June 2006
TNC Pacific Island Countries
Report No 1/06

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

Solomon Islands Government

Chapter 7

Seagrasses & Mangroves

Solomon Islands Marine Assessment

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Published by: The Nature Conservancy, Indo-Pacific Resource Centre

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Suggested Citation:
McKenzie, L., S. Campbell and F. Lasi. 2006. Seagrasses and Mangroves. In: Green, A., P. Lokani, W. Atu, P. Ramohia, P. Thomas and J. Almany (eds). 2006. Solomon Islands Marine Assessment: Technical report of survey conducted May 13 to June 17, 2004. TNC Pacific Island Countries Report No 1/06.

Design: Jeanine Almany

Artwork: Nuovo Design

Maps: Stuart Sheppard & Jeanine Almany

Cover Photo: © David Wachenfeld, Triggerfish Images

Available from:

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Executive Summary

- This is the first extensive survey of seagrass resources in the Solomon Islands.
- 10 species of seagrass were identified in the Solomon Islands. The survey involved examination of 1,426 sites and identified 486 individual meadows.
- 6,633 ±1,446 hectares (ha) of predominately intertidal and shallow subtidal seagrass meadows were mapped in the Solomon Islands between 13 May and 16 June 2004.
- 54% of all seagrass meadows (per hectare basis) were found in Malaita Province. All other provinces each included less than 12% of the seagrass meadows.
- Most Solomon Islands seagrasses were found in water less than 10m deep and meadows were monospecific or consisted of multispecies communities, with up to 6 species present at a single location.
- The dominant species encountered were *Enhalus acoroides* and *Thalassia hemprichii*.
- Seagrass distribution appears to be primarily influenced by the degree of wave action (exposure) and nutrient availability.
- Solomon Islands' seagrass habitats can be generally categorised into four broad habitats: estuaries (incl. large shallow lagoons), coastal (incl. fringing reef), deep-water and reef (e.g., barrier or isolated)
- Seagrass meadows in the region as a whole are in relatively healthy condition compared to many other regions globally.
- Coastal fringing mangrove communities appear to be generally intact, with only localised impacts.
- High sedimentation/turbidity in coastal waters, primarily the result of logging activities, was identified as a major threat at some locations.
- Other impacts were similarly localised, and included soil erosion related to coastal agriculture (coconut plantations), sewage discharge (human and agriculture), industrial pollution, port/village infrastructure/dwellings and overfishing. Most of these impacts can be managed with appropriate environmental guidelines.
- Future recommendations include: establishing more protected areas, promoting seagrass and mangrove conservation through development of education resource materials, and establishing a Pacific Island monitoring program of seagrass and mangrove ecosystem health.

Introduction & Background

The primary goal of the survey was to provide a comprehensive inventory of seagrass species and to map their distribution in the Solomon Islands.

The Solomon Islands is the third largest archipelago in the South Pacific, comprising a total of 992 islands, scattered in a chain in a south-easterly direction from PNG (Figure 1). The bulk of the land area comprises seven large volcanic islands, which form a double chain running from northwest to southwest and converging on the island of Makira. The Santa Cruz Islands (Temotu Province) are a second group of three larger volcanic islands lying to the east, and separated from the main archipelago of the country by the 6000m deep Torres Trench. These however are outside the boundaries of the scope of the assessment and are not included in this report.

The coastal marine ecosystem of the Solomon Islands includes wide areas still largely unimpacted by human activities, although there are also areas where such pressures are increasing. The islands have one of the fastest population growth rates in the world, and 86 percent of the people are rural. Dependence on coastal marine ecosystems for protein remains high and subsistence fishing is widespread.

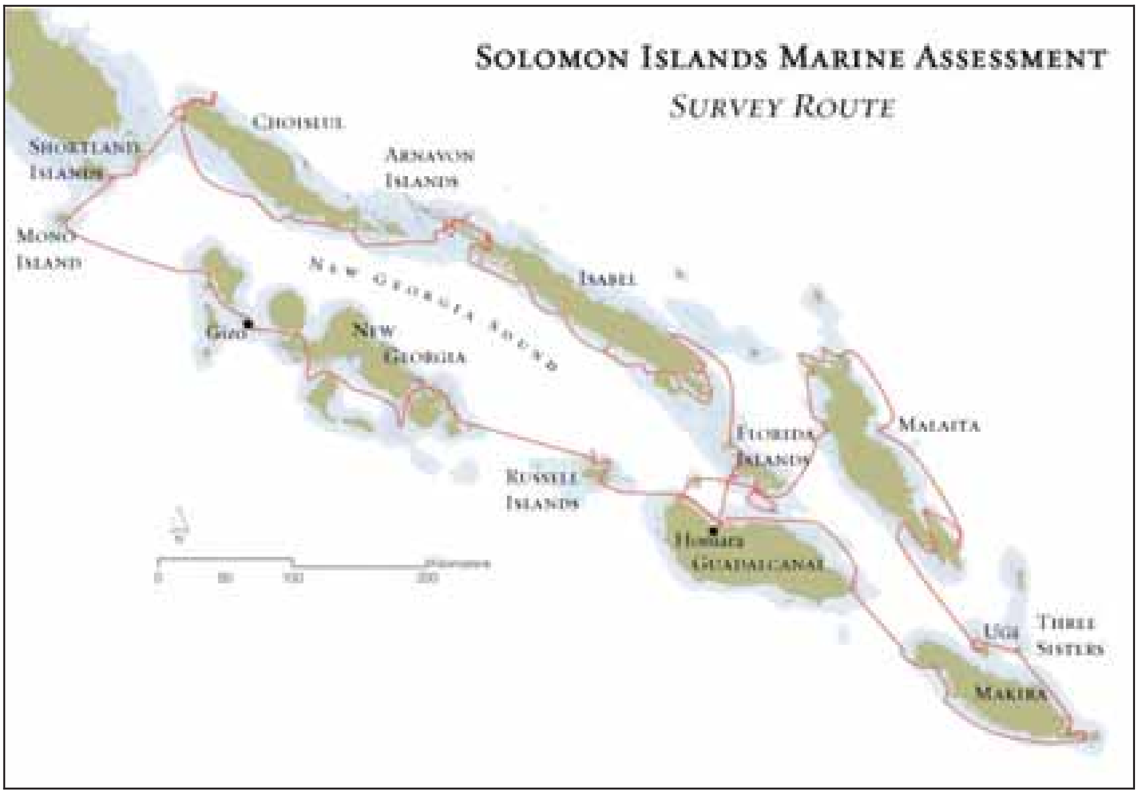


Figure 1. Map of the Solomon Islands Marine Assessment survey route.

Seagrass Meadows

Seagrass meadows are a significant coastal habitat of the Solomon Islands. Seagrasses are a functional grouping referring to vascular flowering plants, which grow fully submerged and rooted in soft bottom estuarine and marine environments. In the Solomon Islands, they are found in habitats extending from the intertidal to subtidal, along mangrove coastlines, estuaries, shallow embayments, as well as coral-reef, inter-reef and offshore island situations.

Seagrasses rank as one of the major marine ecosystems on world terms. In the last few decades, seagrass meadows have received greater attention with the recognition of their importance in stabilising coastal sediments, providing food and shelter for diverse organisms, as a nursery ground for fish and invertebrates of commercial and artisanal fisheries importance, as carbon dioxide sinks and oxygen producers, and for nutrient trapping and recycling. Seagrass are rated the 3rd most valuable ecosystem globally (on a per hectare basis) and the average global value for their nutrient cycling services and the raw product they provide has been estimated at ^{1994}US\$19,004 ha^{-1} yr^{-1} (Costanza *et al.* 1997). This value would be significantly greater if the habitat/refugia and food production services of seagrasses were included.

Seagrasses are also food for the endangered green sea turtle (*Chelonia mydas*) and dugong (*Dugong dugon*) (Lanyon *et al.* 1989), which are found throughout the Solomon Islands, and used by traditional communities for food and ceremonial use. Tropical seagrasses are also important in their interactions with mangroves and coral reefs. All these systems exert a stabilizing effect on the environment, resulting in important physical and biological support for the other communities. Seagrasses slow water movement, causing suspended sediment to fall out, and thereby benefiting corals by reducing sediment loads in the water.

MANGROVES

Mangroves are a taxonomically diverse group of predominantly tropical shrubs and trees growing in the intertidal zone between Mean Sea Level (MSL) and Highest Astronomical Tide (HAT) bordering the banks of estuaries and foreshores along protected parts of the coastline (Duke 1992).

Areas of deposition of mud and silt at the mouths of rivers and creeks and in the lee of larger offshore islands protected from strong wave action support the most extensive mangrove communities (Dowling and McDonald 1982). Mangroves can tolerate a wide range of sediment types, water temperatures, flow rates, salinity, nutrient and oxygen levels. Mangroves vary in their tolerance of these environmental factors, and a pattern of species zonation occurs (Lovelock 1993).

Mangroves form complex systems in coastal waters providing physical, biological and ecosystem functions which include:

- Habitat, shelter and structural complexity for resident and transient birds, fish, crustaceans and reptiles. Many prawns and fish that inhabit mangroves are of commercial and recreational importance or important to traditional fishing communities (Rönnbäck 1999);
- Providing a major marine source of carbon for complex food webs through direct grazing or through detrital pathways (Clough 1992);
- Assisting in the stabilisation of coastlines, assimilating wastes, mitigating flood water by controlling the outflow, buffering pollution and storms and reclaiming land (i.e. helping in the formation of islands and the extension of shorelines);
- Providing for human uses, including recreational (fishing and boating) and indigenous uses (food, medicine, weapons and other tools).

Mangrove roots, debris, and other vegetation structures provide structural complexity in intertidal habitat. The structural complexity that mangrove roots and debris form are often referred to as “snags”, and enhances the refuge aspect of the marine environment. Mangroves provide a sub-surface shelter by trapping soft muds suitable for burrowing (Rönnbäck 1999). Mangroves also have the hydrodynamic ability to retain immigrating fish, crustacean and mollusc larvae and juveniles. Spatio-temporal variations in the availability of food and shelter, and retention capacity, affect the quality of individual mangrove microhabitats for fish and shellfish (Rönnbäck 1999).

The presence of wetland vegetation improves water quality of estuaries and near-shore waters through nutrient storage in plant tissues and their regulated release into the surrounding water, and also by removal of water-borne contaminants (e.g. heavy metals and pesticides) and suspended sediments. Extensive tidal wetlands also stabilise channel banks and protect shorelines from erosion and store and dissipate the energy of floodwaters.

A study from a mangrove forest in north-eastern Australia has found that mangrove primary productivity and associated leaf litterfall can be substantial (Clough 1992). The annual litterfall has been estimated at 8-10t dry weight per ha, with a maximum of up to 20t dry weight per hectare (Clough 1992). The mangrove crab can consume or store 30-80% of this litterfall (Robertson *et al.* 1992). These crabs are subsequently consumed by fishes and therefore constitute an important link at the primary consumer level in food webs, beginning with mangrove plant production and leading to higher level consumers harvested by humans.

Mangrove communities have long been recognised for their value to fisheries production. Mangrove habitat (particularly *Rhizophora stylosa*) is important as a feeding and nursery area for fish species that contribute to fisheries values (Halliday and Young 1996). Fishes inhabiting tropical mangroves (eg sardines and herring) eat plankton and small bottom-dwelling prey and support fisheries indirectly by providing a food source for larger pelagic species (eg mackerel, tuna, trevally and sharks) that may not use the forest directly (Halliday and Young 1996).

The economic value of natural products and ecosystem services generated by mangrove forests is generally underestimated (Saenger *et al.* 1983). As a consequence mangrove ecosystems have become prime candidates for conversion into large-scale development activities such as agriculture, aquaculture, forestry, salt extraction and infrastructure. More than 50% of the world's mangroves have been removed (World Resources Institute 1996).

It has been estimated that the total value to ecosystem services per hectare of mangroves is ^{1994}US$9990, with a large portion of this value from waste treatment, food production, and recreation provision (Costanza *et al.* 1997). The value of ecosystem goods (such as food) and services (such as waste assimilation) represent the benefits human populations derive, directly or indirectly, from ecosystem functions.

Mangroves form an interface between terrestrial and marine environments. Harmful land use and marine activities can threaten mangrove distribution and abundance. Potential threats to mangrove populations include: natural sources (pathogens, violent storms, fluctuations in rainfall and climatic patterns); land uses (habitat modifications, excess nutrients, toxic chemical leachate, pesticides, herbicides, algicides and insecticides); or marine activities (oil and other contaminant spills) (Duke *et al.* 2005).

Small-scale modifications to the physical structure of mangrove forests can lead to significant effects on the diversity and abundance of macro benthic organisms in mangrove habitats (Skilleter and Warren 2000). Such modifications have the potential to cause cascading effects at higher trophic levels with deterioration in the value of these habitats as nursery and feeding grounds (Skilleter and Warren 2000).

SEAGRASSES OF THE SOLOMON ISLANDS

There is some confusion regarding the number of seagrass species in the Solomon Islands, due to the lack of any comprehensive surveys. Green & Short (2003) list 3 species, however Johnstone (1982) and Womersley & Baily (1969) suggested there could be at least 7. Reviews by Coles and Kuo (1995) and Coles & Lee Long (1999) failed to locate any validated records from herbarium collections or available scientific literature on the seagrasses of the Solomon Islands. Nevertheless, Coles and Lee Long (1999) predicted between 5 and 10 species may occur in the Solomon Islands based on a probability model of species diversity across the Pacific; high in the west and declining towards the east.

