CHAPTER SIX

CONCLUSIONS & RECOMMENDATIONS

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

(1) The three sites were clearly discernible in terms of water quality: the waters of site A had relatively high NH_3-N, O-PO_4 and TSS concentrations, and low DO, pH and salinity; site B had relatively low NH_3-N, O-PO_4 and TSS concentrations, and high DO, pH and salinity; whilst site C waters were low in NH_3-N, O-PO_4 and TSS, and had moderate DO, pH and salinity.

(2) The water quality parameters of site C appear to support a richer, more diverse and evenly spread seaweed community, and with the greatest biomass, whilst the opposite was true for site A. However, the species richness at site A was greater than that of site B.

(3) TSS was the recurring factor that contributed to the biotic parameters of species richness, diversity (*H'*), evenness (*J*) and biomass, and is postulated to be the factor that contributed to the low species diversity (*H'*), evenness (*J*) and biomass, as well as intertidal zonation at site A.

(4) *Sargassum baccularia* was the most important species in terms of frequency and dominance at all three sites. In general, the coral reef ecosystem at Cape Rachado is *Sargassum*-dominated, which suggests that the system is detritus-driven.

(5) When the data of the 1987/88 and 1998 surveys were compared, the following observations were made:

(i) sampling occasion accounted for variations in all water quality and biotic parameters except species evenness (*J*). Location accounted for variations in all water quality and biotic parameters except salinity. The interaction between sampling occasion and location accounted for variations in all water quality and biotic parameters except TSS, biomass and species evenness (*J*).

(ii) At site A, the significant changes involved a reduction in biomass and evenness (*J*) and an increase in species richness in 1998. At site B, no

biotic parameters had changed significantly except for the increase in species richness in 1998. At site C, species richness and diversity (*H'*) had increased significantly in 1998.

(iii) The increase of species since 1987/88 at more than one site thus argues for a possible general increase or recruitment of algal species at Cape Rachado.

(iv) No significant correlations were found between the biotic and water quality parameters. The water quality parameters contributed to the biotic parameters in various combinations, but TSS was the recurring parameter that influenced all biotic parameters except for biomass. Biomass was influenced mainly by pH and salinity.

(v) There were clear changes in the frequency and dominance of various seaweed species. At site A, the Chlorophyta (*Udotea, Cladophora* and *Enteromorpha* spp.) and Rhodophyta (*Hildenbrandia, Gelidiella* and *Ceramium* spp.) were the most frequently occurring forms in 1998, replacing the Phaeophyta observed in 1987/88. The Phaeophyta (*Sargassum*, *Padina* and *Turbinaria* spp.) were still the most frequently occurring forms at sites B and C.

(vi) *Sargassum oligocystum* was the dominant species at all sites in 1987/88 but had been replaced by *Gracilaria salicornia* at site A and *Sargassum baccularia* at sites B and C in 1998. The dominance of *G. salicornia* on the nearshore, muddy zones of site A is likely to be attributed to its ability to tolerate higher sediment loads and longer exposure periods. The dominance of *S. baccularia* at sites B and C in 1998 suggest that these two sites suffer less TSS loadings than they did in 1987/88, a fact confirmed by the TSS analysis.

(6) The seaweed community structure on the reef flats of Cape Rachado indicate that the reefs at sites B and C experience low-nutrient and low-grazing conditions, are

detritus-driven, and have minimal contribution to accretion from the seaweed component. The reef at site A is a degraded one with relatively low seaweed diversity and abundance. The high TSS load was postulated to be the main cause of coral reef and seaweed community degradation.

6.2 Recommendations

(1) The Cape Rachado fringing reef ecosystem is the last remaining reef of its kind on the West Coast of Peninsular Malaysia and as such, must be preserved for its capacity to contribute much to the scientific community, particularly in the understanding of the biology and ecology of fringing reefs, and the effect of anthropogenic impacts on the reef community.

(2) The priority locations have been revealed by this study: the greatest species diversity and abundance of the seaweed community at site C implies the highest conservation value for this site, followed by site B. The site A coral and seaweed community has been extensively degraded, but still offers opportunities for researchers interested in the responses of seaweeds to high TSS loads and sedimentation.

(3) Sites B and C are part of the Cape Rachado Strict Nature Reserve, and as such are protected by "no-collection" laws. At the time of this study, however, no proper enforcement system seemed to be in place. Holothuroid collectors flocked to site C, while site B, by virtue of its accessibility, was popular with holiday-makers who were not prohibited from walking on the reef.

(4) In terms of water quality, TSS load control would be the most important recommended management step. The situation at site A may be too fargone for mitigation, but sites B and C must certainly be kept from the same fate. TSS is derived from earthworks and land clearing and as such, land development on the surrounding coast that involves surface vegetation removal should be monitored and controlled.