Exploring the Ecological Dynamics of Mangrove Ecosystems in Bobbin Head National Park

NBCS NORTHERN BEACHES CHRISTIAN SCHOOL

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Introduction

Every day, 166 people die due to the direct or indirect effects of climate change (University of Reading, 2022). This is perpetuated by the human-induced destruction of major carbon sequesters such as coral reefs and mangrove forests. These are vital ecosystems that need to be preserved in order to reduce the levels of carbon within the Earth's atmosphere.

Mangrove forests are extremely valuable as they mitigate the effects of climate change by storing excess carbon throughout the soil. They store more carbon p/unit area than any other ecosystem, covering only 0.1% of the planet's surface but storing up to 10x more carbon p/ha than other forests (Conservation International, 2022).

As investigated, humans play a crucial role in the optimisation of mangrove environments and subsequently the health and continuation of this carbon sequestering plant. Although wetlands are very resilient to natural stresses, they aren't able to cope and adapt at the rapid rate of destruction caused by climate change and other human-induced impacts, and with it, their ability to decelerate the effects of climate change is diminished. In order to reestablish these ecosystems, it is vital to learn of their internal processes that allow them to survive in such harsh conditions, and the ways in which human activity affects a mangrove's environment, thus learning of methods to mitigate the effects moving forward.

Throughout this investigation, the abundance of the *Avicennia marina* mangrove species, also known as the Grey Mangrove, was examined within Bobbin Head National Park. The exact locations sampled are seen in figures 2 and 4.

The factors investigated are those that directly influence the functioning of different tissues within the plant, including aiding in the mobility of nutrients throughout the plant via the xylem and phloem (figure 1).

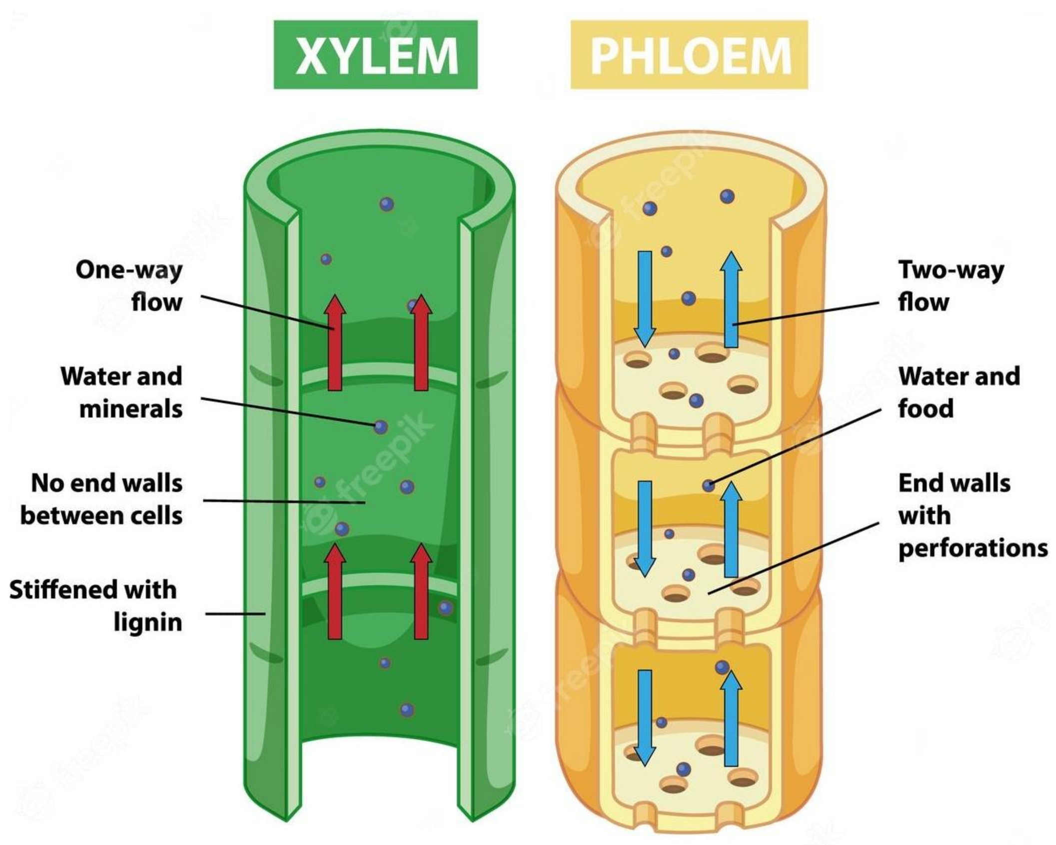

Figure 1. Graphic of the structures and components of plant vascular tissues the xylem and phloem. (Cornell, 2016)

