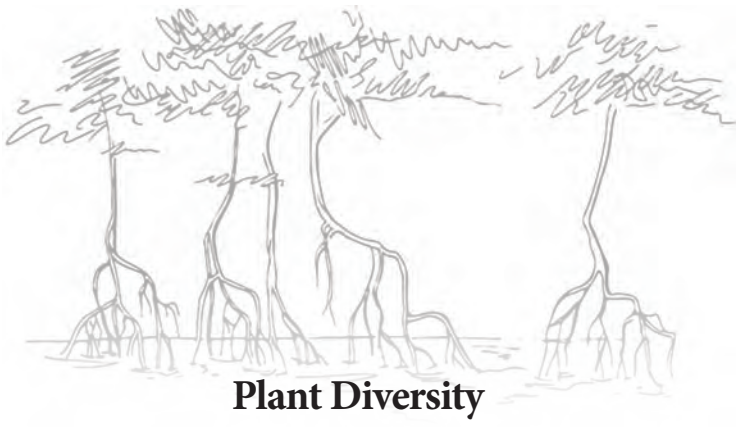

Plant Diversity

Ismail Jusoh

Introduction

'Mangroves' refer to plants that survive in intertidal forest communities (Tomlinson, 2016). These plants are salt-tolerant trees and shrubs that grow in coastal areas of tropical and subtropical regions where rivers drain into the seas (Kraynak and Tetrault, 2003). Mangrove forests play a vital role in erosion and flood control, fisheries, carbon storage, biodiversity conservation and in nutrient cycling. South-east Asia supports the world's largest area of mangroves, originally extending over 6.8 million hectares and representing 34–42 percent of the world's total (Giesen *et al*., 2006). The largest areas of mangrove in south-east Asia are in Indonesia (almost 60 percent of south-east Asia's total), Malaysia (11.7%), Myanmar (8.8%) and Thailand (5.0%).

As of 2017, the total mangrove forests in Malaysia encompass an area of about 629,038 ha, with most located in Sabah (61%) and Sarawak (22%), while about 17% are in Peninsular Malaysia (Hamdan *et al*., 2018; Hamdan *et al*., 2019). The largest mangrove forest (43,292 ha) in Peninsular Malaysia is located in the State of Perak. The total area of mangrove forests in Sarawak is ca. 139,890 ha, which is about 1.1% of the total area of Sarawak (Hamdan *et al*., 2019). About 80% of Sarawak's mangrove forests are in Kuching and Mukah Divisions, another 5% in Limbang Division, the rest 15% distributed in Sri Aman, Sibu and Miri (Abg Ahmad *et al*., 2008)

Mangrove species can be categorised into two groups, according to their features and morphological adaptations, namely, true mangroves and mangrove associates (Shin *et al*., 2015; Tomlinson, 2016). True mangroves occur in wet and saline habitats. Mangrove associates are those in mangrove habitat that do not show obvious morphological adaptations to such habitats,

and may occur as terrestrial vegetation. In Malaysia, true mangrove comprise 39 species in 18 genera, belonging to 12 families, and mangrove associates include 65 species, 59 genera and 38 families (Shin *et al*., 2015). *Avicennia, Bruguiera, Ceriops, Nypa, Rhizophora* and *Sonneratia* are the most common genera of true mangroves, while *Acanthus, Brownlowia, Derris* and *Hibiscus* are examples of associated genera.

Despite their value, mangroves along much of the coastline of Sarawak are threatened by conversion to agriculture or coastal industrialisation and urbanisation. Adverse impacts due to clearance for shrimp ponds, extraction for timber, pollution and alteration of water flow pattern are known to damage mangrove environments. Many of the remaining mangrove forests are partially denuded and poor in species. Few remaining mangrove forests in Sarawak are unaffected by human activities, and these therefore must be recognised, studied and protected.

Mangrove forests within the Asajaya-Sadong Jaya mangrove estuary are diminishing in extent, due to extraction, conversion to agricultural lands and shrimp farming. Furthermore, development, urbanisation and constructions of coastal roads have been intensified in the area, resulting in deterioration of mangrove areas. This chapter assesses the current status of mangroves in terms of species composition and distribution. The specific objectives of this chapter are to determine species composition and distribution, and ascertain characteristics of mangrove stands of the Sadong Jaya mangrove forests.

Vegetation Profile

Sadong Jaya mangrove forests are of the coastal type, located within an accreting deltaic mangrove system dominated by Batang Samarahan and Batang Sadong that supplies silt load for mudflats, and extend up to four kilometres seawards.

The mangroves are spreading seawards, with the abundant supply of seedlings from adjacent mudflats (Figure 2.1). Over time, trees have increased in age and size, creating a smooth canopy. Sadong Jaya mangrove forests show a distinct zonation vegetation pattern (Figure 2.2). The highly exposed seaward zone that is inundated during all high tides is characterized by low floristic diversity compared to inland mangrove forests. Two mangrove species dominating the seaward mangrove belts are *Sonneratia alba* ('Perepat') and *Avicennia marina* ('Api Api Jambu'). They are adapted to surviving in marine tidal environments, with their network of pneumatophores, and are typical pioneer species, and are light-demanding (Figure 2.3). *Sonneratia alba* is known for its ability to colonise newly-formed mudflats, while *Avicennia marina* survives in muddy coastlines.