The total area of seagrass meadows in the Solomon Islands is also unknown, as no broad scale mapping exercises have been conducted (Coles *et al.* 2003). This is because mapping in tropical systems is generally from field observations, since remotely sensed data (satellite and aerial imagery) is generally ineffective for detecting tropical seagrasses of low biomass and/or in turbid water (McKenzie *et al.* 2001). Some estimation could be possible using a simple modelling approach, based on the high likelihood that between 4% and 5% of almost all shallow water areas of reef and continental slope within the depth range of most seagrasses (less than 10 metres below MSL) would have at least a sparse seagrass cover. This however, has not been attempted. The closest attempt so far is a new dataset prepared by the United Nations Environment Programme World Conservation Monitoring Centre (http://stort.unep-wcmc.org/maps). These maps however should be interpreted with caution as they have been migrated to GIS based on literature review and outreach to expert knowledge. Much of the information is from only a few localities and is generally historic.

MANGROVES OF THE SOLOMON ISLANDS

The area of mangroves in the Pacific Islands is estimated at 343,735ha, approximately 2.4 percent of the worlds mangroves (Ellison 1999). 20 species and 2 hybrids of mangrove have been reported in the Solomon Islands (Ellison 1995). They include: *Heritiera littoralis, Aegiceras corniculatum, Sonneratia alba, S caseolaris, S x gulngai, Osbornia octodonata, Lumnitsera littorea, Rhizophora apiculata, R stylosa, R x lamarckii, R mucronata, Bruguiera gymnorrhiza, B parviflora, B sexangula, Ceriops tagal, Excoecaria agallocha, Xylocarpus granatum, X mekongensis, Avicennia alba, A marina, Scyphiphora hydrophyllacea* and *Nypa fruticans* (from Ellison 1995, Spalding *et al.* 1997). These mangroves are of the Indo-Malayan assemblage. The greatest diversity of mangroves is found in northern Australia and southern PNG, and decline in diversity from west to east across the Pacific, reaching a limit at American Samoa. The Solomon Islands is the eastern limit for some mangrove species. 4 species do not extend beyond the Solomon Islands to the rest of the Pacific Islands, and 8 other species do not extend past the Solommon, Vanuato and New Caledonia island groups (Ellison 1999).

Larger areas of mangrove are limited in the Solomon Islands due to the lack of suitable intertidal habitat. In the Solomon Islands, Hansell & Wall (1976) mapped 642km^2 (64,200 ha) of mangroves from air photographs, which constitutes 2.6 percent of the total forest area. The largest area (208km^2 on Isabel, followed by Rennell & Shortland (137km^2), Malaita (124km^2) and New Georgia (97km^2). This area has been reduced by clearance for subsistence agriculture and commercial logging (Scott 1993).

In the Solomon Islands, mangroves are protected under the Forest Resources and Timber Act (Kwanairara 1992). However, although legislation exists to control the use of mangroves, is not always exercised (Spalding *et al*. 1997). Mangroves are exploited for firewood, and areas are degraded by siltation or lost to landfill and settlements.

Mangrove areas in the Pacific Islands are traditionally used for fishing and gathering of clams and crabs, wood for construction and handicrafts, and for fuelwood. Tannins from the Rhizophoraceae are also used for protection of nets and fish traps owing to their fungicidal properties. The prop roots of *Rhizophora* are frequently used for the construction of fish traps, fuelwood or light construction. A brown dye is obtained from the bark.

Scientific information about mangroves in the Pacific Islands tends to be generally poor and not well documented, though the local knowledge in some locations is very detailed. Studies in the Solomon Islands have shown significant fish stocks in association with mangroves. There is an endemic subspecies of the mangrove monitor *Varanus indicus spinulosus* with very limited distribution and populations of the saltwater crocodile *Crocodylus porosus* are threatened in the Solomon Islands (Messel & King 1989)

Methodology

Survey Strategy

The survey focused on the main island group of the Solomon Islands, stretching from Choiseul Island in the northwest to Makira in the southeast (Figure 1). While a comprehensive survey of the entire Solomon Islands archipelago, including the outer islands, would be desirable, it was beyond the scope of this assessment. Similarly, due to the size of the SI coastline (over 6000 km), locations were selected for detailed assessment based on the probability of significant seagrass communities, logistic constraints and with the guidance of the Solomon Islands Marine Assessment Coordinating Committee(SIMACC) (see *Conservation Context,* this report). These areas included representative examples of marine habitats of interest and special and unique areas.

The survey was conducted from 13 May to 16 June 2004, and primarily focused on to providing detailed information (distribution & abundance) on high priority intertidal and shallow subtidal seagrass ecosystems in the regions. Where possible, similar observations were made for mangrove forests.

Within each location, field sites were chosen for examination (ground truthing) to ensure all suitable/possible seagrass habitats were assessed. Intertidal and sub-tidal areas were surveyed using boats and divers. This was done with points and transects approximately 100-500 m apart. Benthos was examined at sites along transects (sites every 1 m depth contour), which extended from the upper intertidal to depths beyond the outer edge of seagrass meadows (usually 5-6m). Points (sites) between transects were also dived to check for continuity of habitat types. Some locations were surveyed at a lower intensity, with sites >500 m apart, but sufficient to map and describe the major seagrass habitats.

Fringing mangroves were examined at coastal sites, and generally incorporated a 10m section of frontage to a visual depth of approximately 20m inland (depending on type of mangrove community).

Data Collection

Seagrass habitat characteristics including visual estimates of above-ground biomass/percentage cover (3 replicates of a 0.25 m^2 quadrat), species composition, % algae cover, sediment type, water depth and geographic location were recorded at each site. A Global Positioning System (GPS) was used to accurately determine geographic location of sampling sites (±5 m). Seagrass species were identified where possible according to Waycott *et al.* (2004) and voucher specimens were collected for taxonomic verification. Depths of survey sites were recorded with an echo-sounder and field descriptions of sediment type from hand or grab samples were recorded for each site: shell grit, rock gravel, coarse sand, sand, fine sand and mud.

Above-ground biomass was determined by a "visual estimates of biomass" technique modified from Mellors (1991). At each intertidal and shallow sub-tidal site, observers recorded an estimated rank of seagrass biomass and species composition in three replicates of a 0.25 m^2 quadrat per site. To ensure standardisation over the survey period, a standard set of photographs was used as a guide. On completion of the survey (conducted back in Australia), each observer ranked ten quadrats that were harvested and the above-ground dry biomass (g DW. m^{-2}) measured. The regression curve representing the calibration of each observer's ranks was used to calculate above-ground biomass from all their estimated ranks during the survey. Observers had significant linear regressions (r^2 >0.9) when calibrating above-ground biomass estimates against a set of harvested quadrats.

Seagrass community types were determined by dominant seagrass species found within each meadow (Table 1) and their landscape structure (Figure 2). Seagrass habitat types were determined by species composition and physical attributes (ie intertidal or subtidal, coastal or fringing reef) influencing each seagrass community.

Table 1. Nomenclature for community types in the Solomon Islands.

Community type	Species composition
Species A	Species A is 100% of composition
Species A with Species B	Species A is 60% of composition
Species A with Species B/Species C	Species A is 50% of composition
Species A/Species B	Species A is 50% - 60% of composition

Isolated seagrass patches - The majority of area within the meadows consisted of unvegetated sediment interspersed with isolated patches of seagrass.

Aggregated seagrass patches - Meadows are comprised of numerous seagrass patches but still featured substantial gaps of unvegetated sediment within the meadow boundaries.

Continuous seagrass cover - The majority of area within the meadows was comprised of continuous seagrass cover interspersed with a few gaps of unvegetated sediment.

Figure 2. Seagrass meadow patchiness categories used in the seagrass survey.

At each of the locations visited, mangrove species and riparian vegetation were also assessed. Assessments only included the immediate (seaward) mangrove fringe, and did not continue up-stream into brackish/freshwaters. All mangroves at each site were identified to species level in the field according to Lovelock (1993). Other riparian vegetation was identified as far as possible in the field. Where positive field identifications could not be made, voucher specimens of species were collected to confirm field identifications.

GEOGRAPHIC INFORMATION SYSTEMS (GIS)

A GIS of seagrass community distribution was created in MapInfo® and ArcMap® using the above survey information. A CD Rom copy of the GIS with metadata has been archived at TNC Brisbane offices and the original archived with the custodians (QDPI&F) at the Northern Fisheries Centre, Cairns.

Errors in GIS maps include those associated with digitising and rectifying basemaps and with Global Positioning System (GPS) fixes for survey sites. The point at which divers estimated bottom vegetation may be up to 5 m from the point at which a GPS fix was obtained. These errors are considered to be within the errors associated with distance between survey sites.

In the survey, each seagrass meadow was assigned a qualitative mapping value, determined by the data sources and likely accuracy of mapping. Boundaries of seagrass habitat were interpreted using one or more of the following: seagrass data at each dive site, extent of habitat visible from the vessel, satellite imagery and bathymetry. Boundaries of meadows in intertidal depths were usually mapped with greatest reliability (identified from surface observations, from dive sites usually less than 100 m apart). Boundaries in sub-tidal depths were mapped with less reliability because of a) very gradual changes in habitat and b) poor underwater visibility. Where the depth of outer boundaries were established, bathymetry was used to help outline the meadow boundary between survey sites where possible. Estimates of reliability in mapping meadow boundaries ranged from 7.5 m to 500 m.

The Biogeography of the Solomon Archipelago Seagrasses

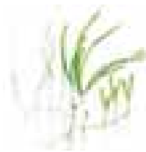
Ten seagrass species were recorded/collected during the Solomon Islands Rapid Ecological Assessment (SIREA), from 13 May to 16 June 2004. They included:

Family **CYMODOCEACEAE** Taylor

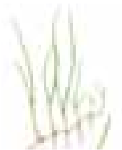
Cymodocea rotundata Ehrenb. & Hemp. Ex Aschers

Cymodocea serrulata (R. Br.) Aschers. & Magnus

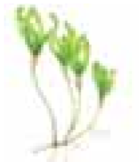
Halodule uninervis (wide- & narrow-leaf) (Forsk.) Aschers.



Syringodium isoetifolium (Aschers.) Dandy



Thalassodendron ciliatum (Forsk.) den Hartog†

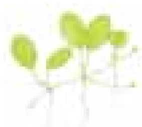


Family **HYDROCHARITACEAE** Jussieu

Enhalus acoroides (L. *f*) Royle

Halophila decipiens Ostenfeld

Halophila minor (Zollinger) den Hartog



Halophila ovalis (R. Br.) Hook f.

Thalassia hemprichii (Ehrennb.) Aschers in Petermann

Approximately 6,633 ±1,446 hectares (ha) of predominately intertidal and shallow subtidal seagrass meadows were mapped in the Solomon Islands between 13 May to 16 June 2004. 485 individual meadows were identified and mapped from 1,428 ground truthed sites. A conservative estimate of the total area of seagrass meadows in the Solomon Islands would be ~10,000 ha, taking into account locations which could not be visited during the survey which possibly have seagrass present. In interpreting the maps and seagrass distribution it is essential to note that not all coastal areas were surveyed. The seagrass distribution mapped for this report

† *Thalassodendron ciliatum has also been reported from East Rennell & Southern Malaita (WCMC, Seagrass Atlas Appendix 1.)*

is for intertidal and shallow subtidal seagrasses in the provinces of Choiseul, Western, Isabel, Malaita, Central, Makira and Guadalcanal (Figure 3).

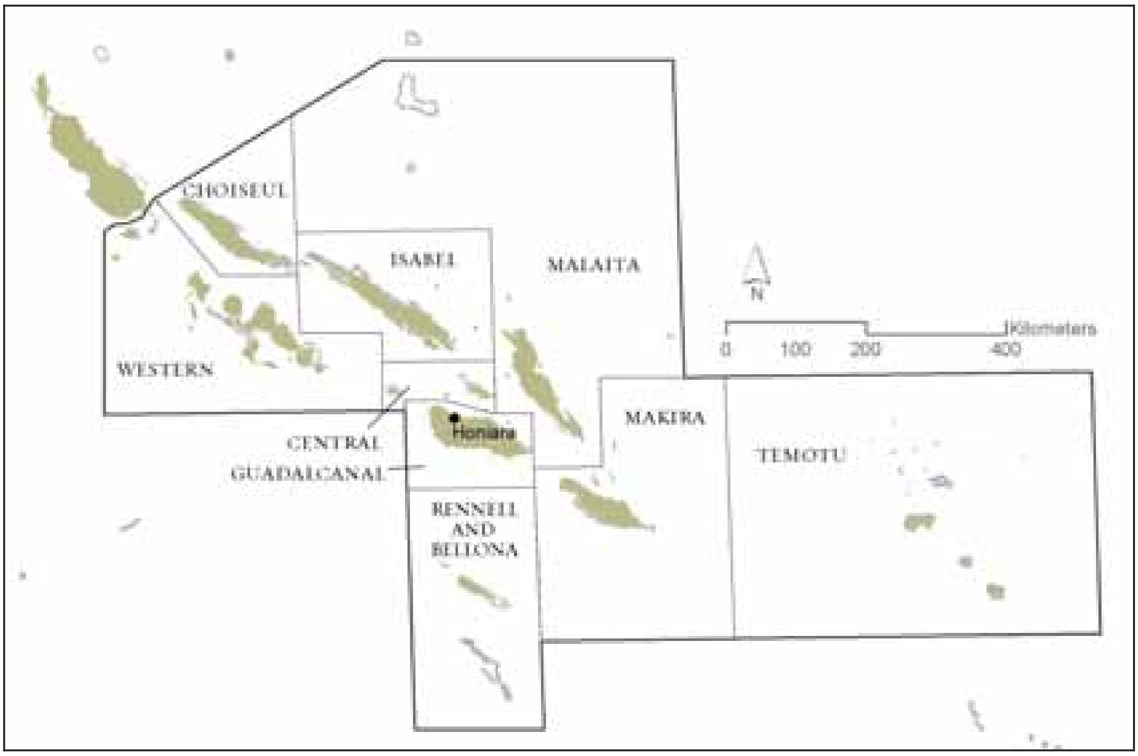


Figure 3. The provinces of the Solomon Islands.

