Characterizing a Populated Riparian Zone

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Abstract

Developments adjacent to river, over the years, have impacted the ecological systems along riparian zones. This paper is to explore the changes occurring in a populated riparian zone. For over 35 years, the nipah swamps along the study site at the edge of Kuching city, Sarawak, Malaysia are subjected to human disturbances. Once a nipah forest is dominated by *Nypa fruticans*, the study site is being replaced by *Sonneratia caseolaris*—a mangrove forest. Both plants are indigenous to Southeast Asia region. We observe in the study site that *Nypa fruticans*, habitually a dominant species, is weakened when human disturbances are high, and leads to event taken over by *Sonneratia caseolaris*. We point out that *Sonneratia caseolaris* behaves intrusively rather than neighborly in disturbed systems. Here, we suggest that the plant also has high resistance towards human disturbances. This is a growing behavior contradictory to reports of *Sonneratia caseolaris* in natural systems.

Keywords
Mangrove, Nipah Swamp, *Nypa fruticans*, *Sonneratia caseolaris*, Urban River

1. Background

Human activities increasingly either degrade ecosystems, leading to harsher abiotic conditions and/or more limited dispersal of the species originally present; or introduce new species which alter the biotic environment and potentially reduce chances for system redevelopment. In both situations, novel ecosystems can be expected [1]-[3]. This paper is to gain understanding of the mentioned changes in a populated riparian zone because this would allow people to identify, proactively address specific concerns and monitor changes over time.

Riparian zones are the interfaces between terrestrial and aquatic ecosystems, and host a wide array of plant and animal life [4]-[6]. Understanding of terrestrial-aquatic interactions is critical for assessing ecological effects of development because human settlements are often clustered near such areas [7] [8]. Environmental
changes caused by human activities are often agent of perturbation in these systems [9].

2. Study Site

Located at the eastern edge of Kuching city, the study site is near Muara Tabuan Light Industrial Park. The industrial park is beside the confluence point of tidally-influenced Tabuan and Kuap Rivers (Figure 1). Earliest development of this area was traced to 1978 with the construction of a manufacturing plant, followed by housing estates and villages nearby. It was once a nipah swamp, characterized by nipah palms or *Nypa fruticans* lining the banks of Kuap River. For over 35 years, the nipah swamps along the two rivers are subjected to human interventions [10]. It is for this reason that makes this area an ideal site to have an investigation on its characteristics. A total of 22 polygons of 100 m × 100 m are delineated along the riparian strip for analysis. Some intact nipah swamps are still thriving on the opposite bank of the industrial park, allowing comprehensible comparison to the polygons being studied.

3. Field Investigation

Borneo Island is one of the many islands dotted the western Indo-Pacific region. As such, the typical mangrove zones depicted in Figure 2 holds true for the study site [11]. The site is located about 18 km from the estuary to South China Sea, making it categorized as landward zone of mangrove habitat. In the case of Kuap River, *Nypa fruticans* which is indigenous to this region [12] dominates the water edges (Figure 3). In its most pristine conditions, they form unbroken swampland, often stretch miles into the land. Having said so, it is also known there...
is no clear boundary for wetland species. Sometimes, other species are found occasionally intermingling with nipah palms along river banks.

Nipah palms grow in soft mud and uniquely in river stretches with a mix of low salinity, regular inflow of freshwater and nutritious silt. The plants are less salt tolerant than mangroves and often occur in pure stands of nipah swamp/forest. Its ability to withstand slight salt water gives them an advantage to flourish in between freshwater and salt water ecosystems. It can tolerate infrequent inundation, so long as the soil does not dry out for too long. Its horizontal creeping stem stabilises river banks preventing soil erosion. New fronds emerge quickly after damage and so quickly protect the land after storms and also continuously produce useful products for the locals [13]-[15].

The conditions of riparian vegetation reflect the influence of human activities in the riparian zones [16] that often devastating the vegetation (Figure 4). A measurement of vegetation cover in the outlined 22 polygons points to the fact, not surprising that the once governing nipah palms are only found in small pockets (Figure 5). Percentage and lushness of nipah palm in each polygon are obtained for the assessment (Table 1). This is
achieved through a series of air photo inspections [17], in which the feather-like nipah leaves give a distinctive texture that easily indefinable and measurable of its coverage. Otherwise, it is rather difficult to differentiate other forms of vegetation.

Through field trips, the conditions of the site are more clearly observed and documented. What cannot be defined through air photos is assisted by field trips to reveal that the riparian zones are dominated by *Sonneratia caseolaris*, normally categorized as mangrove species. Photos depicting the conditions of the riparian zone under study are supplemented in the appendices. We perceive that human activities spanning over 35 years have induced the nipah palm to taper off and lead to event of taking over by other species.

Similar to *Nypa fruticans*, *Sonneratia caseolaris* is also indigenous to this region. Naturally, the plant is found in lower saline areas on deep muddy soil along tidal creeks with slow moving freshwater. As a pioneering species that colonizes newly formed mudflats, it was reported to expand rapidly in number, especially in optimum conditions of low salinity [18] [19]. It is fast growing with low seed viability (sets fruit only three months of the year). This species can grow up to 30 m in the center of its range. On the extremities of its range, it grows only to less than 10 m. It is associated with the firefly insect (*Ptyeroyx* spp.).

