CHAPTER 12

Lessons Learnt from Habitat Restoration at Marsiling Park

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Introduction

Marsiling Park, formerly known as Woodlands Town Garden, is a 12.8-hectare park located in the northern part of Singapore. The park comprises 1.26 hectares of mangrove forest, 8.32 hectares of water body and 3.22 hectares of park land. The natural vegetation is made up of four different types of key habitats, namely back mangrove, freshwater stream, grassland, and secondary forest. The site is bordered by the Bukit Timah Expressway (BKE) and Woodlands Centre Road (Fig. 1).

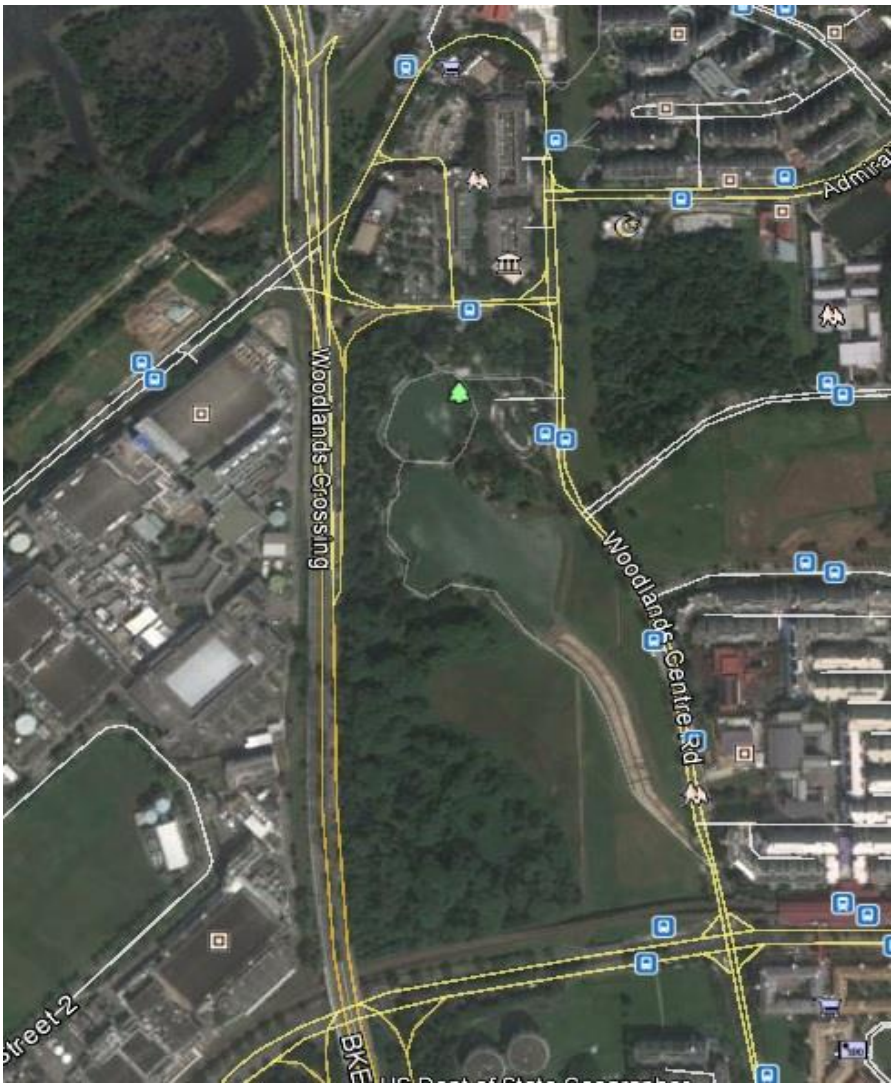
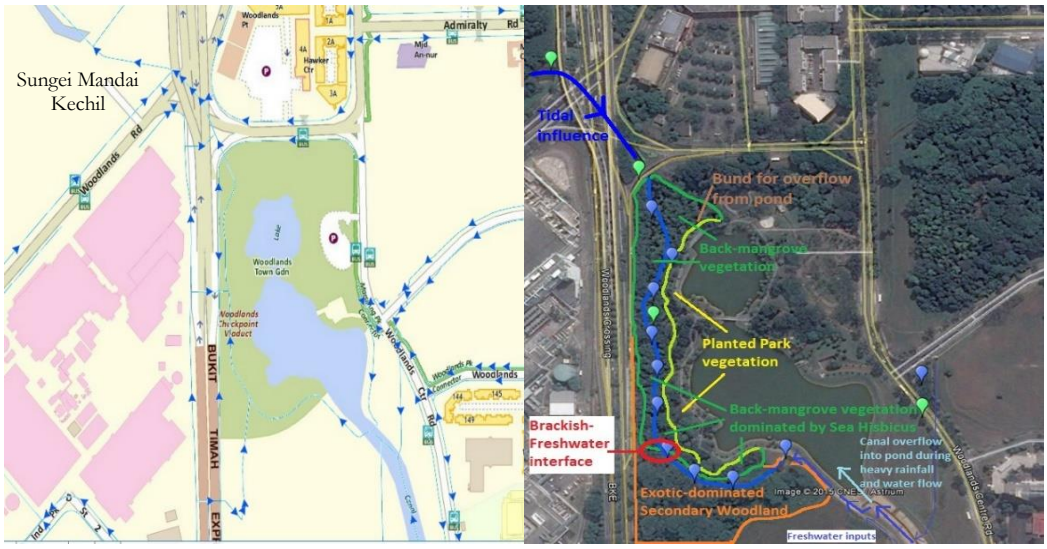