Meadows are predominately on fringing reef flats and mostly continuous (93% of all meadow area) in landscape structure (Table 2). Meadows dominated by *Thalassia hemprichii* were the most common, comprising approximately 42% of area of all meadows encountered. The most dominant single seagrass community (21%) was monospecific *Enhalus acoroide*s meadows. Meadows of the greatest cover were dominated by *Cymodocea* spp.

Table 2. Meadow categories, total area (hectares) and numbers of intertidal/shallow subtidal meadows in Solomon Islands – May/June 2004.

CATEGORY	Biomass (g DW m^{-2})	Cover (%)	Area in hectares (number of meadows)			Total (ha)
			Isolated seagrass patches	Aggregated seagrass patches	Continuous seagrass cover	
H. uninervis/T. hemprichii/C. rotundata		49.5 ±1.45			0.19	0.19
H. minor	3.52 ±0.78	42.22 ±2.70			0.50 (4)	0.50
E. acoroides with *H. uninervis*		26.67 ±6.67		0.87 (1)		0.87
T. hemprichii/H. ovalis with *E. acoroides*	6.70 ±1.77				0.99 (1)	0.99
C. serrulata with mixed species	1.79 ±1.79	83.84			1.07 (1)	1.07
H. uninervis with *H. ovalis*		37.78 ±4.80			1.10 (3)	1.10
H. decipiens		6 ±2.08			1.12 (1)	1.12
C. rotundata		45.40 ±3.87		0.83 (2)	0.38 (3)	1.21
H. ovalis with mixed species	2.68 ±0.67	41.78 ±4.25	0.19 (1)	1.10 (2)	0.15 (1)	1.45
H. uninervis	2.01 ±1.16			1.98 (1)		1.98
C. rotundata/ H. uninervis with mixed species	32.81 ±1.77	48 ±1.89		1.86 (2)	0.13 (1)	1.99
C. rotundata with *E. acoroides*		74.33 ±12.21			2.43 (2)	2.43
E. acoroides/H. ovalis	15.07 ±15.07	12 ±6.24		2.98 (1)		2.98
T. ciliatum		0		3.72 (2)		3.72
T. hemprichii with *H. uninervis* & mixed species		58 ±12.81			4.67 (2)	4.67
H. minor with *H. uninervis*		24.17 ±2.63			5.12 (2)	5.12
H. ovalis with *E. acoroides*	5.86 ±2.06	42.29 ±4.68	0.09 (1)	3.00 (1)	2.15 (3)	5.23
T. ciliatum/C. rotundata with mixed species					5.36 (1)	5.36
H. uninervis with *E. acoroides* & mixed species	2.34 ±0.39	33.83 ±6.61		0.97 (2)	4.41 (1)	5.38
H. uninervis with *H. ovalis* & mixed species	0.36 ±0.36	24.75 ±6.57		5.54 (2)		5.54

CATEGORY	Biomass (g DW m^{-2})	Cover (%)	Area in hectares (number of meadows) Isolated seagrass patches	Aggregated seagrass patches	Continuous seagrass cover	Total (ha)
T. hemprichii with *H. ovalis* & mixed species	5.69 ±2.44	34.75 ±6.00	0.01 (1)		6.74 (2)	6.75
T. hemprichii/E. acoroides with *C. rotundata*		71.11			6.79 (1)	6.79
E. acoroides/Cymodocea spp with mixed species		50.73 ±8.90		0.29 (1)	6.75 (4)	7.04
H. uninervis with *Cymodocea* spp/*T. hemprichii* & mixed species		51.5 ±2.68		0.10 (1)	8.04 (1)	8.14
H. uninervis with *T. hemprichii* & mixed species	23.77 ±8.88	52.33 ±12.32			8.22 (6)	8.22
S. isoetifolium with mixed species	111.82 ±5.95	65.00 ±10.63		0.25 (1)	8.69 (3)	8.94
T. hemprichii with *H. ovalis*	16.54 ±7.31	68.61 ±5.40	1.61 (3)	1.49 (1)	8.25 (2)	11.35
E. acoroides/H. uninervis with *T. hemprichii*		63.33 ±3.33			11.84 (1)	11.84
E. acoroides with *H. ovalis*	0.39 ±0.39	36.36 ±4.77	0.56 (1)	5.85 (3)	7.89 (5)	14.30
Cymodocea spp with *T. hemprichii*					14.59 (2)	14.59
H. ovalis	2.72 ±1.52	44.24 ±2.24	0.64 (3)	10.61 (11)	3.87 (9)	15.12
C. serrulata/S.isoetifolium with mixed species	128.56	85.72 ±5.53			15.80 (2)	15.80
H. uninervis/H. ovalis		38.59 ±6.45			16.36 (3)	16.36
T. hemprichii/C. rotundata with mixed species	112.49 ±1.16	57.50 ±9.34			16.73 (4)	16.73
T. hemprichii with mixed species		42.21 ±8.19			19.31 (1)	19.31
E. acoroides with *Cymodocea* spp & mixed species	20.53 ±20.53	50.56 ±8.02			19.95 (3)	19.95
Cymodocea spp with *E. acoroides* & mixed species		77.27 ±4.72	2.81 (1)		21.27 (4)	24.08
T. hemprichii/H. ovalis	4.35 ±0.91	42.33 ±3.18		0.35 (1)	25.09 (3)	25.43
E. acoroides/T. hemprichii with mixed species	39.97 ±17.53	61.79 ±7.03		0.11 (1)	29.54 (5)	29.64
C. rotundata with mixed species	27.99 ±7.00	54.99 ±6.42	1.30 (2)	0.46 (2)	32.12 (7)	33.88
C. serrulata with *E. acoroides* & mixed species		79.00 ±5.84		0.28 (1)	36.14 (4)	36.43
E. acoroides/T. hemprichii		56.48 ±7.59	0.001 (1)		39.11 (7)	39.11
C. rotundata with *T. hemprichii*		75.2 ±6.56			46.08 (6)	46.08
C. rotundata/T. hemprichii with mixed species	35.99 ±27.82	59.04 ±10.41			49.03 (10)	49.03
C. rotundata with *T. hemprichii* & mixed species	50.00 ±21.55	58.97 ±6.29	1.73 (2)	2.22 (2)	46.53 (10)	50.47
C. rotundata with *E. acoroides* & mixed species		81.28 ±7.10			51.57 (2)	51.57
E. acoroides/S.isoetifolium/C. rotundata & mixed species		53.44 ±4.70		66.19 (1)		66.19
C. rotundata/E. acoroides/T. hemprichii with mixed species	9.37	58.22 ±4.91			88.18 (1)	88.18
T. ciliatum/T. hemprichii/C. rotundata with mixed species		50.60			90.75 (1)	90.75
T. hemprichii with *C. rotundata*	25.62 ±18.71	51.44 ±5.45	1.10 (3)	1.94 (3)	90.64 (8)	93.69
H. ovalis/T. hemprichii with *E. acoroides*		31.42 ±2.00			99.67 (1)	99.67
T. hemprichii	12.26 ±3.23	37.08 ±3.30	1.40 (8)	37.16 (19)	64.58 (18)	103.14
C. rotundata/T. hemprichii/H. uninervis with mixed species		51.15 ±2.33			136.42 (1)	136.42
E. acoroides with *T. hemprichii/H. ovalis*		31.43 ±2.61			139.09 (3)	139.09
E. acoroides with *T. hemprichii/Cymodocea* spp & mixed species	15.49 ±18.85	59.80 ±5.51			150.16 (7)	150.16
C. rotundata with *E. acoroides/T. hemprichii*	6.92 ±6.92	63.33 ±2.89			156.46 (3)	156.46
C. rotundata/T. hemprichii	60.60 ±7.70	48.33 ±13.13		14.84 (2)	243.99 (4)	258.83
T. hemprichii/E. acoroides	65.29 ±65.29	43.42 ±5.03	0.09 (1)	11.13 (2)	281.59 (3)	292.81
E. acoroides with *T. hemprichii*	27.50 ±15.95	46.10 ±5.46	0.13 (1)	1.673 (3)	297.31 (18)	299.11
T. hemprichii with *C. rotundata* & mixed species	38.61 ±16.16	48.26 ±5.58			347.83 (12)	347.83
E. acoroides with *T. hemprichii* & mixed species	2.01 ±2.00	46.32 ±7.54	6.17 (1)		360.26 (5)	366.43
T. hemprichii with *E. acoroides* & mixed species	20.57 ±14.47	67.19 ±8.54		3.63 (3)	399.95 (8)	403.58
T. hemprichii/E. acoroides with *S.isoetifolium*		65.33 ±4.26			700.14 (1)	700.14
T. hemprichii with *E. acoroides*	9.56 ±2.77	46.461 ±6.62	3.92 (4)	149.49 (3)	630.93 (10)	784.34
E. acoroides	6.39 ±3.85	25.78 ±5.24	50.35 (51)	44.70 (35)	1322.07 (51)	1417.13
Total			**72.08 (85)**	**375.60 (112)**	**6186.13 (289)**	**6633.82**

Halophila decipiens was the rarest species in the Solomon Islands, being found at only one site in Tambea, north western Guadalcanal. This however, may be an artefact of the sampling design, as the survey concentrated on areas down to 6m depth and *Halophila decipiens* is generally found in deeper waters. Other species that were also relatively rare inlcude: *Thalassodendron ciliatum*, being found only on the eastern coastline of Malaita; *Halophila minor*, only found at six sites (incl. southern Choiseul, Florida Islands, and northern Guadacanal & Savo). *Syringodium isoetifolium* was absent from Central and Guadalcanal provinces, and *Cymodocea serrulata* was mainly restricted to islands south of 8 degrees latitude. The only location north that *Cymodocea serrulata* was found was on the fringing reefs between Chirovanga and Polo (NE Choiseul). All other species were widely distributed throughout the Solomon Islands.

Rhizophora stylosa, was the most common mangrove encountered and it had the widest distribution in the survey area, occurring throughout the Solomon Islands. Where *R. stylosa* occurred it also tended to be the dominant species.

MALAITA PROVINCE

Long stretches of white-sand beaches line the shore of northern Malaita Island (Figure 4). 3607.62 hectares of seagrass was mapped in 59 meadows in the province between 10 - 14 June 2004. 99 percent of seagrass meadows in the province were of continuous cover (Table 3) and located on large intertidal reef/mud flats in protected bays, lagoon and on the leeward side of vegetated islands. Most of the meadows (90%) identified were either *Thalassia* or *Enhalus* dominated communities (<1m depth) adjacent to mangroves and coral reefs in lagoons, protected bays or on the leeward side of larger islands. Seagrass cover was moderately high and often associated with the macro-alage *Caulerpa racemosa*, *Halimedia cylindrical* and *Halimedia opuntia*. Meadows of *Halophila ovalis* (2-3 m depth) were found in sheltered lagoon channels, usually on coarse sand, associated with *Halimedia cylindrica*. On fringing reefs, inside the reef crest on exposed coast, *Thalassia* and *Cymodocea* meadows dominated (<1 m depth) on coarse sand, shell, reef substrate associated with *Halimedia* and turf algae.

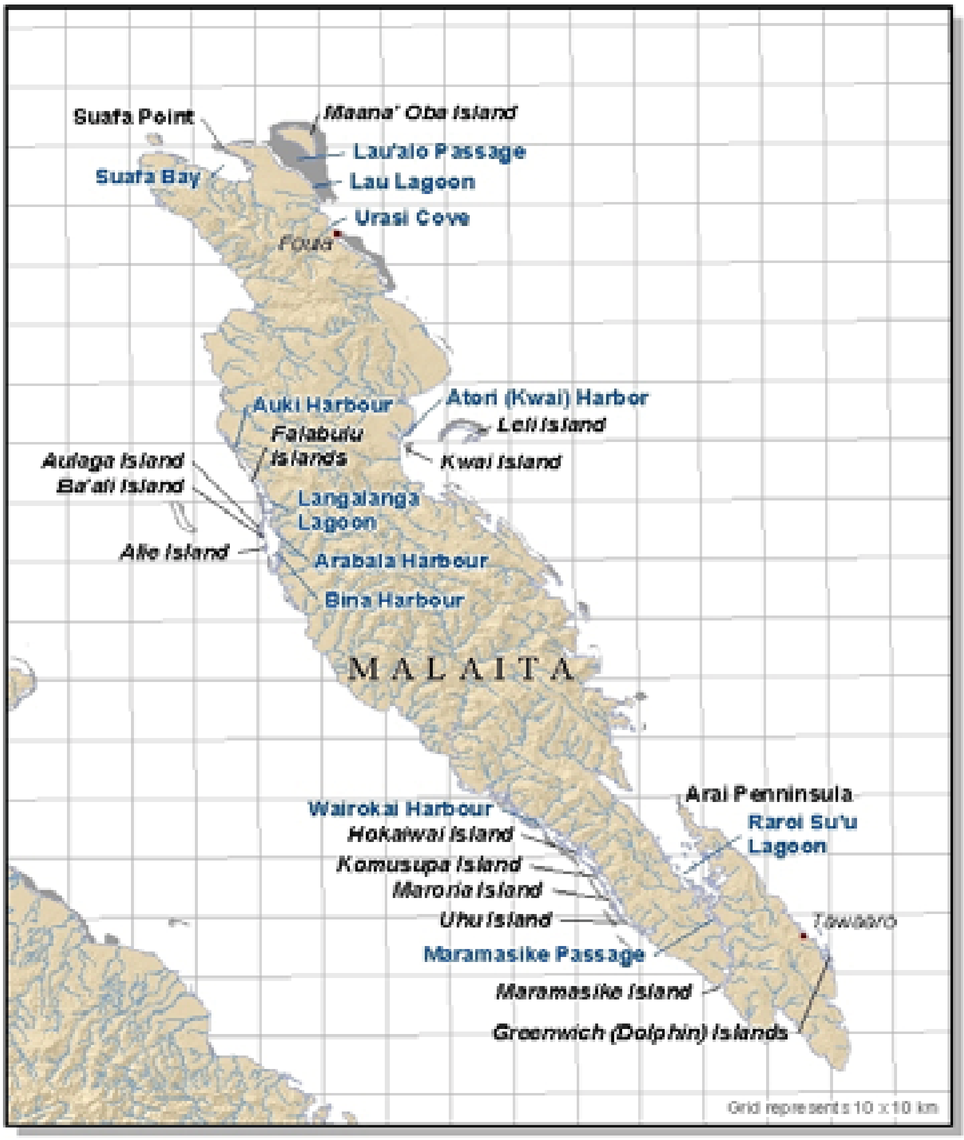


Figure 4. Malaita Province

Extensive intertidal and subtidal meadows were present in Lau Lagoon. The large shallow (~1.5m deep) lagoon stretched 3-5 km along the coast between Maana'oba Island and Malaita (Lau'alo Passage), on the north-eastern coast.

