

Study of mangrove biomass at Pacific Reef Fisheries Prawn Farm: Alva, Queensland.

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Introduction

Gassman Development Perspectives (GDP) was commissioned by Pacific Reef Fisheries to undertake a broad scale assessment of the approximate total biomass of mangroves present on the Pacific Reef Fisheries Alva prawn farm located at Lot 1, Trent Road, Alva (Figure 1). The purpose of this assessment was to continue to collect data on the biomass of mangroves present on the farm to continue to track the changes in approximate mangrove biomass present on the farm.

The mangrove communities present on the land occupied by the farm have been artificially established and form part of the Pacific Reef Fisheries discharge water treatment system. Prior to the construction and operation of the aquaculture facility, the mangrove cover on the subject land was minimal.

Methodology

The same four (4) mangrove areas were investigated as last monitoring occasion for consistency. These areas were considered to represent a robust cross section of different mangrove communities present on the subject site. The locations of these study areas are represented in Figure 2. At each location, a permanent quadrat was established of an appropriate size considered the surrounding waterways and infrastructure. The dimensions of each quadrat are outlined in Table 1 below.

Table 1 – Size and dimensions of sample quadrats

Quadrat Number	Quadrat Size
1	11x20m = 220m ²
2	8x40m = 320m ²
3	20x20m = 400m ²
4	60x5m = 300m ²

The same quadrats utilised for the baseline survey were examined on this occasion. A GPS location was taken at each of the quadrats. At each location, all mangroves present were identified to species level and individual trees counted. Counts were divided into trees over 4m in height and trees under 4m in height. The dominant canopy height was also recorded. Photographs taken at each quadrat is included in Appendix 1.

This study was only commissioned at a broad scale and as a result, specific measurements such as diameter at breast height (DBH), individual tree heights and wood biomass were not collected. The basis of estimating the average biomass of individual trees was calculated using data collected by Fromer et al. (1998) whose study investigated aboveground biomass of mangrove genera which were comparable to those present on the Pacific Reef Fisheries property.

The site based survey determined that the majority of trees over 3m in height displayed a DBH of between 13 to 16cm. Trees under 3m in height generally displayed a DBH of between 3 to 5cm. Consequently, the biomass of trees of these sizes as quantified by Fromer et al. (1998) were used as the basis for the estimation of biomass at Pacific Reef Fisheries.

Results

The results of each of the four quadrats sampled are included below in Table 2. Stem counts for each quadrat were undertaken for trees over and under 3m in height, and the density calculated on a per hectare basis.

Table 2 – Results of quadrat data

Quadrat	Area of quadrat surveyed	Species Present	Canopy height	Number trees over 3m	Density of trees over 3m	Number of trees under 3m	Density of trees under 3m
1	220m ²	<i>Avicennia marina</i> , <i>Aegilitis annulata</i>	5m	59	2681/ha	41	1863/ha
2	320m ²	<i>Avicennia marina</i> , <i>Exocoeria agallocha</i>	6m-8m	44	1375/ha	5	156/ha
3	400m ²	<i>Avicennia marina</i> , <i>Aegilitis annulata</i>	7m	66	1650/ha	33	825/ha
4	300m ²	<i>Avicennia marina</i> , <i>Rhizophora stylosa</i> , <i>Ceriops sp.</i> , <i>Aegilitis annulata</i>	6m	85	2833/ha	145	4833/ha
Average					2134.75/ha		1874.25/ha

According to Fromer et al. (1998), the aboveground biomass weight of mangroves in their study for *Avicennia* mangroves which measured 13cm in DBH was 71.8kg and 15.5cm was 87.6kg. An average figure of these two biomass weights was calculated to be 79.7kg. As the majority of mangroves over 3m in height ranged between these DBH values, this average weight reported by Fromer et al. (1998) is used as the basis for calculating mangrove biomass at Pacific Reef Fisheries.