Landwards at the middle region of Sadong Jaya mangrove forests, the higher intertidal zone is dominated by *Avicennia marina*. Other mangroves, such as *Avicennia alba, Nypa fruticans* and *Rhizophora apiculata* are common. Further landwards are drier and more mangrove species, although it too is dominated by *Avicennia marina.* In the drier regions, other species recorded include *Nypa fruticans, Rhizophora apiculata, Ceriops tagal, Bruguiera parvifolia, Acanthus ilicifolius, Aegiceras corniculatum* and *Aegiceras floridum.*

Although zonation pattern is also noted along the Sungai Semera riverbanks, the species differ from those recorded in the mangrove forests. At the estuary of Sungai Semera, the riverbanks are dominated by *Sonneratia alba*. Gradually, as it extends upstream, the common mangroves found are *Avicennia alba, Avicennia marina* and *Sonneratia alba*. Further upstream or landwards, where the zone is influenced by freshwater, the riverbanks are populated with a richer mix of mangroves, which include *Avicennia alba, Avicennia marina*, *Sonneratia alba, Nypa fruticans, Rhizophora apiculata* and *Aegiceras corniculatum*.

Species Composition

A total of 1,015 trees with DBH ≥ 5 cm were recorded in the 24 sampling plots (Table 2.1). *Avicennia marina* was the dominant species recorded in the mangrove forests, with 726 (or 72%) trees enumerated. Other species dominating the forest area were *Sonneratia alba* (16%) and *Avicennia alba* (7%). In terms of family dominance, Acanthaceae represented almost 78% of total enumerated stem with DBH ≥ 5 cm, followed by the Lythraceae, with 16%. *Sonneratia alba* was usually found in abundance on muddy mudflats along the coastline and riverbank and grows up to a height 10–12 m. It can be identified by the grey to dark grey, more or less fissured bark surface (Figure 2.4), numerous flaky pneumatophores, succulent, ovate leaves and green, apple-like fruits. It occurs further inland along riverbank, or at the convex sections of the riverbanks, where new silty mud flats are formed. Further inland, it become infrequent. This species maintains its status by colonization rather than through regeneration.

Avicennia marina usually grows gregariously up to a canopy height of 10–12 m, and can be recognised by the distinctive flaky bark, mottled greenish-yellow, that is peeling in patches (Figure 2.5). *Avicennia alba* occurs in a mix with *Avicennia marina*. It is found in abundance along the Sungai Semera riverbanks, and can be easily recognised by its rough but fissured bark, which is brown in colour. Another diagnostic feature is the development of a sooty mold (which is visually black and powdery) on older stems (Figure 2.6).

Figure 2.1 *Sonneratia alba* seedlings colonising newly accreted muddy mudflats along the Sadong Jaya coastline

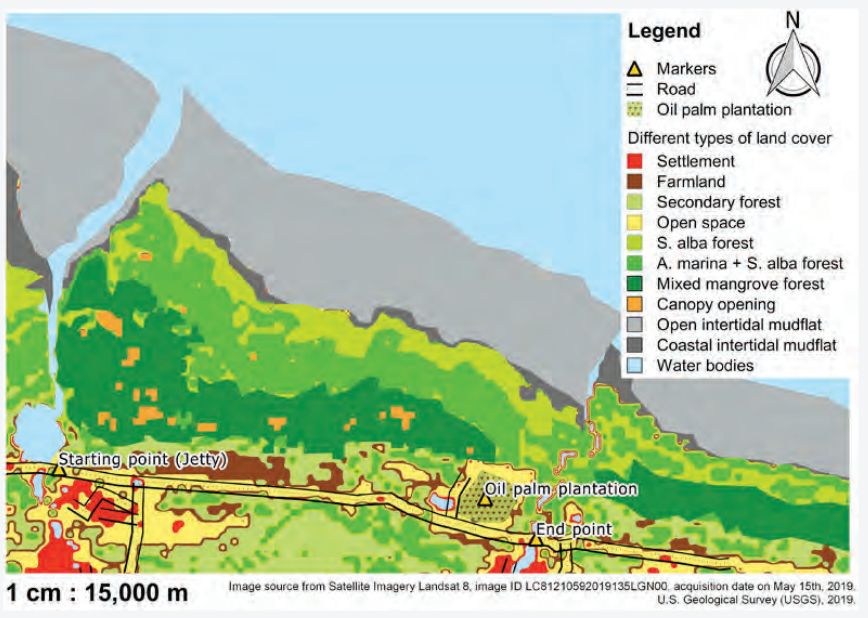

Figure 2.2 Classification and zonation of Sadong Jaya mangrove forest