The lagoon is up to 1 km wide and fringed by significant stands of mangroves (*Rhizophora stylosa*) on the mainland side. The landward edge was dominated by *E. acoroides* (mean quadrat cover = 34%) in mud sediments. Towards mid regions of the lagoon communities of *E. acoroides*, *Thalassia hemprichii*, *Cymodocea rotundata*, *Halophila ovalis* dominated and were interspersed with reef. Seagrass cover was generally more abundant (mean quadrat cover = 52%) in the mixed species meadows. The mid region represented the dominant community type, surviving in relatively sheltered waters and coarse sand and shell sediments. On the seaward edges of the island expansive *Cymodocea rotundata*, *Thalassia hemprichii* and *Halophila ovalis* were present inside the reef crest. The area possibly represents the largest stand of seagrass in the eastern Solomon Islands. Seagrass stretched north into a large embayment and also continued southward through numerous sea-based communities inhabiting dwellings built on modified coral reefs.

Along the north western part of the passage, meadows of *Thalassia hemprichii/Enhalus acoroides* with *Syringodium isoetifolium* were present on the large fringing reef flats adjacent to the main coastline. *Thalassia hemprichii* with *Enhalus acoroides* meadows and *Thalassia hemprichii* with *Cymodocea rotundata* & mixed species meadows surrounded Maana'oba Island. The region is believed to be significant dugong and green turtle feeding grounds (Bruno Manele, Ruben Sulu Pers comm.). *Thalassodendron ciliatum* was reported from Urasi Cove, Malaita (Johnstone 1982) near Fouia village, just south of Lau Lagoon. Also aggregated patches of *Thalassodendron ciliatum* were found in Suafa Bay on the western side of Suafa Point on the edge of the fringing reef.

Table 3. Meadow categories, total area (hectares) and numbers of intertidal/shallow subtidal meadows in Malaita Province, Solomon Islands – June 2004.

CATEGORY	Cover (%)	Area in hectares (number of meadows)			Total (ha)
		Isolated seagrass patches	Aggregated seagrass patches	Continuous seagrass cover	
C. rotundata/T. hemprichii with mixed species	86 ±12			0.1 (1)	0.1
C. rotundata/T. hemprichii/H. uninervis with mixed species	51 ±2			136.42 (1)	136.42
E. acoroides	17 ±3	0.19 (3)	21.11 (8)	1024.17 (12)	1045.47
E. acoroides with *T. hemprichii*	40 ±3			68.89 (4)	68.89
E. acoroides with *T. hemprichii* & mixed species	54 ±7			357.25 (2)	357.25
E. acoroides with *T. hemprichii/Cymodocea* spp & mixed species	47 ±5			4.81 (2)	4.81
E. acoroides with *T. hemprichii/H. ovalis*	38 ±2			2.14 (1)	2.14
H. ovalis	39 ±5	0.18 (1)			0.18
H. ovalis/T. hemprichii with *E. acoroides*	31 ±2			99.67 (1)	99.67
T. hemprichii	50 ±5		1.33 (1)	10.06 (3)	11.39
T. hemprichii with *C. rotundata*	39 ±3			22.77 (2)	22.77
T. hemprichii with *C. rotundata* & mixed species	55 ±4			215.32 (3)	215.32
T. hemprichii with *E. acoroides*	24 ±5			535.15 (4)	535.15
T. hemprichii with *H. uninervis* & mixed species	58 ±12			3.71 (1)	3.71
T. hemprichii with *H. ovalis* & mixed species	35 ±6			4.72 (1)	4.72
T. hemprichii with mixed species	42 ±8			19.31 (1)	19.31
T. hemprichii/E. acoroides	33 ±1			280.34 (2)	280.34
T. hemprichii/E. acoroides with *Syringodium isoetifolium*	65 ±4			700.15 (1)	700.15
T. ciliatum			3.72 (2)		3.72
T. ciliatum/C. rotundata with mixed species				5.36 (1)	5.36
T. ciliatum/T. hemprichii/C. rotundata with mixed species	51 ±0			90.75 (1)	90.75
Total		**0.37 (4)**	**26.16 (11)**	**3581.09 (44)**	**3607.62 (59)**

Aggregated patches of *Enhalus acoroides* line the edges of the mangroves of Auki Harbour, in northern Langalanga Lagoon. Meadows were only 30-40m wide and were generally scattered southward throughout the lagoon. Communities were very patchy with some sheltered *Enhalus acoroides*, *Thalassia hemprichii* and *Halophila ovalis* assemblages near the mangroves. Larger meadows of continuous and aggregated patches of *Thalassia hemprichii* with *Enhalus acoroides* were located on the reef flats of the Falabulu Islands. Only a few small aggregated patches of *Enhalus acoroides* were present in the Harbours of Bina and Arabala, south of Langalanga Lagoon. No seagrasses were present on the seaward edges of Alite, Ba'ali and Aulaga Islands due to exposure from oceanic swells.

The lagoons immediately south and north of Wairokai Harbour were devoid of seagrass, and there was no seagrass in the entrances from the ocean. Rocky shore platforms on the outer coast were too exposed and did not appear to support seagrass growth. Mangroves (predominately *R. stylosa*) and coral reef fringe much of the lagoon except for areas where settlement occurs and numerous mangrove islands occur throughout the lagoon.

South of Wairokai Harbour, in the lagoon between Hokaiwai Island and the mainland, a patch (30mx60m) of *Halophila ovalis* was found in a small sheltered channel. Further south, patchy *Enhalus acoroides* meadows were located on the eastern lagoon side of Komusupa Island extending its entire length to the oceanic entrance with Maroria island. No seagrass was found on the mainland coast opposite Komusupa Island but patches of monospecific *Enhalus acoroides* were found on the mainland coast inside Maroria Island. Fringing reefs on Maroria Island (north and south) supported *Thalassia hemprichii* and *Cymodocea rotundata* meadows along the shoreward fringe extending about 50m seaward. The reef crest was situated about 200-300m from shore providing sufficient protection for the largest seagrass meadow in the region. At the entrance between Maroria and Uhu Islands, *Thalassia hemprichii* meadows were found on the oceanic fringing reefs of Maroria Island but not on Uhu Island (too exposed and rocky). Meadows of *Enhalus acoroides* on the lagoon side of Uhu Island ranged from isolated patches to continuous meadows and were also found as isolated patches on the mainland coast inside Uhu Island. A deep-water *Halophila ovalis* meadow was found at 22m on western exposed side of Uhu island, outside the entrance of Maroria and Uhu island.

On the mainland eastern coast of Malaita, very patchy *Enhalus acoroides* meadows (few plants only) were scattered around the edges of Kwai Harbour, fringing the mangroves. Larger continuous *Thalassia hemprichii* meadows were located around Kwai Island, further south. On the mainland coast a large expanse (~500m wide) of seagrass in a lagoon on the landward side of the reef crest dominated the area. Typically communities of seagrass (*Thalassia hemprichii, Cymodocea rotundata, Enhalus acoroides, Halophila ovalis*) were scattered across the coastline (~3-5km) with small islands and reefs interspersed among seagrass which dominate near the reef crest. In sheltered bays *Enhalus acoroides* grew adjacent to mangroves in mud sediments and interspersed with sheltered reefs. Also in areas along the open coast but sheltered by reefs more than 500m from the coast are *Enhalus acoroides* meadows growing to 3m adjacent to black sand beaches. The waters here were typically brownish in color, possibly tannins from nearby coastal vegetation. Local men harvest coral for building materials. Numerous small dwellings are built on coral reefs modified by additions of coral blocks.

About 3 km off the Maliata east coast is horseshoe shaped Leli island. In the protected lagoon were extensive *Thalassia hemprichii, Cymodocea rotundata* and *Halophila ovalis* meadows growing in sand dominated sediments. On the outer side of the island were mangroves and communities of *Thalassia hemprichii* and *Halophila ovalis* on coarse sediments.

Off southern Malaita is Maramasike Island. It is separated from Malaita Island proper by the 20km long Maramasike Passage which in places is only 400m wide. Nietschmann *et al.* (2000) reported significant seagrass meadows in the region, but no further description is given.

Although not ground truthed, northern Raroi Su'u Lagoon in the northern part of the passage was visited during the survey. Seagrasses may be extensive in the area, as it is a calm, protected waterway fringed by mangroves. At the end of the Maramasike Passage was a number of small mangrove fringed islands possibly surrounded by small (<50m) fringing reefs and *Enhalus* *acoroides* meadows. The sheltered habitat of this embayment is suitable for *Enhalus acoroides* and likely to be present. Mangroves also fringed the mainland coast on both sides of the embayment and scattered patchy *Enhalus acoroides* meadows may be present. *Thalassodendron ciliatum, Halophila ovalis* and *Cymodocea rotundata* were found near the cape of Arai Peninsula.

On the south eastern coast of Maramasike Island are the Greenwich (Dolphin) Islands. This region had high seagrass diversity and extensive seagrass meadows consisting of sheltered *Enhalus acoroides* habitat, lagoon communities of *Thalassia hemprichii, Halophila ovalis*, *Cymodocea* spp, *Halodule uninervis* and *Thalassodendron ciliatum*. A large, abundant and continuous *Cymodocea rotundata/Thalassia hemprichii/Halodule uninervis* with mixed species meadow was located across the extensive reef flat adjacent to Tawaaro. Here the people hunt dolphin, capturing up to 700 at one time (see *Oceanic Cetaceans & Associated Habitats*, this report). A population of about 20 dugong were reported to regularly feed in the area.

CHOISEUL PROVINCE

Choiseul Island is a long, narrow, densely wooded island, with a shoreline consisting of long narrow beaches, some of which are bordered by large, shallow freshwater wetlands (Figure 5). 753.93 hectares of seagrass was mapped in 49 meadows in the province between 21 – 24 May 2004. Approximately 80 percent of seagrass meadows were dominated by *Thalassia hemprichii*, with *Enhalus acoroides* or other species present. 70 percent of seagrass meadows in the province were of continuous cover (Table 4) and located on large intertidal fringing reef flats in protected bays, lagoons and on the leeward side of vegetated islands. Meadows located on the narrow fringing reefs adjacent to mangroves (predominately *R. stylosa*) were predominately aggregated *Enhalus* communities (<1m depth).

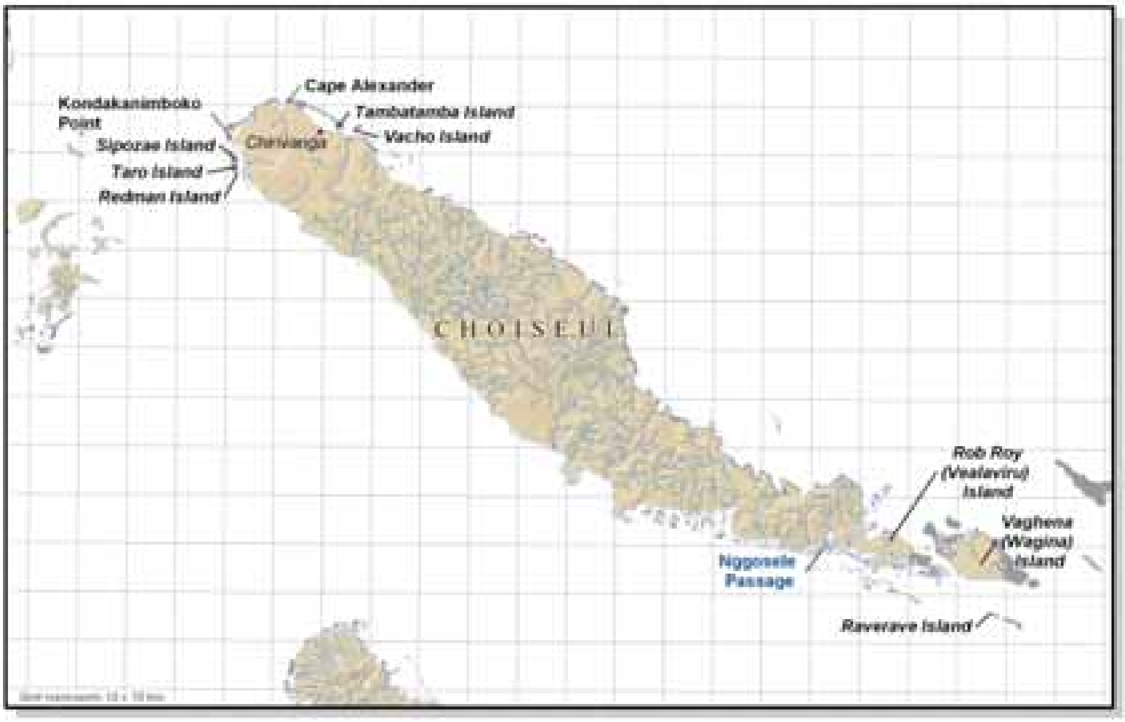


Figure 5. Choiseul Province

Table 3. Meadow categories, total area (hectares) and numbers of intertidal/shallow subtidal meadows in Choiseul Province, Solomon Islands – May 2004.

