CHAPTER 5

CONCLUSIONS

Zooplankton populations of the Matang mangrove swamp varied both spatially and temporally. A systematic spatial variability was observed along both the aquaculture river, Sg Sangga Besar (SSB), and the non-aquaculture river, Sg. Sangga Kecil (SSK), where the mean zooplankton abundance generally increased towards the mouth of the river. In SSB the mean zooplankton density of 7,250 ind. m^{-3} at 3.5 km upstream increased to 9,820 ind. m^{-3} at the river mouth. At SSK, the upstream (4.1 km) mean density at 2,857 ind. m^{-3} increased to 16,634 ind. m^{-3} downstream. Superimposed on this spatial variability, is a temporal variability that probably indicates seasonal changes in Matang's zooplankton abundance. For instance, zooplankton abundance (20,328 ind. m^{-3}) in December 1999 was the highest compared to that observed in the subsequent 4 months of sampling.

Notwithstanding the above natural variability in zooplankton abundance, this study has conclusively shown that the zooplankton inside the floating fish culture cages was significantly more abundant than away from the farm cages in the same river (SSB). There was a mean difference in abundance of approximately 1.4 times.

Fish cage aquaculture also has an impact on the structure of the zooplankton community in SSB. The common zooplankton found dominating the fish cage area are copepods like *Pseudocalanus* spp., *Acartia* spp., *Oithona* spp., cirripede nauplii, amphipods and brachyuran zoeae. The aggregations of these groups of zooplankton in the fish farm were likely due to increased availability of food resulting from increased phytoplankton production, leftovers of mashed trash fish used as food for the cultured fish.

The diurnal phytoplankton peak in the fish farm in SSB during mid-afternoon (1500 – 1700 hr) appeared not limited by dissolved nutrients, and was superseded by a peak in zooplankton abundance. When the phytoplankton abundance fell during night (light-limited), the zooplankton abundance also fell but remained at a level (possibly due to nocturnal surface movements) that was much higher than observed in the morning (0800 hr – 1200 hr).

The DO concentrations inside and outside of the cage farm area in SSB varied diurnally, following quite closely the photosynthetic activity of phytoplankton. However, DO levels inside the fish farm area were significantly lower than away from the fish farm during night, particularly from 2100 hr – 0600 hr. The significantly depressed DO level during night is attributed to the higher rates of oxygen consumption by zooplankton, bacterioplankton and cultured fish, and to the lack of tidal flushing inside the fish farm area. This time period is considered the most risky for fish farmers in the Matang estuary, since fish kills are most likely to happen then.

In Sangga Kecil river (SSK), where there was no aquaculture, the density of zooplankton was significantly higher than in SSB. Zooplankton community structure in SSK was also different from SSB. There were more nauplii of cirripedes and copepods, cypris larvae and harpacticoid copepods (*Microsetella* spp.) which increased in abundance towards the mouth of the river. The diurnal cycle of phytoplankton abundance in SSK appeared nutrient-limited, peaking earlier (1400 hr) and dropping soon after, but never reached the peaked level as observed inside the fish farm area in SSB (Fig. 3.19). These observations suggest a change in the structure of the zooplankton community in SSB possibly due to environmental changes brought about by the aquaculture activity.