↳ DISCUSSION

Seagrass abundance and distribution

Large seagrass meadows in the sheltered bays (Missionary, Shepherd, and Cleveland Bays) formed the most prominent seagrass features in the Dunk Island to Cleveland Bay region. Other important features were dense meadows of mostly *Halophila* and *Halodule* species along the Cardwell and Townsville foreshores and in the lee of the large continental islands: Dunk, Palm and Magnetic. It is unclear why large, sheltered, sub-tidal meadows were dominated by low-biomass *Halophila* species in the northern Hinchinbrook region but by the high-biomass *Cymodocea serrulata* in Cleveland Bay. Major differences in seagrass community type between localities are likely to influence secondary productivity and other species of fisheries importance, but this remains little understood.

The species found in this survey represent almost 80 percent of the known species listed from Queensland (Lee Long *et al.* 1993) and most are typical of the Indo-West Pacific region (den Hartog 1970; Fortes 1989; Coles and Kuo 1995). A wide range of coastal, island and fringing reef features in this region contribute to a high diversity of seagrass species, communities and habitat types, including coastal intertidal to subtidal, fringing reef and deepwater habitats. These types of seagrass communities and habitat types are common to many localities on the Queensland east coast (Lee Long *et al.* 1993). The total area which receives shelter from south-easterly trade winds and swells is large in this region and probably very important in determining the maximum potential area of seagrass habitat compared to neighbouring regions. The overall seagrass distribution in the region is probably mostly influenced by shelter, water turbidity and tidal exposure.

High turbidity nearshore, a result of high concentrations of phytoplankton and suspended solids (Furnas and Mitchell 1997), appears to limit the maximum depth of coastal seagrasses to approximately 4 m (below MSL), eg., in the Hinchinbrook Channel and Townsville foreshore. An increase in the depth range of seagrass growth from inshore to offshore localities is most likely related to general decrease in turbidity offshore (thus increased availability of photosynthetically active radiation at depth). *Halophila ovalis* was found to 15m deep at Dunk and Palm Islands. Large meadows of *Halophila ovalis* and other *Halophila* species have been found in clearer offshore waters at least 25 m deep near Lizard Island in the far northern Great Barrier Reef (Lee Long *et al.* 1996) and Hervey Bay, southern Queensland (Lee Long *et al.* 1992; Preen *et al.* 1995).

Seagrass depth ranges in the survey region otherwise appear typical of most coastal localities on the Queensland coast north to Cape York (Coles *et al.* 1987) and south to Bowen (Coles *et al.* 1992). Further south in the Shoalwater Bay region, seagrass survival is mostly restricted to the intertidal zone (Lee Long *et al.* 1997a). In Shoalwater Bay large tidal ranges and tidal currents create greater resuspension of fine, coastal sediments and high water turbidity, so that seagrasses appear only to receive sufficient light for photosynthesis on the shallow banks during low tide.

In Shoalwater Bay the seagrass distribution restricted to intertidal banks probably limits opportunities for dugong to feed (ie., high tide access only) and may limit dugong numbers there. In the Hinchinbrook and Townsville regions, large areas of sub-tidal seagrass habitat should be a significant alternative food source for dugong and turtle populations when access to intertidal seagrass habitat is restricted during low tide periods.

The seagrass habitats mapped between Dunk Island and Cleveland Bay are likely to be regionally important to fisheries and dugong/turtle populations because the next substantial areas of seagrass habitat occur large distances to the north (Cairns) and south (Upstart Bay)

(Coles *et al.* 1992; Lee Long *et al.* 1993). The ecological links between various seagrass habitat types and associated fisheries species needs clarification. Detailed fauna sampling in seagrasses is necessary to identify the priority areas of greatest prawn and fish productivity, and assist in managing conflicting uses of these coastal habitats.

Temporal change in seagrass distribution and abundance

Maps of seagrass habitat from this survey provide the first fine-scale baseline suitable for future monitoring of the Hinchinbrook region. The estimates of reliability of meadow boundaries vary according to the survey techniques used and associated errors in mapping for each area. These estimates of reliability for each meadow are recorded in the GIS and will be used when attempting to detect changes in the area of habitat during monitoring programs.

Large areas of seagrass habitat mapped in 1996 occurred in places which, during earlier (1987) broad-scale surveys, did not appear to support seagrass habitat. Increases in habitat area since 1987 were mostly in subtidal areas of Missionary Bay, Shepherd Bay, Townsville foreshore and Cleveland Bay.

These increases in subtidal habitats include mostly *Halophila* and *Halodule* species, the preferred food species of dugong. Marsh (In Press) notes that such long-term and moderate-scale changes in seagrass abundance could influence dugong populations by impacting fecundity, reproductive success and survival of infants. Sudden large-scale losses of seagrass in Hervey Bay in 1992 led to direct mortalities and emigration of dugongs from the Hervey Bay population (Preen *et al.* 1995). Limpus (pers comm. 1997) noted decreases in sea turtle vitellogenesis, spermatogenesis and adolescent growth rates following cyclone-related seagrass losses at Shoalwater Bay in 1991, then increases in these same parameters with observed recovery of local seagrass resources in 1995/96. The impact of long-term changes in habitat on associated fisheries stocks in north-eastern Queensland is not as well understood.

Little else is known about long-term changes in seagrass distribution and abundance for the Hinchinbrook region, but aerial observations and surface reconnaissance surveys in 1992 (Mellors pers comm. 1992) found very little intertidal seagrass habitat in this and neighbouring regions where there was seagrass in 1987 (cf., Coles *et al.* 1992). The observed changes in area of intertidal and subtidal habitat since 1987 and 1992 is evidence for large natural variability in these habitats. We suspect that long-term changes in seagrasses may be influenced by region-wide changes in climatic conditions, perhaps related to *El Nino* events. Seagrass growth is largely influenced by availability of photosynthetically active light (Dennison *et al.* 1993), so years of reduced light (eg., prolonged climatic conditions of strong wind and cloud cover) will likely inhibit seagrass growth and survival (McKenzie 1994). Conversely, years of clear, calm weather would contribute to greater seagrass growth and survival. Species at sub-tidal depths and at the deep extent of their distribution would be most vulnerable to changes in the amount of available light for photosynthesis.

Monitoring of seagrasses at a range of localities, with information on climatic factors and water quality conditions, may elucidate long-term patterns and causes of change. Anthropogenic influences such as runoff from agricultural catchments also need to be measured within monitoring programs, to help identify the influences of land run-off on coastal seagrass systems. Incremental increases in the impacts of coastal development and catchment run-off may result in incremental degradation of habitats going "un-noticed". Formal habitat monitoring programs have been recommended to ensure that both incremental and acute damage is detected and early action be taken to avoid further loss (Lee long *et al.* 1997b). Monitoring and management of seagrass resources at both local and regional scales will enable detection of incremental losses and help in managing animal populations which are dependent on regional-scale seagrass resources.