Figure 2. Satellite image with an aerial view of Bobbin Head National Park. Areas sampled indicated by the coloured dots.

Methods and Materials

Throughout this investigation, the pH, temperature, turbidity, absorbance and transmittance of water samples were compared against the abundance of pneumatophores with a diameter ≥ 5mm.

pH and temperature: this data was collected on-site using a PASCO temperature probe and PASCO pH monitor. They were placed inside the wet soil 3 times in each of 6 quadrats per location (3 locations) (figures 5 and 7).

Colorimeter analysis: this data was collected through a Büchner funnel to collect chlorophyll-A (figures 11 and 12). This was then dried out, cut up and mixed with alcohol solution to make a homogenous solution. These were placed in cuvettes and measured in the PASCO colorimeter sensor. The different values were recorded regarding the violet, blue and green wavelengths of light absorbance and transmittance through each of the water samples (figures 6, 8 and 9).

Turbidity: this data was collected by placing the three water samples from each of the three locations into cuvettes as well as a control of distilled water and a sample of known turbidity of 100 NTU (figure 10). Turbidity levels were measured using the PASCO wireless Turbidity sensor.

Abundance: The abundance was found by counting the number of *Avicenna marina* pneumatophores within each quadrat whilst using a digital caliper to measure the diameter. The number of pneumatophores with a diameter ≥ 5mm was put as a fraction over the total number of pneumatophores. The mean abundance for each location was then calculated (figure 10).

Characteristic of soil/water	Quantitative value required for optimal carbon absorption & pneumatophore growth in *Avicennia marina*
pH	6.7 - 7.3 (Slightly more acidic is better, Alsumaiti & Shahid, 2018)
Dissolved oxygen level (DOL)	8.4 - 37.2 mg m-3h-1 (Mitra, 2018)
Temperature	24°C (Queensland Government, 2023)
Turbidity	~600 NTU (Santarosa, 2023)

Figure 3. Summary table of the ideal conditions for growth

Results

As seen in figures 5-13, there are trends that arise within the three water samples from each of the three locations. The water sample from the location with the highest abundance (ie: solution C), tends to correspond with the ideal soil/water characteristics, seen in figure 3, which are published values from peer reviewed sources.

These results illustrate that the more human activity in an area that occurs, the more that the environment differs from the optimal conditions. This ultimately impacts the growth and abundance of pneumatophores, thus diminishing the vital process of carbon sequestration within pneumatophores.

Location name	Level of Human Activity (0 to 5, 5 being the highest)
Bobbin Head canoe ramp	5
Bobbin Head canoe launch area	3
Gibberagong Track Mangrove	2

Figure 4. Table of locations sampled within the Bobbin Head National Park and observed measurements of the level of human activity/disturbance