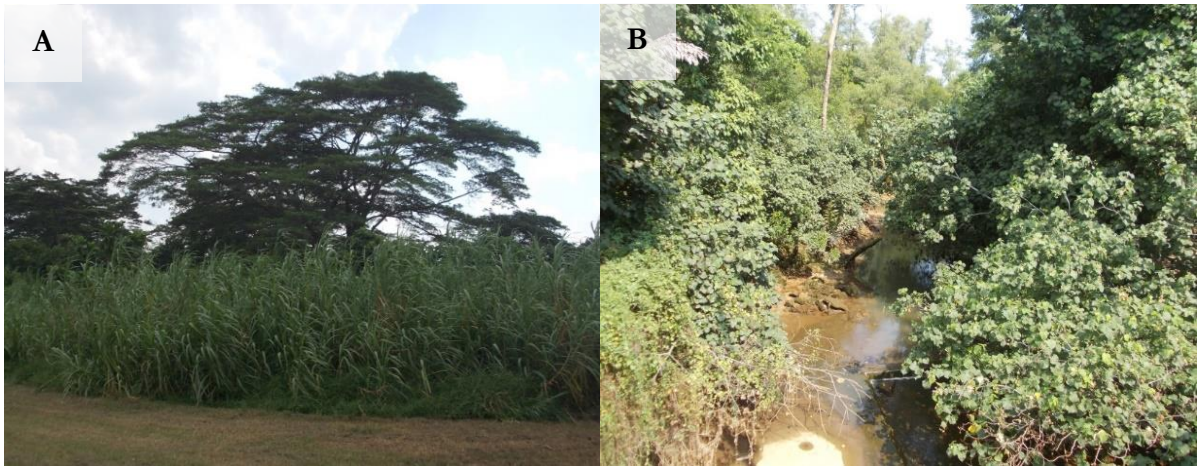
Fig. 1. Google Earth Map showing the location of Marsiling Park. (Image credit: Base map Google Earth@2016)

The mangrove forest is a highly degraded remnant back mangrove (National Parks Board, 2006), with freshwater inputs entering it via the bund for overflow from the PUB storm water pond and lined drains (Fig. 2 & 3). It also includes the uppermost end of the upstream section of Sungei Mandai Kechil, thus it is inundated during high tide. The lower course reaches to Sungei Mandai Kechil and is surrounded by Sungei Mandai Mangrove. The substrate of the site is mainly composed of siliceous sand. Surrounding the back mangrove is grassland, secondary forest, and typical trees in the park (Fig. 4). The section that connects Marsiling Park and Sungei Mandai Mangrove has been turned into a concrete channel as a result of urbanisation (Fig. 5).