Also according to Fromer et al. (1998), the aboveground biomass weight of *Avicennia* mangroves in their study which measured 3.5cm and 4.5cm DBH weighed 2.8kg and 5.7kg respectively. The average weight between these two values of 4.25kg has been utilised as the value for trees under 3m in height.

Consequently, the average mangrove biomass per hectare was calculated using these values and the average stem count for trees over and under 3m in height across all four (4) quadrat sites. The results are outlined in Table 3 below.

This average biomass for mangroves found on the Pacific Reef Fisheries farm was then multiplied by the number of hectares of mangroves present on the subject site.

Table 3 – Calculation of total biomass of mangroves per hectare

	Average weight of tree	Stems per hectare	Total biomass per hectare
Trees over 3m	79.7kg	2134.75/ha	170.14 t/ha
Trees under 3m	4.25kg	1874.25/ha	7.97 t/ha
			178.11 t/ha

This biomass of 178.12 t/ha is comparable to the findings of Fromer et al. (1998) who reported two (2) stands of mature coastal mangroves in French Guiana as containing 180 t/ha and 315 t/ha respectively. It has increased by approximately 13t/ha from the result of 165.47 t/ha measured a year earlier, and returns comparably to initial surveys in 2014 which recorded 170.45 t/ha.

A total of 23.37 hectares of mangroves were found to be occurring on the Pacific Reef Fisheries farm site (Figure 3). A total of 4162.42 tonnes of mangrove biomass was estimated to currently

occur on the Pacific Reef Fisheries farm site (Table 4) in contrast to 3983.42 tonnes of mangrove biomass estimated to be occur in April 2014 and 3929.20 tonnes in April 2015 and 3867.03 tonnes in April 2016 (Table 5). Across all sites, trees over 3m in height had slightly increased and trees under 3m in height had notably decreased at all sample sites, and. The increase in taller trees more than offset the reductions in smaller trees and overall, represents a 7% increase in overall biomass over the past year.

Table 4 – Total biomass of mangroves for Pacific Reef Fisheries Farm

Total biomass per hectare	Total hectares of mangroves	Total biomass for entire farm
170.14 t/ha	23.37 ha	4162.42 tonnes

Table 5 – Total biomass of mangroves for Pacific Reef Fisheries Farm (baseline results, April 2014, April 2015, April 2016)

Year	Total biomass per hectare	Total hectares of mangroves	Total biomass for entire farm
2014	170.45 t/ha	23.37 ha	3983.42 tonnes
2015	168.13 t/ha	23.37 ha	3929.20 tonnes
2016	165.47 t/ha	23.37 ha	3867.03 tonnes

Conclusion

This study has estimated the approximate biomass of mangroves present on the Pacific Reef Fisheries site. This information is important to monitor changes in mangrove biomass which may in turn impact upon the rates of uptake of nitrogen, phosphorous and other elements over time.

In consideration of the minimal mangrove biomass previously present on the subject land prior to the construction and operation of the aquaculture farming activities, the establishment and maintenance of approximately 4162.20 tonnes of mangrove biomass is considered to be a

substantial improvement in the environmental condition of the marine habitat surrounding this locality.

Following four (4) years of monitoring, the biomass of the mangrove populations do not appear to fluctuate substantially. To this end, it is concluded that the population can be considered to be stable and effective in removing nitrogen, phosphorous and other elements resulting from aquaculture activities.

It is recommended that monitoring of mangrove biomass utilising the permanent quadrats established on this initial baseline monitoring occasion occur every year to ensure the ongoing health and viability of mangroves is maintained within the farm site.

References

Fromer et al. (1998). Structure, above-ground biomass and dynamics of mangrove ecosystems: new data from French Guiana. *Oecologia* 115: 39-53.

Appendix 1 – Photographs of Mangrove Quadrats

Quadrat 1 – 3 photos







Quadrat 2 – 4 photos









Quadrat 3 – 4 photos









Quadrat 4 – 2 photos