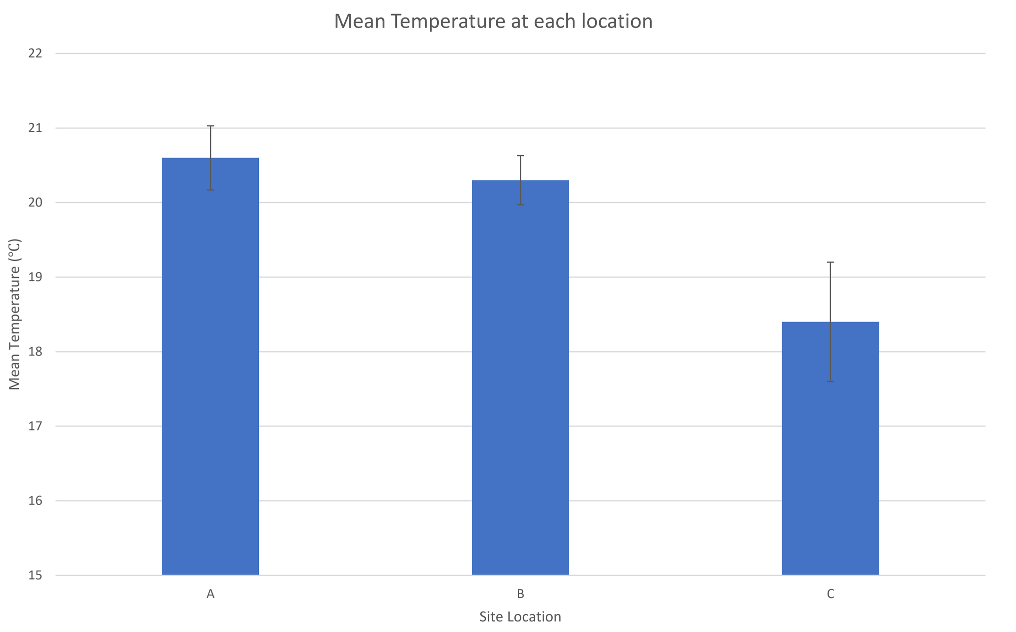

Figure 5. Graph of mean temperatures

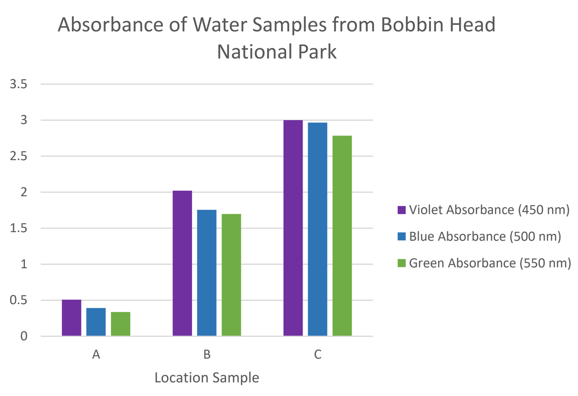

Figure 6. Graph of light absorbance

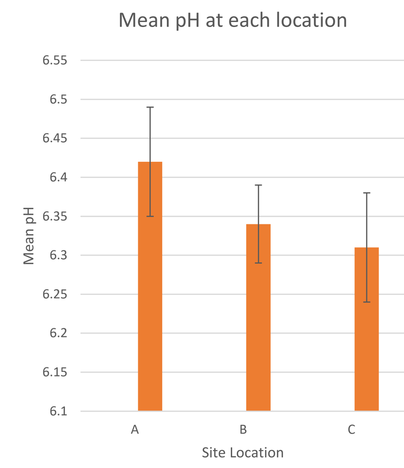

Figure 7. Graph of mean pH

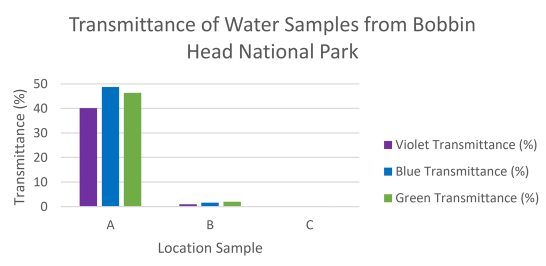

Figure 8. Graph of light transmittance

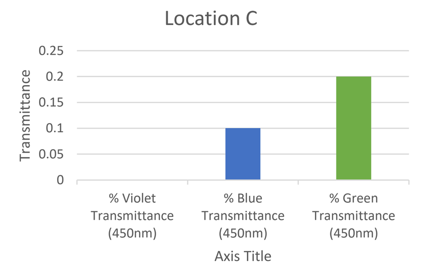

Figure 9. Graph of Location C results

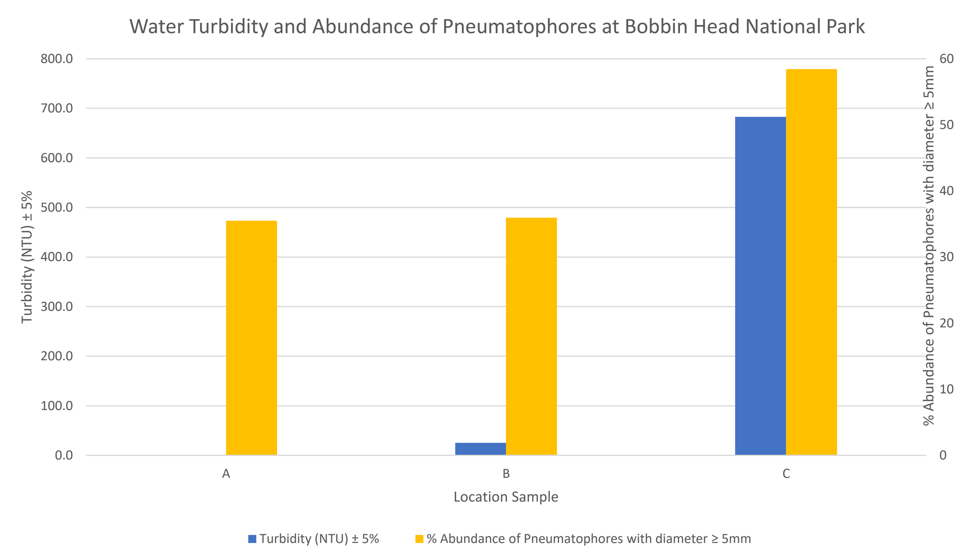

Figure 10. Graph of abundance and turbidity at the three locations

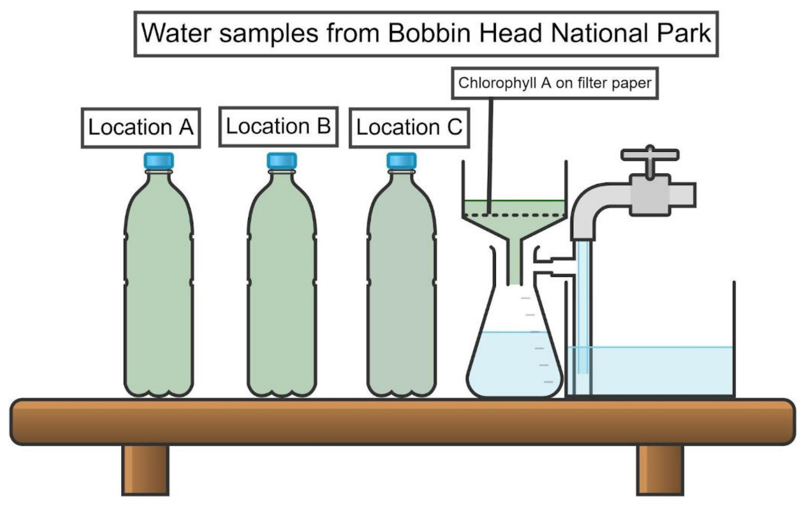

Figure 11. Diagram of set up of filtration of water samples

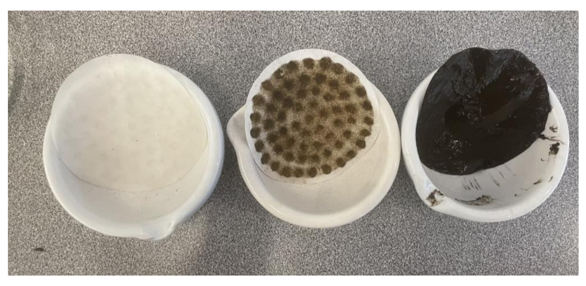

Figure 12. Photograph of filter paper from the three samples after filtration

Figure 13. Photograph of cuvettes of water samples

Conclusions

This investigation has found that human activity plays a critical role on the growth and abundance of mangrove plants, therefore demonstrating the importance of treating nature with care and creating protected wetlands where minimal disturbance is ensued.

The analysis of water and soil samples from Bobbin Head National Park demonstrate how areas of lower human activity maintain the optimal conditions needed for mangroves to thrive. Location C was found to have the greatest abundance of pneumatophores as well as the lowest level of human activity.

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