

# MANGROVES

## A TALE OF SURVIVAL

Mangroves are an integral part of the marine ecosystem. **Ang Seow Leng** explains why these hardy and resilient plants are vital for the survival of humankind.

Mangroves, the forest between land and sea, are fast disappearing as the urban jungle encroaches on its existence and threatens its survival. Mangrove Watch, a global monitoring programme based in Australia that partners mangrove scientists and the community, has noted that the world's mangroves are disappearing at an average of 2 percent a year.<sup>1</sup>

Mangroves are defined as "a tree, shrub, palm or ground fern, generally exceeding one half metre in height, that normally grows above mean sea level in the intertidal zone of marine coastal envi-

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ronments and estuarine margins".<sup>2</sup> The term mangrove is also used to describe the habitat that is made up of such trees and shrubs. Mangrove habitats are also known as "coastal woodlands", "mangals", "tidal forests" and "mangrove forests".<sup>3</sup> They are distributed in tropical and sub-tropical regions, with approximately 70 known species found in the world today.

### Mangrove Impressions

According to the botanist Philip Barry Tomlinson, mangroves have existed since prehistoric times, dating back to the Paleocene period more than 60 million years ago. However, these hardy trees, with their maze of tangled roots, were researched and studied only from the 16th and 17th centuries onwards when European colonisation began.<sup>4</sup>

Mangrove swamps did not always leave a favourable impression on those who

encountered them. In 1878, the zoologist William Hornaday (who was later appointed the first director of the New York Zoological Park, known today as the Bronx Zoo), was tasked to collect natural history specimens for a Professor Ward of Rochester, New York. Hornaday described his first glimpse of mangroves in Singapore:

"Entering Singapore by way of New Harbour is like getting into a house through the scullery window... For the first stage out from New Harbour, the road is built through a muddy and dismal mangrove swamp. Here and there we pass a group of dingy and weather-beaten Malay houses standing on posts over the soft and slimy mud, or perhaps over a thin sheet of murky water. Delightful situation, truly, for the habitations of civilized human beings. Monkey[s] would choose much better."<sup>5</sup>



**(Facing page)** Mangroves at Pulau Semakau. Photo taken by Ria Tan on 9 August 2011. *Courtesy of WildSingapore.*

**(Above)** Mangroves at Sungei Buloh Wetland Reserve. All rights reserved, Yong, D. L., & Lim, K. C. (2016). *A Naturalist's Guide to the Birds of Singapore* (p. 5). Oxford, England: John Beaufoy Publishing.

It was a more pleasant scene some 30 years later in 1908 when another visitor, Count Fritz von Hochberg, had this to say:

"... I was astonished to see how much had been done to the place since I was there four years ago. Lots of these swampy, feverish places around the harbor and the Chinese quarter have been filled up and planted, and it made the place ever so much nicer looking".<sup>6</sup>

### The Mangrove Ecosystem

Studies have shown that the "dismal" and "swampy, feverish" mangroves offer a myriad of uses and benefits for both humans and the environment. These fragile ecosystems provide shelter and protection for several species of fishes, crustaceans and reptiles as well as serve as feeding, nesting and roosting grounds for migratory birds.

Several flora and fauna species are indigenous to mangrove swamps in Singapore, such as the Singapore Rubble Crab, *Favus granulatus*, that was discovered in 1900 on our intertidal shores.<sup>7</sup> Mangrove wood is used as fuel and for thatching, piling and construction purposes. Mangrove trees also act as an effective natural barrier and help to protect shorelines against soil erosion and tsunamis. Some species of mangroves are also used in traditional folk medicine as cures for various malaise.<sup>8</sup>

Perhaps, most importantly, mangroves act as carbon sinks to absorb huge amounts of carbon dioxide from the atmosphere – between two and four times greater than the rates observed in mature tropical forests. In this sense, mangroves play a key role in mitigating the deleterious effects of climate change and global warming.<sup>9</sup>

A study carried out in late 2014 by a team of researchers from the National University of Singapore's Department of Geography revealed that mangroves occupy just 960 hectares or less than 1 percent of the land area in Singapore, but store disproportionately high levels of carbon – 450,571.7 tonnes to be exact, or 3.7 percent of Singapore's national carbon emissions in 2010.<sup>10</sup> Additionally, mangroves are able to absorb heavy metals, metalloids and certain pollutants from the air, thus hampering the flow of toxins into the food chain.<sup>11</sup>

Unlike other plant species, the ever resilient mangroves can survive in oxygen-poor soils and high salinity environments. One of the ways in which mangroves survive in a hostile environment is to grow anchor roots that penetrate deep into the soft sediments as well as long aerial roots called pneumatophores that radiate from the trunk just beneath the soil to prop itself up above water. These breathing roots also perform the function of absorbing oxygen from the air. As a result, mangrove plants have developed a tangle of prop-root structures that are either pencil-like (*Avicennia sp.*) in appearance, resemble the human bent knee (*Bruguiera sp.*) or look like stilts (*Rhizophora sp.*).<sup>12</sup>