Figs. 2. Map of Marsiling Park showing the mangrove forest and its hydrological connections. (Image credit: Base map OneMap@2016; Base map Google Earth@2016, National Parks Board, 2016b)

Fig. 3. Freshwater inputs entering the mangrove forest via the bund for overflow from the pond and lined drains.

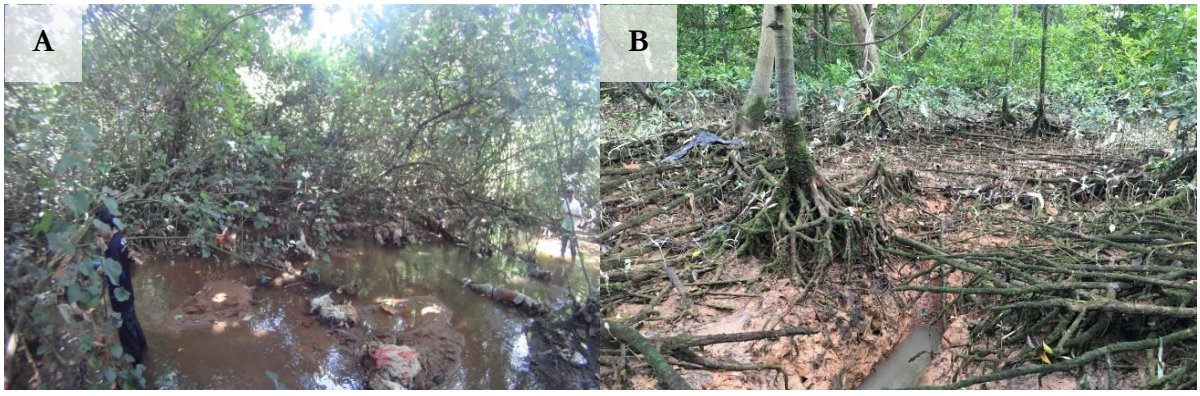


Figs. 4. (A) Grassland park; (B) Secondary forest and trees in the park buffering the mangrove area.

Figs. 5. Part of the Sungei Mandai mangrove that had been concretised into drains.

Threats to the mangrove forest

The mangrove forest faced threats such as the massive inflow of freshwater from the drains and storm water pond that was filled with flotsam during heavy rainfall (Fig. 6A), human disturbance like littering and poaching, and the canalisation of Sungei Mandai Kechil into concrete drains which reduced the inundation by seawater during high tides and thus altered the site's hydrology. This also caused the mangrove habitat to further degrade; the habitat could even disappear eventually in the long term due to the lack of saline water input, which lowered the salinity level of the water in the mangrove site, and could result in the loss of some key species of the flora and fauna. In addition, soil erosion and siltation had slowly built up along the mangrove course due to the changes in hydrology at site (Fig. 6B).



Figs. 6. (A) Flotsam in the mangrove area; (B) Soil erosion observed at the mangrove patch next to the PUB Storm Water Pond. (Photo credit: Cai Yixiong)

An in-depth study of the existing habitats, especially the mangrove of the park, was vital to the understanding of the current conditions and enhancement of the mangrove habitat through restoration of the existing ecosystems from further degradation and future losses. A series of site surveys were conducted to find out the present physical, hydrological and biodiversity conditions of the various habitats found and their impact to the surroundings of the park.