CATEGORY	Biomass (g DW m^{-2})	Cover (%)	Area in hectares (number of meadows)			Total (ha)
			Isolated seagrass patches	Aggregated seagrass patches	Continuous seagrass cover	
C. rotundata/H. uninervis with mixed species		69 ±4		1.7 (1)		1.7
C. serrulata with *E. acoroides* & mixed species		90 ±6			17.41 (1)	17.41
C. serrulata/S.isoetifolium with mixed species		77 ±9			8.75 (1)	8.75
E. acoroides		25 ±6	2.45 (6)	2.82 (2)	5.97 (2)	11.24
E. acoroides with *T. hemprichii*		38 ±3			0.91 (1)	0.91
E. acoroides with *T. hemprichii/Cymodocea* spp & mixed species		58 ±3			24.07 (1)	24.07
E. acoroides/S.isoetifolium/C. rotundata & mixed species		53 ±5		66.19 (1)		66.19
E. acoroides/T. hemprichii		10 ±4	0.005 (1)			0.005
E. acoroides/T. hemprichii with mixed species	64.95 ±31.6				0.06 (1)	0.06
H. minor	3.515 ±0.77	63 ±5			0.03 (2)	0.03
H. ovalis	2.845 ±1.18	54 ±4		1.12 (2)	0.36 (3)	1.48
H. ovalis with mixed species		56 ±3			0.15 (1)	0.15
T. hemprichii	13.11 ±2.60		0.2 (2)	0.68 (1)	5.71 (5)	6.59
T. hemprichii with *C. rotundata*	6.361 ±1.00				1.63 (1)	1.63
T. hemprichii with *E. acoroides*	7.085 ±1.74	48 ±7	1.66 (1)	148.72 (1)	79.58 (3)	229.96
T. hemprichii with *E. acoroides* & mixed species	15.89 ±7.71	64 ±4			374.48 (4)	374.48
T. hemprichii with *H. ovalis*	7.756 ±7.47	71 ±4	0.79 (2)		8.14 (1)	8.93
T. hemprichii with *H. ovalis* & mixed species	9.374 ±3.72		0.01 (1)			0.01
T. hemprichii/H. ovalis	0.669 ±0.66				0.33 (1)	0.33
Total			**5.12 (13)**	**221.23 (8)**	**527.58 (28)**	**753.93 (49)**

Rob Roy and Wagina Islands, off Choiseul's south-eastern coast, are partly mangrove and surrounded by large intertidal/shallow subtidal (<10m) reef and sandflats. On the eastern side of Wagina Island at the shoreward extent of the large banks were significant meadows of *Enhalus acoroides* and *Thalassia hemprichii*, with *Cymodocea* spp & mixed species covering an estimated combined total of 200ha. Elsewhere, meadows are reduced to narrow intertidal/shallow subtidal fringes along the sheltered shorelines of the many scattered islands. Small patches of seagrass can be found within the sheltered lagoons of barrier reef islands (e.g., Raverave Is).

John Pita reported seagrass meadows in Nggosele Passage near Taora village, however due to time constraints we were unable to examine the Passage. They were likely to be *Enhalus acoroides* and *Halophila* species bordering the mangroves. Similarly, reports of seagrass meadows in the Kuliu region (mid-western coast) and Nanago Reef (mid-eastern coast) could not be verified.

A few kilometers to the west of Nggosele Passage, toward Ndololo Island, are several narrow inlets (fjords) with significant freshwater influence. Small patches (<100m^2) of *Halophila minor* were located on the narrow banks.

Seagrass (*Thalassia hemprichii* and *Halophila ovalis*) was scattered across the reef-flats on the western sides of Sipozae, Taro and Redman Islands (~120ha), Choiseul Bay. Significantly more *Halophila ovalis* is present between on the intertidal sandbanks between Taro and Redman Islands than has been recorded throughout the remaining Choiseul Island. These meadows would appear suitable for dugong (a few individuals), confirmed by the sighting of a large individual on the morning of our survey. The remaining seagrasses of Choiseul Bay, were *Enhalus acoroides* and *Thalassia hemprichii* meadows (~6ha) along the eastern shores of Sipozae and Taro Islands and the southern shores of Kondakanimboko Point (West Cape). A few isolated *Enhalus acoroides* along the eastern shores of Choiseul Bay, although not of any significant size.

Some of the most extensive seagrass meadows in the province can be found in the north-eastern corner. Large intertidal and shallow subtidal meadows dominated by *Enhalus acoroides* and *Thalassia hemprichii* can be found across the expansive barrier reef-flats, particularly associated with vegetated islands. The most extensive meadows encountered in the province were on the reef flats out from Tambatamba Island and Cape Alexander. The meadows covered an area of approximately 106ha and 260ha, respectively. The meadow off Tambatamba Island was significantly greater biomass, and appeared productive for artisinal fisheries as 5 groups of fishers were observed using nets and lines during the time of our examination. The meadow was abundant with goatfish (*Barberinus* sp), three-line wrasse (*Stethojulis strigiventer*) and hiding on the seabed with the grass were several white-spotted puffer fish (*Arothron hispidus*).

The coastal meadows sheltered behind the fringing reef flat in the vicinity of Chirivanga, were diverse with up to 7 species present at a single site. Two of the larger meadows encountered, were on the eastern sides of small points opposite Tambatamba and Vacho Islands. These meadows (9 and 17ha respectively) were dominated by *Cymodocea serrulata* and *Syringodium isoetifolium*, with a combination of other species (*E. acoroides, H. ovalis, H. uninervis (wide & narrow leaf form), C. rotundata, T. hemprichii*). These meadows were of high biomass for the species mix, and were abundant fish such as the barred halfbeak (*Hemiramphus far*), scribbled rabbitfish (*Siganus spi*nus) and threespot damselfishes (*Pomacentrus tripunchtatus*).

The remainder of the coastal meadows fringed the mangroves and were dominated by aggregated patches of *Enhalus acoroides/Syringodium isoetifolium/Cymodocea rotundata* & mixed species. In the mangrove islands surrounding the Chirivanga village, meadows were dominated by *Enhalus acoroides* with relatively few other species present.

ISABEL PROVINCE

Isabel is the longest island in the Solomon's and dominates the province (Figure 6). It is a large, mainly volcanic landmass with steep mountain ranges and mangrove and freshwater wetlands prevalent along the coast. 535.99 hectares of seagrass was mapped in 99 meadows in the province between 14 – 20 May 2004. Seagrass communities are dominated by *Enhalus acoroides* (74% of seagrass area), 86% of which were continuous cover (Table 5). Meadows were located on large intertidal reef/mud flats in protected bays and lagoons. Seagrass cover was moderately high and often associated with the macro-alage *Caulerpa* and *Halimeda*.

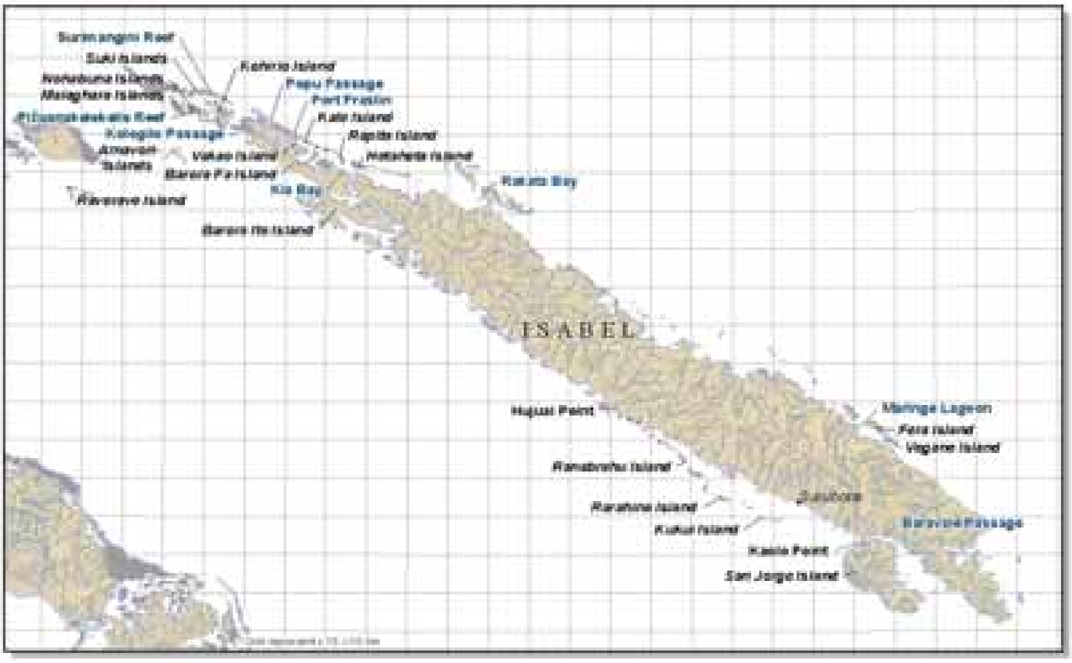


Figure 6. Isabel Province

Table 4. Meadow categories, total area (hectares) and numbers of intertidal/shallow subtidal meadows in Isabel Province, Solomon Islands – May 2004.

CATEGORY	Biomass (g DW m^{-2})	Cover (%)	Area in hectares (number of meadows)			Total (ha)
			Isolated seagrass patches	Aggregated seagrass patches	Continuous seagrass cover	
C. rotundata		38 ±2			0.2 (2)	0.2
C. rotundata with *E. acoroides*		88 ±4			1.91 (1)	1.91
C. rotundata with *mixed species*	34.23 ±8.66	57 ±5	0.82 (1)	0.46 (2)	1.56 (3)	2.84
C. rotundata with *T. hemprichii* & mixed species		50 ±3		1.84 (1)	1.45 (1)	3.29
C. rotundata/T. hemprichii		77 ±9			0.93 (1)	0.93
C. rotundata/T. hemprichii with mixed species	6.026 ±3.06	59 ±3			21.25 (2)	21.25
C. serrulata with *E. acoroides* & mixed species		70 ±6			1.5 (1)	1.5
E. acoroides	10.82 ±5.87	25 ±4	20.27 (10)	2.1 (6)	202.65 (11)	225.02
E. acoroides with *H. uninervis*		27 ±7		0.87 (1)		0.87
E. acoroides with *H. ovalis*	0.334 ±0.33	48 ±9		0.31 (1)	2.21 (1)	2.52
E. acoroides with *T. hemprichii*	54.23 ±31.1	57 ±7		0.17 (1)	112.5 (4)	112.67
E. acoroides with *T. hemprichii* & mixed species	2.008 ±2.00	15 ±5	6.17 (1)			6.17
E. acoroides with *T. hemprichii/Cymodocea* spp & mixed species		80 ±6			0.13 (1)	0.13
E. acoroides/Cymodocea spp with mixed species		64 ±7			4.48 (1)	4.48
E. acoroides/H. uninervis with *T. hemprichii*		63 ±3			11.84 (1)	11.84
E. acoroides/T. hemprichii		69 ±9			34.93 (3)	34.93
H. uninervis	2.008 ±1.15			1.98 (1)		1.98
H. uninervis with *E. acoroides* & mixed species		53 ±12			4.41 (1)	4.41
H. uninervis with *H. ovalis*		11 ±3			0.24 (1)	0.24
H. uninervis with *T. hemprichii* & mixed species	17.40 ±2.41				4.2 (1)	4.2
H. uninervis/H. ovalis		27 ±15			0.54 (1)	0.54
H. ovalis	3.162 ±1.92		0.45 (1)	9.14 (7)	0.64 (1)	10.23
H. ovalis with *E. acoroides*	5.859 ±2.05	48 ±6			2.15 (3)	2.15
S.isoetifolium with mixed species		46 ±4		0.25 (1)		0.25
T. hemprichii	11.66 ±2.32	48 ±2	0.66 (1)	18.55 (6)	0.57 (1)	19.78
T. hemprichii with *C. rotundata*	42.85 ±39.8	50 ±12		1.63 (1)	3.98 (2)	5.61
T. hemprichii with *C. rotundata* & mixed species	40.25 ±9.52				15.22 (2)	15.22
T. hemprichii with *E. acoroides*	10.79 ±3.27	63 ±7	0.8 (1)		5.64 (2)	6.44
T. hemprichii with *E. acoroides* & mixed species		89 ±5			0.26 (1)	0.26
T. hemprichii with *H. ovalis*	70.30 ±17.1	63 ±9			0.11 (1)	0.11
T. hemprichii with *H. ovalis* & mixed species	2.008 ±1.15				2.02 (1)	2.02
T. hemprichii/E. acoroides	65.28 ±65.2	62 ±6		5.77 (1)	1.25 (1)	7.02
T. hemprichii/H. ovalis	8.035 ±1.15	55 ±6		0.35 (1)	23.64 (1)	23.99
T. hemprichii/H. ovalis with *E. acoroides*	6.696 ±1.77				0.99 (1)	0.99
TOTAL			**29.17 (15)**	**43.42 (30)**	**463.4 (54)**	**535.99 (99)**

On the south-eastern coast, seagrasses are located in sheltered lagoons or reef flats. In Maringe Lagoon, seagrasses are predominately *Enhalus acoroides* and *Thalassia hemprichii* with some *Halodule uninervis* and *Halophila ovalis* in places. In the south of Maringe Lagoon, large seagrass meadows cover much of the fringing reef flats with *Enhalus acoroides* and *Thalassia hemprichii* inshore, becoming more isolated patches of *Enhalus acoroides* toward the reef crest amongst the corals (e.g. *Porities*). Along the western shores, the fringing reef is narrow and drops to deep water (~25m) within 100m from the shore. Large beds of *Sargassum* dominate. Seagrass in these areas in restricted to a narrow shallow subtidal fringe on 5-10m wide, dominated by *Thalassia hemprichii* and *Enhalus acoroides*. To the north of the lagoon, seagrasses are absent due to the high exposure to waves. The seabed is barren with isolated patches of *Sargassum* on dark fine highly mobile sands. Turbidity is also noticeably higher. On the leeward sides of Fera and Vegane Islands, seagrasses cover the nearshore shallow subtidal areas adjacent to patches of *Rhizophora stylosa*. Seagrass is also present on the protected side of the main reef. Dominated by *Cymodocea rotundata* and *Halodule uninervis*, with *Thalassia hemprichii* and *Halophila ovalis*, these meadows are relatively small (<1 ha).