### TSUNAMI AND MANGROVES: BOON OR BANE?

In 2015, Sri Lanka became the first nation to protect all its mangrove forests under a comprehensive programme.<sup>21</sup> The following year in July, Sri Lankan President Maithripala Sirisena inaugurated the world's first mangrove museum in Sri Lanka, declaring that the "National Coastal and Marine Resources Conservation Week" be observed in September every year.<sup>22</sup>

Why the great emphasis in protecting mangroves in Sri Lanka? The International Union for Conservation of Nature (IUCN), the world's largest and most diverse environmental network,<sup>23</sup> noted in a 2006 report that the gigantic tidal waves unleashed by the 2004 Indian Ocean tsunami caused much less damage in areas in Sri Lanka that had relatively intact coastal ecosystems.<sup>24</sup> When the IUCN

Furthermore, as mangrove wetlands are coastal plant communities that belong to a larger coastal ecosystem, they act as a connecting link and maintain stability between different coastal ecosystems such as coral reefs, seagrass flats and freshwater swamps.<sup>13</sup>

The four most common mangrove species found in Singapore include *Avicennia* (api-api), *Bruguiera*, *Rhizophora* (bakau), and *Sonneratia*.<sup>14</sup> It is estimated that the island was home to 75 sq km of mangrove forests two centuries ago compared to the minuscule 7.35 sq km found today.<sup>15</sup> By the end of the 19th century, a sizable portion of mangroves had been destroyed by logging activities.<sup>16</sup> In the subsequent decades, large swathes of mangrove forests were removed for industrial development and conversion to coastal reservoirs, the most well known of which is Marina Reservoir in the heart of the new downtown.<sup>17</sup> Today, there are only a few scattered patches of mangroves left in Singapore,<sup>18</sup> and these are mostly found in the northern part of the island.

One of the most well-known mangrove conservation sites is at Sungei Buloh Wetland Reserve. It is a popular site for migratory shorebird watching and photography and has clearly marked nature trails with raised boarded walkways to provide easy access and also prevent wildlife and vegetation from being trampled on.<sup>19</sup> The wetland reserve contains the largest tracts of mangrove forests on the mainland.<sup>20</sup> Other places in Singapore that were named after mangroves, such as Kampong Sungei

compared two tsunami-devastated villages in the Hambantota area of Sri Lanka, it discovered that nearly 6,000 deaths were reported in the village that wasn't protected by dense mangrove and scrub forests compared to just two deaths in another village that was bordered by such vegetation.<sup>25</sup>

However, the Food and Agriculture Organization (FAO) of the United Nations has cautioned such oversimplification, adding that several factors impact the efficacy of mangroves as coastal protection against waves, wind and water. These include the height and velocity of the tsunami, the topography and orientation of the coastline, the width of the forest, and the height, density and the species composition of the mangroves. The FAO warned that it is possible for mangroves and other coastal trees to be uprooted during a tsunami and cause even more extensive damage.<sup>26</sup>



Attap and Sungei Bakau Rungkup in Jurong, no longer exist.<sup>27</sup>

In an article published in *The Singapore Free Press* on 20 January 1951, Marian Wells described the carefree lives of village folks who made a living from firewood harvested from mangrove forests in Jurong:

“The bakau settlers themselves are shabby and poor. Bakau stakes provide walls for huts and lean-tos, and even material for floors. It was amusing to see a kitten clinging desperately to a stake while its body swung in space. It had fallen through a gap in the flooring. Apart from the felling of trees the men are engaged in some fishing and crab catching. Children find sport in racing along raised mudbanks and plank bridges which are their only pathways in a land of mud and sludge.”<sup>28</sup>

### The Regeneration of Mangroves

The debate on land use in Singapore is not a recent phenomenon. In 1951, R. E. Holttum, then Professor of Botany at the University of Malaya, contributed a lengthy article in *The Straits Times* arguing why mangrove swamps should be preserved in Singa-



A 1915 photo by G. R. Lambert & Co. showing some attap houses in a kampong, possibly at Bukit Timah. Mangrove habitats also host nipah palms, whose leaves are used for thatching. *Lee Kip Lin Collection. All rights reserved. Lee Kip Lin and National Library Board, Singapore 2009.*

pore.<sup>29</sup> In Ulu Pandan for instance, some 4 sq km of the mangroves were sacrificed for prawn cultivation in 1957, leaving only 1 sq km untouched.<sup>30</sup>