Three main objectives were identified in the study of the habitat enhancement of the mangrove forest at Marsiling Park (National Parks Board, 2016a):

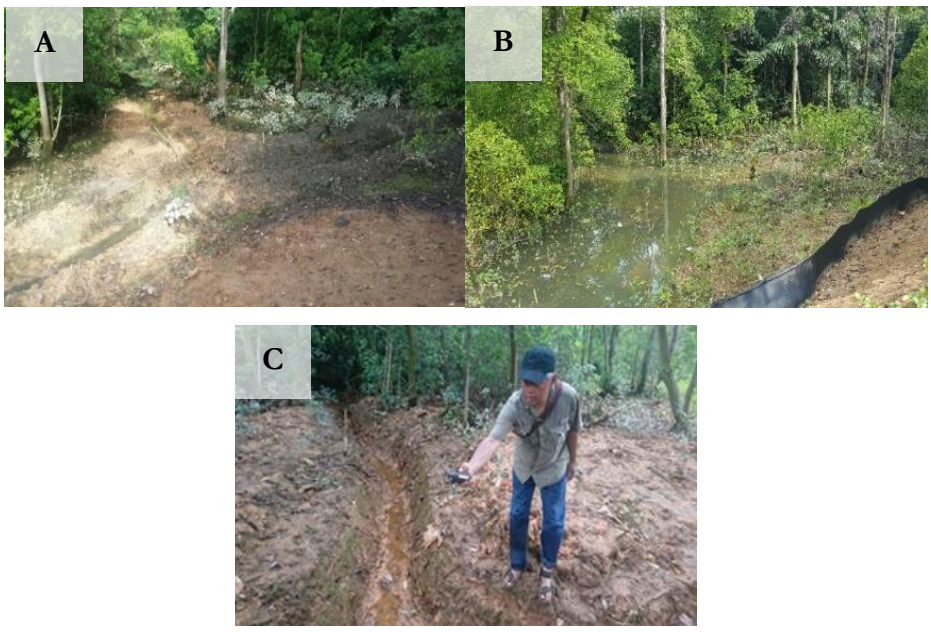
1. To investigate the extent of mangrove habitat degradation and identify the ecological stress and disturbance of the mangrove forest based on the baseline assessment;
2. To reforest and rejuvenate the mangrove forest by changing the profile of the hydrology to prevent further occurrence of soil erosion and working closely with other agencies to mitigate issues of the hydrology and flotsam pollution; and
3. To propose and implement mitigation measures to enhance the ecological and social functions provided by the park.

The reappraisal of the biodiversity on Marsiling Park (National Parks Board, 2016b) revealed and confirmed that the overall species richness for both flora and fauna was still low although a rise in number of terrestrial fauna species had been observed. It was noted, in particular, that no crustacean species was sighted. According to the recent biodiversity assessment, human disturbance and the highly degraded state of the site that had been recognised in 2006 remained valid. Although tidal survey conducted showed evidence of sufficient seawater influence during

the spring tidal period, the loss of the locally endangered mangrove tree *Sonneratia caseolaris* and crustacean fauna, as well as changes in aquatic fauna species in the survey area might suggest that the current mangrove site was showing signs of further degradation. The major causes could mostly be the excessive amount of freshwater input from storm water ponds next to the mangrove patch during the monsoon season as well as the overflows coming through several monsoon drains in the upper stream. A high degree of soil erosion observed at the mangrove next to the opening area of the storm water pond might also contribute to the degradation of mangrove habitat as well as the changes of flora and fauna at the site. Further, the current status of the mangrove and its associated fauna in the stream was undermined as the site was heavily covered with Sea Hibiscus (*Hibiscus tiliaceus*) vegetation and littered with flotsam. The biodiversity of Marsiling Park's mangrove would be further impacted when future development of the site was to take place in the near future.

Mitigation measures and enhancements

In order to change the profile of hydrology, the impact of the tides at the site was studied. Channels were excavated and small islets were created in the channels to improve the water flow into the mangrove and mid transitional habitats (Fig. 7A). These channels were monitored to ensure that sea water would flow smoothly into them (Fig. 7B). They were then mapped using GPS technology for use in future studies of the site (Fig. 7C).