On the southern coast, along the eastern side of the main island, the presence of seagrass depends on the level of protection from the prevailing winds and seas. In Huali Bay, Seagrass meadows are only found on the fringing reefs around Tanabuli Island and Tatamba.

Seagrass was absent in the turbid waters of Kaolo Point, near the mouth of Baravale Passage, which is lined with extensive intact mangrove stands (*Rhizophora*). The sands are finer and darker in colour and exposed to the waves and oceanic swell. *Sargassum* is abundant (25-100% cover). On the north-western side of San Jorge Island, isolated plants of *Enhalus acoroides* are present within a few metres of the shore, particularly if a narrow fringing reef is present. On the northern sides of headlands where the waters are more protected, small meadows dominated by *Cymodocea serrulata* with *Enhalus acoroides* can be found, of significant abundance (60-80% cover). There also appears to be significant mixing of freshwater, as the top few centimetres of the waters are low salinity. These areas are heavily fished for trevally and baitfish. On the seaward edge and reef crest, *Sargassum* is abundant. In bays where the reef flat is much wider the seagrass meadows are larger. Inshore, adjacent to the mangroves (*Rhizophora stylosa*) the meadows is almost exclusively *Enhalus acoroides*, this changes to a *Thalassia hemprichii* and *Cymodocea rotundata* dominated meadows with isolated *Enhalus acoroides* plants at approximately 10-15m from shore. Towards the reef crest, *Syringodium isoetifolium* is present, before the reef flat becomes more coral/*Sargassum* dominated with a few isolated *Enhalus acoroides* plants.

Heading northward along the coast between Baravale Passage and Susubona Village, seagrasses are limited to the protected northern sides of headlands, within relatively narrow fringing reefs (50-100m). These areas are protected from oceanic swells and the prevailing trade winds. Seagrass meadows are generally small and dominated by *Cymodocea rotundata* with *Thalassia hemprichii* and isolated *Enhalus acoroides* plants. Seagrasses are also found on the leeward (northern) intertidal/shallow subtidal flats of vegetated islands. These meadows can be very extensive and diverse. They are mainly dominated by *Thalassia hemprichii* and *Cymodocea rotundata*, with *Halophila ovalis, Halodule uninervis* and the occasional *Enhalus acoroides* plant. Smaller islands with smaller reef flats are generally dominated by *Thalassia hemprichii* with *Halophila ovalis* on coarse sand.

Along the parts of the coastline, which are protected by an outer barrier reef (Kukui, Rarahina and Tanabrahu), the waters are generally more turbid and the size of the meadows dependent on the size of the fringing reef. Much of the coast in these sheltered waters is fringed by dense mangroves and within 10m of deep-water (20-30m) drop-offs and larger rivers which drain catchments into the lagoon. The turbidity of the coastal waters may be a consequence of the logging activities. With such narrow fringing reefs, only a few isolated plants of *Enhalus acoroides* are able to exist. On the much larger fringing reef flats, the meadows are sometimes more extensive and dominated by abundant (60-80% cover) *Thalassia hemprichii*/*Cymodocea rotundata* and *Enhalus acoroides* with *Halodule uninervis*. Islands along the barrier reef are more exposed and if vegetated often have some *Thalassia hemprichii* and *Halophila ovalis* present (30-50% cover). Unvegetated cays are often associated with more mobile sediments and seagrass appears unable to establish.

Further northward along the coast, the reefs are fringing and are quite extensive in size. Seagrasses are generally confined to the lee side of large headlands (e.g., Hujuai Point), or are confined to the very shoreward portion of the reef. Behind headlands, isolated *Enhalus acoroides* plants are present just inside the reef crest, associated with *Caulerpa* and *Sargassum*. Moving shoreward, *Thalassia hemprichii* becomes more abundant and along the shore a narrow band of seagrass (5-10m wide) is generally dominated by *Halodule uninervis*/*Thalassia hemprichii* with *Halophila ovalis*. On the southern sides of large bays, *Halophila ovalis* is often found subtidally (down to 4m), and in the calmer inshore waters are *Enhalus acoroides*/*Thalassia hemprichii*/*Halodule uninervis* shoreward. These areas also often have high amounts of macroalgae (*Caulerpa* and *Halimeda*) and benthic micro-algae.

On the large fringing reefs, the seagrass meadows can be very different, depending on the size of the reef-flat, the presence of any islands, and the level of water movement. *Thalassia hemprichii* is often scattered across the reef-flat, and the occasional *Enhalus acoroides* plant is present within the protected environments of *Porites* corals. Shoreward the meadows become more continuous forming a distinct meadow dominated by *Thalassia hemprichii*/*Cymodocea rotundata*/*Halodule uninervis* with *Enhalus acoroides* and *Halophila ovalis*, often adjacent to mangroves (*Rhizophora* and *Brugeria*). On the very large reefs, often mangrove islands have established and a back lagoon is present. These reef-flats are predominately bare sand with isolated pockets of reef. *Halophila ovalis* is scattered across the sandy banks and can be quite abundant behind the mangrove islands. Isolated *Enhalus acoroides* plants are also present, often adjacent to small *Porites* bommies. Inshore of these large fringing reefs, the back lagoons can be quite deep (15-20m), rising quickly to the edge of the mangroves. *Enhalus acoroides* is sometimes present in sheltered pockets, but otherwise the extensive mangrove fringe is often bare.

Seagrass was found surrounding the north western bays of Barora Ite Island. Meadows were generally narrow, dominated by *Enhalus acoroides* and fringe intact *Rhizophora stylosa* and *Bruguiera*. Often the *Enhalus* plants are mixed in with coral (e.g., *Porities*) and macro-alage (*Valonia* & *Caraesmosa*). Juveniles of targeted reef fish (e.g., coral trout) were also abundant.

On the wider fringing reef flats, meadows are predominately *Thalassia hemprichii* with *Cymodocea rotundata*. On the eastern facing reef flats protected by small islands, meadows are generally continuous *Enhalus acoroides/Cymodocea spp* with mixed species. These meadows are often in highly turbid waters, with abundant fish (e.g., trevally, sardines) and high epiphytes. Seagrass was generally absent from the barrier reefs. Small patches of *Thalassia hemprichii* however were found on vegetated barrier reef islands (e.g., Hilihavo Island).

Within Rob Roy Channel, aggregated patches of *Enhalus acoroides, Thalassia hemprichii* (with *Cymodocea rotundata*) or *Halophila ovalis* were found on the fringing reef flats.

A small aggregated patch of *Enhalus acoroides* was the only seagrass located along the passage between Barora Ite Island and Isabel Island, contrary to previous reports from the region. The passage in generally deep (25-50m), narrow (~10m at the narrowest point), has high currents, turbid (2m visibility) and bordered by *Rhizophora stylosa* and narrow fringing reefs.

Between Kia Bay and Port Praslin, seagrasses communities can be found bordering the mangroves adjacent to narrow fringing reefs which surround some of the medium sized mid shelf islands (e.g., Ghateghe & Viketongana Islands). Between these islands and the larger island of Barora Fa, seagrasses are less common. Mangroves are more extensive, turbidity is higher and the sediments muddier. No seagrass was found on the western sides of Ghateghe or Vakao Islands. Seagrass was not common on the barrier reef islands. No seagrass was found surrounding Koropagho, Rapita or Hetaheta Islands, although a small meadow of *Thalassia hemprichii/Cymodocea rotundata/Halodule uninervis* was found on the western side of Kale Island. The large shallow reef flats were generally barren or contained patches of *Halimeda/Caulerpa*.

Unfortunately, Rakata Bay and its surrounds the reefs and islands could not be surveyed due to time constraints. It is highly likely that significant seagrass meadows may cover the sheltered fringing reefs in the area. Seagrasses have also been reported from Tina biro on the mid-eastern coast (Paul Riju pers comm.) but these were similarly not examined due to time constraints.

The Western Islands are a collection of more than 100 islands, along with the tiny Arnavon Islands, located off the northern coast of Isabel. Some of these islands are mangrove and have extensive reefs and sandbars. Seagrasses were not common on the fringing reef flats west of Popu Passage. Due to the strong currents passing through Kologilo Passage, seagrasses are restricted to isolated meadows behind larger islands. These meadows are sparse *Thalassia hemprichii* and *Halophila ovalis*. In some sites (eg Kohirio Is) the meadows also contain *Cymodocea rotundata* and form a more cohesive meadow within a few metres of the shore. The larger shallow reef flats are generally bare substrate with isolated patches of *Halimeda* and *Caulerpa*.

Seagrass was absent from the large shallow reef flats across the very northern tip of Isabel Island (Maduko, Surimangini & Pizuanakelekele Reefs). Seagrass was generally absent from the reef flats surrounding the exposed barrier reef islands of Suki and Malaghara. However, small meadows of *Halophila ovalis*.and *Halodule uninervis* were sometimes present in more sheltered locations adjacent to the slightly larger Nohabuna and Sibau Islands. Isolated patches of *Enhalus acoroides* were adjacent to the mangroves which bordered the passage between Kohirio and Kohirio Islands. No seagrass was on the exposed western reef flats of Kohirio Island.

The Arnavon Islands contain one of the largest nesting grounds in the world for the endangered hawksbill turtle (*Eretmochelys imbricata*) and is a declared MPA. Seagrass was virtually absent from the Arnavon Islands, with the exception of a small-scattered *Cymodocea rotundata* meadow adjacent to the TNC Research Station on Kerehikapa Island The remaining reef-flats and sandbars contained significant amounts of *Caulerpa*. Can you say any more about the mangroves in the Arnavons please?

WESTERN PROVINCE

The province includes the New Georgia, Treasury and Shortland Islands (Figure 7). 754.5 hectares of seagrass was mapped in 134 meadows in the province between 25 May - 1 June 2004. The Western Province had the highest diversity of seagrass communities in the Solomon Islands, with 37 different categories identified (Table 6). Most (89%) of seagrass meadows in the province were of continuous cover (Table 6) and approximately 50% of the meadows were *Cymodocea rotundata* dominated communities (<4m depth) located on large intertidal reef/mud flats in protected bays and lagoons. Of the remaining meadows, 22% were *Enhalus acoroides* dominated and 19% *Thalassia hemprichii* and *Halodule uninervis* dominated.

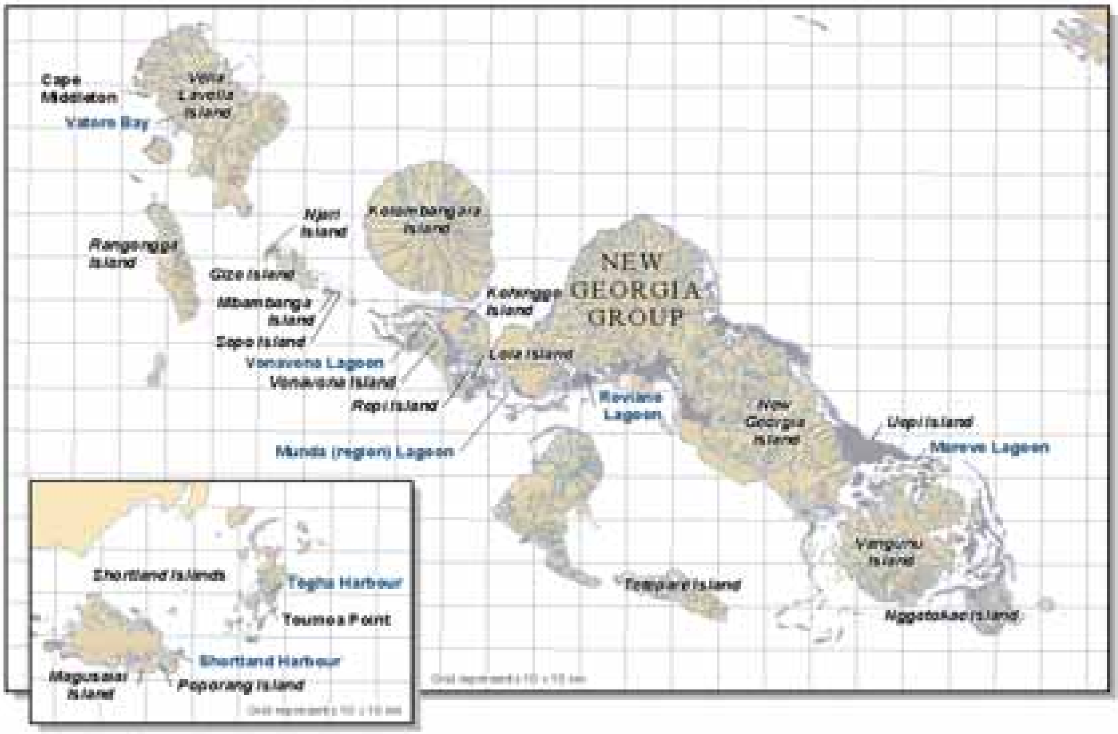


Figure 7. Western Province

Table 4. Meadow categories, total area (hectares) and numbers of intertidal/shallow subtidal meadows in Western Province, Solomon Islands – May/June 2004.

