# 1. INTRODUCTION & BACKGROUND

Seagrass meadows in Queensland are important nursery habitat for commercial species of penaeid prawns and fish (Coles and Lee Long 1985; Coles *et al.* 1993; Watson *et al.* 1993). Seagrasses are essential food for dugong, *Dugong dugon* (Miller), and green sea turtles, *Chelonia mydas* (Linnaeus) (Lanyon *et al.* 1989) and act as nutrient and sediment sinks (Short 1987). Seagrasses in coastal regions play important roles in maintaining sediment stability and water clarity. Coastal seagrass meadows are therefore an important resource economically and ecologically. Information on the species composition, abundance and distribution of seagrasses is used by management to zone for protection of seagrass habitats.

Accurate information on seagrass habitats (distribution, abundance and species composition) is therefore vital, although the type of questions asked by managers ultimately determines the sampling design implemented in surveys of seagrass habitats. Surveys which rely mostly on diving based operations can be difficult in turbid waters and when vast areas are to be covered. Diving based surveys also increase the risks to diver safety where dangerous marine animals occur. A reliable remote sensing technique for surveying seagrasses would help to reduce these risks and improve the intensity and resolution of data collected.

Current remote-sensing techniques (satellite and aerial imagery) are useful for mapping dense seagrass meadows in the clear waters of temperate regions, but in the tropics they are inadequate for detecting seagrasses of low biomass or in turbid water. Recent advances in acoustic techniques for surveying benthic habitats present new possibilities for applications in seagrass surveys in tropical Australia. We provide a preliminary evaluation of acoustic techniques for surveying tropical Queensland seagrass habitats and compared these techniques against currently-used diving-based survey methods.

## 1.1 Surveying techniques used in tropical seagrass habitats

Tropical seagrass habitats in north Queensland are currently surveyed using diving-based surveys coupled with various methods of remote sensing. Aerial reconnaissance (eg., by helicopter), aerial photography (visible and infra red), underwater video and satellite imaging can provide mapping information over a large area in minimal time and a permanent image of the seagrass habitat for historical reference. These methods provide information that is relatively precise, but can be expensive. The use of aerial surveys to obtain clear images of seagrass meadows is also limited to localities with low turbidity and high density seagrass habitat. Aerial surveys are best when determining seagrass coverage in intertidal or shallow sites. Coupled with intensive ground-truthed seagrass data, visual remote-sensing data can be used to map the distribution of high-density seagrass communities over large areas.

Dive-based surveys can be undertaken to examine seagrass meadow parameters at either broad or fine spatial scales. Although this method is labour intensive, it provides both qualitative and quantitative data. Qualitative information may be in the form of presence/absence, percent cover and/or species composition. Quantitative data may include density or biomass measures, species composition, seagrass growth characteristics and depth distribution at a particular site. A visual biomass estimation technique adapted from Mellors (1991) has been used extensively in north Queensland to determine seagrass biomass. This survey method requires extensive field resources (labour and time) and involves increasing risks to diver safety where dangerous marine animals occur.

## 1.2 Acoustic techniques

Acoustic/echo-sounding methods are an important tool in fisheries studies; mapping of sea-floor types, underwater vegetation, sediment and sub-bottom sediment types (Hundley *et al.* 1994; Collins and Gregory 1996). They are also used in underwater searching for sunken vessels, downed aircraft and pipelines. The advantages of using acoustic energy over visual or other mediums to retrieve information in the marine environment, lie in the fact that sound travels underwater without appreciable attenuation relative to optical methods in the sea. Acoustic signals are less sensitive than light to turbidity or depth. Data is collected at higher spatial resolution than is usual with dive-based surveys and large areas can be surveyed quickly. Data is recorded digitally on PC in the field, and can be linked with GPS and processed into GIS format.

Vessel-mounted acoustic systems coupled with a GPS have been used previously to map seagrass habitats in temperate (Higginbotom *et al.* 1995) and tropical (Anon. 1995) waters. The system uses high frequency acoustic pulses to map the substrate and associated biota of the immediate area within a chosen swath width (approx. 50 m). An acoustic technique used in Lake Macquarie to map temperate *Zostera capricorni* meadows distinguished medium density (500-3500 shoots $m^{-2}$) from high density (>3500 shoots $m^{-2}$) habitat (Hundley *et al.* 1994). The same technique was used to map *Zostera* meadows of lower density (280 shoots $m^{-2}$) at Narrabeen Lake, NSW (Hundley and Denning 1994). Reports of acoustic techniques for mapping tropical seagrass habitats are few. The SAVEW acoustic system was used to map low density *Halophila*, *Cymodocea*, *Syringodium* and *Zostera* in tropical U.S. waters (Anon. 1995; Bruce Sabol, Pers. Comm.).

## 1.3 Objectives

We provide a preliminary evaluation of an acoustic technique to map tropical seagrass habitats, for possible application in Shoalwater Bay and other tropical Australian localities. Test surveys were conducted in Cairns Harbour, an accessible locality which supports a range of coastal seagrass habitats typical of tropical Australia. Seagrasses were surveyed using two methods: the acoustic remote sensing technique, and a visual estimation technique (adapted from Mellors (1991)). The results from the two methods were then compared. Logistics are considered in a simple cost-benefit analysis and recommendations on applicability of this technique are made. The objectives of the study were:

1. *To determine the viability of an acoustic technique for mapping edges of tropical seagrass meadows in selected intertidal and subtidal sites.*
2. *To assess the effectiveness of an acoustic technique for determining the biomass of seagrass in intertidal and subtidal sites.*
3. *To determine the effectiveness of an acoustic surveying technique for describing sediment type in intertidal and subtidal sites.*
4. *To assess the efficiency in mapping tropical seagrass habitats using acoustic techniques against current dive survey methods.*