Figs. 7. (A) Excavated channels in mangrove; (B) Monitoring of tidal flow at the channels; (C) Mapping of the excavated channels.

In addition, a biweekly maintenance cleansing regime to remove the flotsam, trash, and litter from the stream was executed to ensure that the stream was minimally impacted in the long run. A filtration system was installed at the start of open concrete drain outlet to limit the amount of rubbish getting into the stream (Fig. 8). Public Utilities Board (PUB) also stepped up its cleansing regime in removing the flotsam from the storm water ponds next to the mangrove patch especially during the monsoon season.

Figs. 8. A filtration system at the start of drain channels into the mangrove area.

Fig. 9. Back mangrove saplings along the creek.

The common and easy-thriving mangrove plants had been reintroduced mainly in the habitat enhancement of the mangrove site. The planting of 10% dominant species, namely *Avicennia* spp., *Sonneratia* spp., *Rhizophora* spp., and *Bruguiera* spp., would facilitate the restoration of the mangrove habitat (Fig. 9). The heavy Sea Hibiscus vegetation along the mangrove creek next to the park side had also been removed and those located opposite the park had been pruned to make head room for the new mangrove saplings to nurture and become established at site. Fallen branches were regularly removed so that these saplings could thrive in the long run.

Fig. 10. Plant species adapted to the edges of the creek.

Furthermore, the back mangrove area had been enhanced with plant species that could do well in a low density of brackish water. These plants include Cannonball Mangrove (*Xylocarpus granatum*), Katong Laut (*Cynometra ramiflora*), Mangrove Palm (*Nypha fruticans*), False Lime (*Suregada multiflora*), and White Samet (*Melaleuca cajaputi*). Species such as *Neolitsea zelaynica*, Penaga Laut (*Calophyllum inophyllum*), Chengal Pasir (*Hopea odorata*), and Thick-Leafed Jambu (*Syzygium pachyphyllum*) that adapted to the landward edge of the mangroves were also planted along the periphery to create a natural buffer between the mangrove forest and the park (Fig. 10).

Monitoring to sustain the habitats

Monitoring of the key ecosystems of the park was very vital so that continued survival and sustainability of the habitats in the park could be achieved. A fauna survey of birds, butterflies and dragonflies was highly recommended to be carried out on a biannual basis, with regular transects lined along the mangrove route. One such survey, BioBlitz, recorded a reasonable number of fauna life at the site. With frequent, regular fauna surveys, the patterns and population of the fauna life could be tracked and monitored. A detailed survey on the mangrove site should take place sometime later, for example, two years after the newly planted mangrove saplings had grown up and established. This should then be continued on a yearly basis for the next five years.

As details of the future development plans for its surrounding areas had not been confirmed, any changes to the park site and its adjacent areas should be tracked and recorded so that immediate mitigation measures could be taken to minimise the impact from the development works. In addition, active liaison with the key stakeholders or agencies such as PUB, Immigration and Checkpoints Authority, Land Transport Authority, and Housing & Development Board would be essential so that updates on their works and development plans within the vicinity of the park would be known to NParks as early as possible for mitigation measures to be taken. It is crucial that NParks works closely with these agencies so that a seamless, continuous, and integrated green buffer area could be created between the park and its development site, ensuring that key habitats of ecosystems in the park would be safeguarded and conserved. Careful plant selection would be carried out to create a naturalistic buffer zone and perimeter sites of a wooded park, further facilitating habitat connectivity and movement through the park and its adjacent green coverage within the town area.

Schools within walking distance in the vicinity of the park would also play vital roles in the outreach and education of the biodiversity of the park. Students from the schools could help raise awareness and importance on the key habitats of the ecosystems and their values in the life cycles. Interactive guided walks, interesting outdoor class lessons and activities, informative interpretative signboards were some ways that would encourage young children and teenagers to learn about the biodiversity of Marsiling Park.

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