CATEGORY	Biomass (g DW m^{-2})	Cover (%)	Area in hectares (number of meadows) Isolated seagrass patches	Aggregated seagrass patches	Continuous seagrass cover	Total (ha)
C. rotundata		42 ±3		0.23 (1)	0.18 (1)	0.41
C. rotundata with *E. acoroides* & mixed species		81 ±7			51.57 (2)	51.57
C. rotundata with *E. acoroides/T. hemprichii*	6.919 ±6.91	63 ±3			156.46 (3)	156.46
C. rotundata with *mixed species*	3.013 ±0.33		0.42 (1)		27.78 (1)	28.2
C. rotundata with *T. hemprichii*		84 ±2			43.36 (3)	43.36
C. rotundata with *T. hemprichii* & mixed species	31.47 ±26.2	70 ±3	0.62 (1)	0.37 (1)	20.07 (2)	21.06
C. rotundata/E. acoroides/T. hemprichii with mixed species	9.374 ±9.37	58 ±5			88.18 (1)	88.18
C. rotundata/T. hemprichii with mixed species		80 ±9			2.67 (1)	2.67
C. serrulata with *E. acoroides* & mixed species		78 ±6		0.28 (1)	17.24 (2)	17.52
C. serrulata with mixed species	1.785 ±1.78				1.07 (1)	1.07
C. serrulata/S.isoetifolium with mixed species	128.5 ±4.63	95 ±2			7.04 (1)	7.04
Cymodocea spp with *E. acoroides* & mixed species		78 ±4	2.81 (1)		14.97 (2)	17.78
Cymodocea spp with *T. hemprichii*					14.59 (2)	14.59
E. acoroides	0.502 ±0.50	33 ±7	25.3 (26)	15.46 (14)	65.77 (13)	106.53
E. acoroides with *Cymodocea* spp & mixed species	16.74 ±16.7	62 ±8			14.92 (1)	14.92
E. acoroides with *H. ovalis*		43 ±11	0.56 (1)	3.95 (1)	0.18 (1)	4.69
E. acoroides with *T. hemprichii*		47 ±6	0.13 (1)	0.88 (1)	9.17 (3)	10.18
E. acoroides with *T. hemprichii* & mixed species		42 ±12			2.52 (2)	2.52
E. acoroides/Cymodocea spp with mixed species		46 ±8		0.29 (1)	1.71 (2)	2
E. acoroides/H. ovalis	15.06 ±15.0	12 ±6		2.98 (1)		2.98
E. acoroides/T. hemprichii		84 ±3			0.69 (1)	0.69
E. acoroides/T. hemprichii with mixed species	88.38 ±31.3	61 ±9			19.42 (3)	19.42
H. uninervis with *Cymodocea* spp/*T. hemprichii* & mixed species		38 ±1			8.04 (1)	8.04
H. uninervis with *E. acoroides* & mixed species	2.343 ±0.33			0.61 (1)		0.61
H. uninervis with *H. ovalis*		51 ±6			0.87 (2)	0.87
H. uninervis with *H. ovalis* & mixed species	0.357 ±0.35	23 ±2		3.79 (1)		3.79
H. uninervis with *T. hemprichii* & mixed species		41 ±11			1.29 (1)	1.29
H. uninervis/H. ovalis		34 ±4			15.48 (1)	15.48
H. uninervis/T. hemprichii/C. rotundata		50 ±1			0.19 (1)	0.19
H. ovalis	0.334 ±0.17	36 ±3	0.01 (1)	0.02 (1)	0.4 (2)	0.43
H. ovalis with mixed species	2.678 ±0.66	8 ±3	0.19 (1)	0.62 (1)		0.81
T. hemprichii	10.95 ±4.88	32 ±3	0.36 (3)	6.3 (4)	16.1 (4)	22.76

CATEGORY	Biomass (g DW m^{-2})	Cover (%)	Area in hectares (number of meadows) Isolated seagrass patches	Aggregated seagrass patches	Continuous seagrass cover	Total (ha)
T. hemprichii with *C. rotundata*	16.74 ±9.96				60.13 (2)	60.13
T. hemprichii with *C. rotundata* & mixed species	0.167 ±0.16	45 ±12			0.78 (1)	0.78
T. hemprichii with *E. acoroides*		63 ±14	1.47 (2)			1.47
T. hemprichii with *E. acoroides* & mixed species	25.17 ±21.2	75 ±22		3.62 (2)	15.02 (1)	18.64
T. hemprichii/E. acoroides		37 ±5		5.36 (1)		5.36
TOTAL			**31.87 (38)**	**44.76 (32)**	**677.86 (64)**	**754.49 (134)**

The Shortland Islands are a scattered group at the north-western tip of the Solomon Island chain and only 9km from Bougainville, Papua New Guinea. The north-western side of Shortland Island is dotted with reefs and islets. Seagrass meadows were found fringing the eastern shores of Togha Harbour and in front of Toumoa (Togha Point). *Cymodocea rotundata*, *Thalassia hemprichii* and *Cymodocea rotundata* dominated these meadows with aggregated *Enhalus acoroides* plants (generally amongst the reef). *Halophila ovalis* was also present but only bordering the main meadows. The remainder of fringing reefs in Togha Harbour were either devoid of seagrass or had a small scattering of *Halodule uninervis*. Larger meadows of *Enhalus acoroides* were located on patch reefs within Togha Harbour.

Surrounding the many scattered islands in the area, were smaller seagrass meadows. A narrow meadow of *Enhalus acoroides* and *Thalassia hemprichii* surrounded Rohae Island with scattered patches of *Halophila ovalis* extending down to 12m depth. Mainly intertidal and shallow sand flats, with the occassional scattering of *Halophila ovalis* and *Thalassia hemprichii*, surrounded other islands. Denser meadows were located along the sheltered shoes of the larger islands (e.g. Mania Is) and headlands. These meadows were mainly *Thalassia hemprichii* and *Cymodocea rotundata* with aggregated patches of *Enhalus acoroides* and a mixture *Halophila ovalis* and *Halodule uninervis*.

Significant seagrass meadows were located throughout Shortland Harbour, surrounding the main islands. These were predominately *Cymodocea rotundata/Thalassia hemprichii* in the northern parts, but the remainder were dominated by *Enhalus acoroides*. On the larger sandflats on the eastern sides of Poporang and Magusaiai Islands, *Thalassia hemprichii* was scattered across, with a narrow meadow of *Enhalus acoroides* bordering the mangrove shoreline.

The Treasury Islands include Mono and Stirling, and are the western most islands of the group. Only very small isolated patches of *Halophila ovalis* were found within Blanche Harbour, within a small cove west of Wilson Point on Stirling Island. Local villagers also reported small patches of *Halophila ovalis* along the eastern shores of Falamae, however these may be fairly isolated due to the compact nature of the sandy substrate and the exposure to oceanic waves. No larger meadows were encountered in the remainder of the harbour, a consequence of the relatively small area of fringing reef and the steeply sloping banks into deep (~30m) water.

The western region of the New Georgia Islands includes the Gizo, Kolombangara, Vella Lavella and Ranongga Islands. Most of these larger islands are volcanic (e.g., Kolombangara, Simbo, Vella Lavella), and there are also submarine volcanoes in the region.

In Vatoro Bay (Vella Lavella Island) seagrasses were restricted to the shoreline behind the larger reef flats (Cape Middleton) and in shallow sandy bays sheltered behind headlands. On the reef flats, seagrass were predominately scattered *Thalassia hemprichii* with a narrow *Cymodocea rotundata/Thalassia hemprichii* meadow along the shore. In the sheltered bays, sparse meadows of *Halodule uninervis* (narrow leaf) with *Halophila ovalis* were present on the sandy substrates.

Much of Gizo Island is protected by barrier reefs, sand and coral shoals. Smaller islands and cays with long sandy shores surround the main island. On the barrier reef islands, small patches of *Cymodocea rotundata* were present on the sheltered sides (e.g. Njari Island). Narrow (~15m) *Enhalus acoroides* dominated meadows border the northern shores of Gizo Island. Larger subtidal meadows dominated by *Cymodocea rotundata, Cymodocea serrulata, Thalassia hemprichii, Halodule uninervis* with some *Halophila ovalis* and *Enhalus acoroides* surround the islands of Mbambanga and Sepo. Two Seagrass-Watch monitoring sites were established on either side of Mbambanga Island in April 2004 and are monitored by WWFSPP-Gizo.

Two of the larger islands, which could not be examined due to time contratints, were Kolombangara and Ranongga. It is likely however, that the presence of seagrass would be limited as most of Kolombangara coastline is narrow coral-sand beaches/bays, and on the south east are several small protected coves. Kolombangara has also been heavily logged. The western coast of rugged narrow Ranongga Island falls abruptly into deep water, while the eastern coast is much lower, with terraces and onshore reefs.

In the Munda region of the Western New Georgia Islands is Vonavona Lagoon. The lagoon (>10m deep) is 28km long and located between Vonavona and Kohinggo Islands, and also protected by barrier reefs. Mangrove forests (predominately *Rhizophora*) fringe many parts of the lagoon. Within the lagoon are many islets, ringed by coral-encrusted shallows interspersed with deeper seas. Most of the inner chain of islets are surrounded by white coral-debris beaches, connected by sandbars at low tide. Seagrass meadows in the lagoon are predominantly subtidal with a narrow intertidal fringe, often adjacent to mangroves. Species include *Thalassia hemprichii, Cymodocea rotundata, Cymodocea serrulata, Halodule uninervis, Enhalus acoroides* and *Halophila ovalis*. Approximately 250 ha of seagrass was mapped across the intertidal and shallow-subtidal banks between the islands of Lola and Repi in southern Vonovona Lagoon. These large continuous meadows of relatively low cover and biomass were dominated by *Cymodocea rotundata* with *Thalassia hemprichii* and isolated patches of *Enhalus acoroides.* Dugongs are known to frequent these meadows, particularly between Repi and Lola Islands. The remaining meadows appear important for turtle feeding and subsistence fisheries. Vonavona is also an area with important hawksbill and green turtle nesting areas.

Mercier *et al.* (2000) and Dance *et al.* (2003) in a study of *Holothuria scabra* recruitment, reported significant seagrasses in Kogu Veke, Vonavona Lagoon, along the western coast of Kohinggo Island between 1997 and 1998. The bay of Kogu Veke covers an area of ca. 12 000 m^2 in a semi-enclosed lagoon with no freshwater input except for rain. The area was characterised by *Enhalus acoroides* and *Thalassia hemprichii* meadows on sandy and/or muddy sediment, and by coarse coral and shell substrata. An extensive mangrove swamp inundated at high tide for a distance of ca. 70 m bordered the northern limit of the area uniformly. The subtidal area along the southern limit was characterized by the presence of numerous coral patch reefs. Most of the area was exposed at low tide (excluding the mangrove area), while the deepest areas had a maximum depth of ca. 3 m. The bay was protected from storms by its geographical location and limited fetch.

Roviana Lagoon in the north-west New Georgia Group east of Munda, is protected from oceanic swells by barrier reefs and offshore islands 20-40m high. Within the lagoon are many small islets formed from coral shoals. The lagoon contains predominately subtidal seagrass meadows with a narrow intertidal fringe. Species include *Thalassia hemprichii, Cymodocea rotundata, Cymodocea serrulata, Halodule uninervis, Enhalus acoroides* and *Halophila ovalis*. The lagoon is a significant dugong and turtle feeding area and is also important to subsistence fishery. Significant hawksbill and green turtle nesting areas are also present. Tabu shells are also known to be collected from the seagrass meadows of Roviana Lagoon and North New Georgia, and are of cultural significance as they are traded to New Britain (Papua New Guinea) where stocks have been depleted.

Marovo Lagoon, on New Georgia Island's eastern seaboard is the world's largest island-enclosed lagoon. This shallow lagoon is protected along much of it's north-eastern side by narrow raised barrier islands, 5-60m high. It was unsuccessfully nominated for World Heritage Area status. Mangroves are found in estuaries shoreward of many fringing reefs and on many of the lagoon's islets. The landmass the lagoon partially surrounds is Vangunu Island. Seagrass meadows in the lagoon are predominately shallow subtidal with a narrow intertidal fringe. Species include *Thalassia hemprichii, Cymodocea rotundata, Halodule uninervis, Enhalus acoroides* and *Halophila ovalis*. The lagoon is a significant dugong and turtle feeding area with important hawksbill and green turtle nesting areas. The meadows are also important to subsistence fisheries.