Almost three decades later, a 1983 *Straits Times* article by Mark Pestana pondered if mangrove swamps could survive in

land-scarce Singapore, with Dr Wee Yeow Chin of the Malayan Nature Society and Dr Leo Tan of the Singapore Science Centre weighing in on the issue.<sup>31</sup>

Today, mangrove conservation efforts in Singapore are carried out by means of legislation, management and education

as well as targeted restoration efforts in specially demarcated areas. Together, nature lovers, botanists and staff from the National Parks Board (NParks) have taken concrete steps to preserve our remaining mangroves. For instance, the Restore Ubin Mangroves ground-up initiative supported by NParks was formed to study and rehabilitate the mangrove ecosystem at Pulau Ubin as well as to conduct activities to raise awareness of Singapore's rich and diverse mangrove habitats.<sup>39</sup>

In 2015, a mangrove arboretum was set up by NParks at Sungei Buloh Wetland Reserve to conserve the country's dwindling mangrove species, especially the critically endangered Eye of the Crocodile, *Bruguiera hainasii*. Interestingly, Singapore is home to 11 of the remaining 200 trees in the world.<sup>40</sup>

As it is extremely difficult to replant mangroves, Singapore can take pride in two successful mangrove reforestation projects – at Sungei Api Api and Pulau Semakau. Mangroves along Sungei Api Api that were effected by reclamation works at Pasir Ris have been regenerated by NParks. When the Semakau Landfill was created by merging Pulau Sakeng with Pulau Semakau in the mid-1990s, the 13-hectare plot of mangroves

In the 1930s, imported charcoal was unloaded at the beach near Singapore Hainan Hwee Kuan (clan association) along Beach Road but in subsequent years, it moved to the wharf at Clyde Terrace, then to Crawford Street and finally to Tanjong Rhu in the late 1950s.<sup>37</sup> In 1986, temporary warehouse facilities in Lorong Halus, Singapore's only charcoal port, were offered to 17 charcoal merchants from Tanjong Rhu, which was affected by the Kallang River clean-up. By 1992, the Lorong Halus port had closed and the charcoal import and export business moved to Pasir Panjang Terminal.<sup>38</sup>

The use of cooking gas and electricity spelt the end of the charcoal industry in Singapore. In 1948, there were more than 50 charcoal dealers in Singapore, including 12 who owned charcoal kilns in Indonesia. By 1988, only half of the dealers remained. No new licences have been issued to charcoal dealers in recent years and the government has stopped offering rental spaces to charcoal factories.

Southeast Asia where there are abundant tracts of *bakau*.<sup>32</sup> Matang Mangrove Forest Reserve in Perak, the largest of its kind in Malaysia, for instance, produces sizable quantities of charcoal for export.

An interesting pictorial description of Singapore's charcoal burning industry from yesteryear can be found in the 22 June 1935 edition of *The Straits Times* (page 20).<sup>33</sup>

Typically, the harvested *bakau* stems are cut to size and transported along the river to the charcoal production factory, where they are stripped of their barks and arranged according to size before being placed in a kiln to be incinerated into charcoal.<sup>34</sup>

Housewives in pre-war Singapore had to make do with charcoal burning stoves. In his book, *The Singapore House and Residential Life, 1819–1939*, Norman Edwards described these kitchens as “extraordinarily primitive”, consisting of an open stove made of brick with either a stone slab or a concrete top at bench height, with two round holes to place the cooking vessels over burning wood or charcoal underneath. A bundle of approximately 2.5–5 kg of charcoal could last a large family for about two days.<sup>35</sup>

Mr Lim Tiong Sui, who used to run a charcoal business in Singapore, recalls purchasing mangrove wood from the Malay villagers at Chua Chu Kang, Tinggi and the Naval Base areas and supervising the firing of the raw material at his charcoal kiln in Jurong. As the demand for charcoal in Singapore was more than what could be supplied locally, it was also imported from neighbouring countries like Indonesia and Thailand.<sup>36</sup>

### MANGROVE WOOD FOR CHARCOAL

Wood from the *Rhizophora apiculata*, also known as *bakau*, makes for good-quality charcoal, which is essentially carbon-rich burnt down wood that is used as a form of fuel. Charcoal is no longer produced in Singapore today but the trade still thrives in parts of



At the charcoal production factory, the mangrove stems are stripped of their bark and then arranged according to size. The stripped mangrove stems are then placed in the kiln to be incinerated into charcoal. *Photo by J. Yong.*



that were destroyed during reclamation was successfully replanted with 400,000 mangrove seedlings.<sup>41</sup>

As mangroves are one of the most threatened habitats in the world, concerted and sustained efforts are needed to conduct further research into these hardy intertidal plants as well as to educate and create public awareness of an ecosystem that predates even the human species. ♦

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