![Figure 4. Disturbed nipah swamp beside Tabuan River (Polygons 12 - 15).](image)

![Figure 5. Comparison of vegetation cover and nipah palm.](image)
Table 1. Measurement in study site.

<table>
<thead>
<tr>
<th>Polygon</th>
<th>Vegetation Cover (%)</th>
<th>Nipah Palm (%)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Lushness of Nipah Palm</th>
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<sup>a</sup>Nipah palms among the vegetation cover; i. Appearances of *Sonneratia caseolaris*; ii. Heavy human disturbances around the area.

4. Discussion

*Nypa fruticans* is portrayed as a dominant species in natural ecosystems. The followings are reports from the same region of Southeast Asia. Reference [20] wrote about the mangroves in Mahakam Delta of East Kalimantan, Indonesia that the sedimentation zones were colonized first by *Sonneratia caseolaris*, which soon gave way to a fairly varied formation dominated by *Avicennia* sp. This species was gradually replaced by ferns (*Acrostichum*), or by *Nypa fruticans* which covered most of the delta.

Reference [21] stated that *Nypa fruticans* was colonizing along most rivers in Kemaman, Terengganu, Malaysia and generally grows gregariously but not extensively, interspersed with *Avicennia* species and *Sonneratia* species near the river mouth and with *Rhizophora* species and *Bruguiera* species on soft mud further inland. Reference [22] described a mixture of *Sonneratia caseolaris* and *Nypa fruticans* alongside other mangrove species in the marine and brackish stretches of Tutong River, Brunei.

We notice, contrary to the previous reports, the number of *Nypa fruticans* in the study site is dwindling and *Sonneratia caseolaris* is overtaking the palms when implicated by high human disturbances. This is most significant in Polygons 8, 9, 16 and vicinity, where an expansion works of the bridge was carried out for the past three years, see no signs of the palm but dominate by *Sonneratia caseolaris* instead. Reference [23] reported that *Sonneratia caseolaris* was fairly well adapted to freshwater. Here, we suggest that the plant also has high resistance towards human disturbances. We also add to the statements of [21] that *Sonneratia caseolaris* behaves intrusively rather than neighbourly in disturbed systems, as exemplify in Figure 6 and Appendix (Polygons 18 - 22). This is a growing behaviour contradictory to reports of *Sonneratia caseolaris* in natural systems.
5. Conclusion

*Nypa fruticans* is common over Southeast Asia. Locals always consider that the palms are aplenty and hardy, with little attention showers over their wellbeing. Somehow, observation from this study shows the opposite. Once a stronghold region of nipah swamp is slowly faded away, the study site is being replaced by *Sonneratia caseolaris*—a mangrove system. In the viewpoint of water course management, both plants are superior in maintaining the structures of river banks, but losing one system over another is a trade-off to be reckoned of. This should sound an alarm that even abundance of one plant does not guarantee the continuity of the species in the face of human disturbances.

Acknowledgements

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References


## Appendix

### Air Photo of the Study Site

[Image of the study site]

### Photos Taken According to Polygons

<table>
<thead>
<tr>
<th>Polygon</th>
<th>Location</th>
<th>Photos</th>
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<td>1 - 4</td>
<td><img src="image1" alt="Map of Polygons 1-4" /></td>
<td><img src="image2" alt="Photo of Erosion and Sonneratia caseolaris" /></td>
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</table>

*Sonneratia caseolaris* dominates the riparian zone

*Nypa fruticans* is found in small number in Polygons 2, 3 and 4

Note: All photos are taken in 2012-2013

Erosion of river bank and appearance of *Sonneratia caseolaris*.

Intermingling of *Sonneratia caseolaris* and *Nypa fruticans*. Only a few clumps of *Nypa fruticans* remain in Polygon 4.

*Nypa fruticans* in Polygon 2.
Continued

5 - 11

Riparian zone is changed to terrestrial

Note: All photos are taken in 2012-2013

At Polygon 8

Dried river bank

Napier Grass (*Pennisetum purpureum*)

Lalang Grass (*Imperata cylindrica*)
Sonneratia caseolaris dominates the vicinity of the bridge. Nypa fruticans is found in small number in Polygons 14 and 15.

Note: All photos are taken in 2012-2013.

Intermingling of Sonneratia caseolaris and Nypa fruticans. Only a few clumps of Nypa fruticans remain in Polygons 14 and 15.

Bridge construction at Polygon 16. Sonneratia caseolaris dominates Polygons 15, 16 and 17.
Young *Sonneratia caseolaris* dominates most of river banks

*Nypa fruticans* is found in small number in Polygon 19

Note: All photos are taken in 2012-2013

Intermingling of *Sonneratia caseolaris* and *Nypa fruticans*. Only a few clumps of *Nypa fruticans* remain in Polygon 19.

*Sonneratia caseolaris* dominates most of the river banks.
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