Halophila ovalis and *Halodule uninervis* dominated meadows were located on the gently sloping bays on the western sides of the barrier reef islands (e.g., Uepi Island) in the northern section of the lagoon. The central lagoon islands had predominately rocky shorelines with relatively narrow fringing reefs and no seagrass. On the eastern sides of the larger islands (New Georgia and Vanguru), seagrass was generally isolated plants or patches of *Enhalus acoroides* along the mangrove shoreline. Aggregated patches of *Enhalus acoroides* were common on the nearshore islands with larger fringing reef flats bordered by *R. stylosa*. *Halophila ovalis* was found on the sheltered sides of some smaller inshore islands with sandy shorelines.

In southern Marovo Lagoon, there appears a habitat gradient with freshwater influenced reefs adjacent to Vangunu Island in the west, across patch reefs, shallow lagoon areas, to barrier islands in the east with pinnacle reefs and double barrier reef south of Uepi Island to Nggatokae Island. These barrier reefs, with narrow deep channels exiting the main lagoon, are one of the world's best examples of double barrier reefs. Narrow aggregated *Thalassia hemprichii/Enhalus acoroides* meadows were present along the outer reefs (e.g., Mbili) and *Halodule uninervis* (with *Halophila ovalis* & mixed species) or *Enhalus acoroides* lined many of the leeward shorelines of the inner barrier reefs. Isolated patches of *Enhalus acoroides* were often present on the protected sides of larger mid-lagoon islands adjacent to sandy beaches. The most significant meadow was a narrow meadow along the eastern shoreline of Tengomo Island, with dense *Cymodocea serrulata* inshore and spare *Halodule uninervis* and *Halophila ovalis* seaward. A large meadow dominated by *Cymodocea rotundata* with mixed species was also located on the large shallow intertidal banks adjacent to the northern coastline Gatokae.

Most of the larger bays and inlets of Marovo Lagoon had significantly higher turbidity that the outer barrier islands. This is possibly a consequence of the larger size and shallow depth of the lagoon, with a naturally high sediment load from adjacent major rivers and catchments. The level of turbidity however has been exacerbated by the presence of logging operations around much of the lagoon. Assessments of inshore areas adjacent to logging camps in some localities (e.g., Merusu) found seagrass absent and higher than considered natural levels of turbidity. In some instances, the point source of large plumes of very turbid red/brown water was logging camps.

South of New Georgia is Tetepare Island, the largest uninhabited tropical island in the world. The island covers and areas of 120 km^2 and is surrounded by fringing reefs with large seagrass meadows which support abundant dugong, fish and invertebrates. Unfortunately, Tetepare Island could not be surveyed due to weather and time constraints. Visits to the islands are planned by WWFSPP and TNC in the near future and this may be an opportunity to surveys seagrasses in the area.

CENTRAL PROVINCE

The province comprises the Melanesian islands of the Nggela (or Florida) Group, Savo and the Russell's (Figure 8). 651.5 hectares of seagrass were mapped in 56 meadows in the Central

Province. These meadows were mostly continuous in character (98% of seagrass area) and communities were dominated either by *E. acoroides* or *C. rotundata* (56% and 39% of seagrass meadow area respectively) (Table 7).

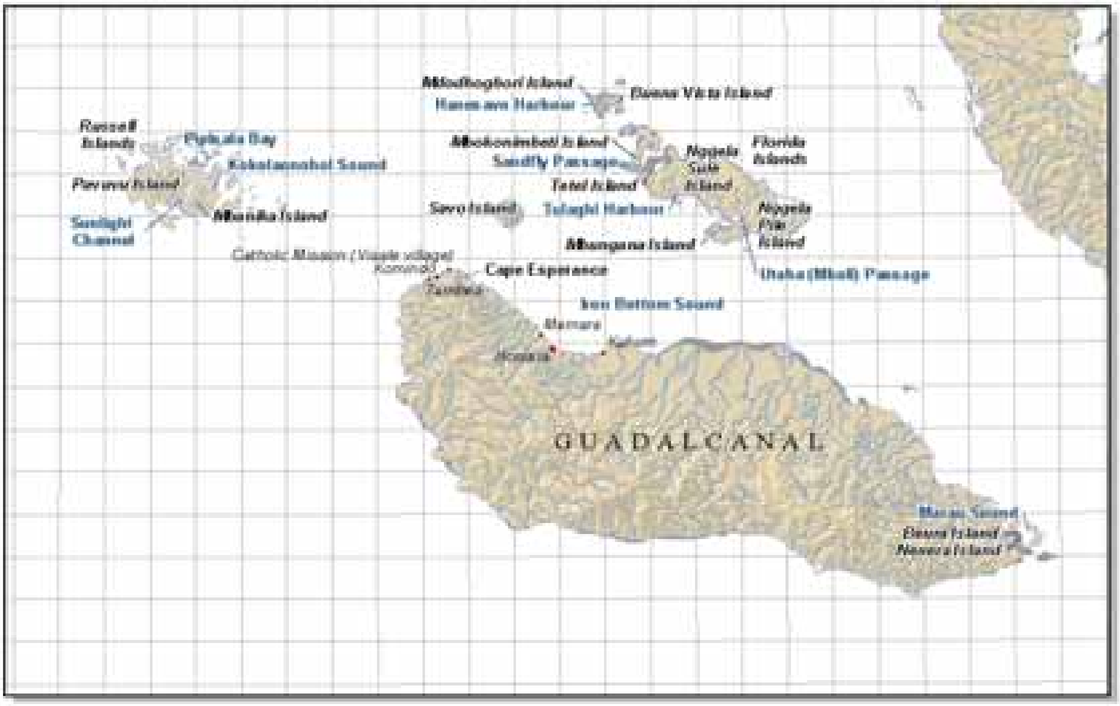


Figure 8. Central Province and Guadalcanal Province

In calm localities with a relatively wide lagoon (100-300m), such as Tetel Island (Florida Islands), the sand-mud flats are generally dominated by *T. hemprichii* shoreward and *E. acoroides* seaward and often bordered by mangroves (*Avicennia, Rhizophora* and *Bruguiera*) when near rivers or streams (Womersley & Bailey (1969).

Table 5. Meadow categories, total area (hectares) and numbers of intertidal/shallow subtidal meadows in Central Province, Solomon Islands – June 2004.

CATEGORY	Biomass (g DW m^{-2})	Cover (%)	Area in hectares (number of meadows) Isolated seagrass patches	Aggregated seagrass patches	Continuous seagrass cover	Total (ha)
C. rotundata with *E. acoroides*		60 ±20			0.52 (1)	0.52
C. rotundata with *T. hemprichii* & mixed species	87.04 ±12.0	63 ±7	1.11 (1)		1.11 (1)	2.22
C. rotundata/H. uninervis with mixed species	32.81 ±1.77			0.16 (1)		0.16
C. rotundata/T. hemprichii	60.59 ±7.70	26 ±14		0.24 (1)	243.06 (3)	243.3
C. rotundata/T. hemprichii with mixed species	65.95 ±52.5				10.6 (1)	10.6
Cymodocea spp with *E. acoroides* & mixed species		76 ±5			6.3 (2)	6.3
E. acoroides	0.479 ±0.47	24 ±5	2.09 (5)	2.4 (3)	16.37 (4)	20.86
E. acoroides with *Cymodocea* spp & mixed species	24.32 ±24.3	47 ±1			1.88 (1)	1.88
E. acoroides with *H. ovalis*	0.435 ±0.43	19 ±2		1.59 (1)	3.89 (1)	5.48
E. acoroides with *T. hemprichii*	0.770 ±0.77	37 ±6		0.62 (1)	80.51 (3)	81.13
E. acoroides with *T. hemprichii/Cymodocea* spp & mixed species	15.49 ±14.8	57 ±7			107.77 (2)	107.77
E. acoroides with *T. hemprichii/H. ovalis*		24 ±3			136.6 (1)	136.6
E. acoroides/Cymodocea spp with mixed species		51 ±15			0.56 (1)	0.56
E. acoroides/T. hemprichii		42 ±15			0.31 (1)	0.31
E. acoroides/T. hemprichii with mixed species	3.270 ±3.52	63 ±5		0.11 (1)	10.07 (1)	10.18
H. uninervis with *T. hemprichii* & mixed species	30.13 ±15.3				0.31 (1)	0.31
H. minor		32 ±2			0.48 (2)	0.48
H. ovalis	1.774 ±0.72			0.33 (1)	0.58 (1)	0.91
H. ovalis with *E. acoroides*		45 ±4	0.09 (1)			0.09
S.isoetifolium with mixed species	111.8 ±5.95				0.3 (1)	0.3
T. hemprichii	18.74 ±2.91	90 ±3		0.65 (2)		0.65
T. hemprichii with *C. rotundata*	35.50 ±25.7	71 ±5	0.72 (2)	0.15 (1)	2.12 (1)	2.99

CATEGORY	Biomass (g DW m^{-2})	Cover (%)	Area in hectares (number of meadows)			Total (ha)
			Isolated seagrass patches	Aggregated seagrass patches	Continuous seagrass cover	
T. hemprichii with *C. rotundata* & mixed species	56.19 ±30.7	36 ±1			8.94 (2)	8.94
T. hemprichii with *H. ovalis*	2.845 ±2.14		0.82 (1)	1.49 (1)		2.31
T. hemprichii/C. rotundata with mixed species	112.4 ±1.15				6.56 (1)	6.56
T. hemprichii/E. acoroides		33 ±12	0.09 (1)			0.09
Total			**4.92 (11)**	**7.74 (13)**	**638.84 (32)**	**651.5 (56)**

The Russell Islands consist of two adjacent larger islands, Mbanika and Pavuvu, plus many smaller islets. Huge coconut plantations cover the islands. Pavuvu Island is the largest island in the Russell's group with extensive reefs to the north and many small, sandy islands within them. *Cymodocea rotundata/Thalassia hemprichii* meadows with some *Halopihla ovalis* dominate the barrier reefs and the extensive fringing reef flats to the north of the region, which are popular Green turtle foraging areas (Job Upo, Karol Kisokau pers comm).

Extensive continuous *Enhalus acoroides* with *Thalassia hemprichii/Cymodocea* spp & mixed species meadows are found bordering the edges of Pipisala Bay, which is surrounded by coconut plantations. These meadows are abundant (58% mean cover) and extend to approximately 3m in the clear water on coarse sand substrates. Large and abundant holothurians of commercial and artisinal importance are also abundant in the deeper waters of the bay. Similarly, these meadows are found in the shallow bays at the northern end of Sera Me Ohol (Sunlight) Channel. Mark Savi (pers comm.) reported a large patch of seagrass in Yadina Bay. Narrow meadows of aggregated *Enhalus acoroides* plants, border Sera Me Ohol (Sunlight) Channel, Kokolaonohol Sound, and small inlets, along the edges of the *Rhizophora stylosa* fringe. These meadows are also adjacent to coconut plantations and villages, receiving high nutrients from point sources such as drains and pig sties.

Two large islands, Nggela Sule and Nggela Pile, separated by narrow Utaha Passage, dominate the Florida Islands. The Florida Islands has a rich coastline consisting of coastal islands replete with exposed and sheltered seagrass communities. On the mainland coast are a series of embayment inhabited by coastal peoples and inlets feeding into the inner reaches of Florida Island (Negella Sule). In the region from Mbungana Islands to Tulaghi Harbour exists a large system of inlets with their waterways reaching into coastal riverine systems. It is likely that this high-energy coastline, subject to strong onshore winds and currents has resulted in dominance by sand shell sediments with a negligible mud component throughout tens of kilometers of seagrass habitat.

These habitats are fringed by mangroves and contain dense stands of *Enhalus acoroides* with *Thalassia hemprichii* and *Halophila ovalis*. Also found in this sheltered habitat were small patches of *Halophila minor* in sand dominated sediments. Inside the inlet interspersed along then mangrove fringed coastline, are areas of sand deposition and beach formation. Low to moderate stands of *Enhalus acoroides* and *Thalassia hemprichii* were found in these sheltered "harbours". On the open coast areas of beach were found in association with lagoons containing a high diversity of seagrass species including *Cymodocea serrulata, Cymodocea rotundata*, *Enhalus acoroides*, *Halophila ovalis*. These lagoonal areas with moderate exposure to the open coast were diverse in their assemblage of seagrass yet only represent about 10% of the area relative to all meadow types in the region. These areas form a protective barrier and harbour to coastal communities.

Sandfly Passage, between Nggela Sule and Mbokonimbeti Island, has deep waters (70-120m), which rise rapidly to narrow (50-100m) shallow fringing reef flats adjacent to mangroves lined shores. Inshore is a 10m wide band of *Enhalus acoroides* mixed with *Thalassia hemprichii* and *Halophila ovalis*. On wider reef flats (100-400m), seagrass communities are dominated by *Syringodium isoetifolium* and *Thalassia hemprichii*, mixed with *Halodule uninervis*, *Cymodocea rotundata*, *Halophila ovalis* and patches of *Enhalus acoroides*. In these meadows, the sea urchin *Tripneutus* and juveniles of the emperor (*Lutjanus harak*) were abundant.

In the far north of the Florida Islands are the Bueno Vista islands. Patches of *Enhalus acoroides* are scattered along the shores between the shoreline and the reef. In the north facing bays (e.g., Sambani Island & Tadhi village seafront), meadows of aggregated *Thalassia hemprichii/Halophila ovalis* or *Enhalus acoroides*/*Thalassia hemprichii* patches are abundant, inside the reef with isolated *Enhalus acoroides* patches in close to beach. In more protected bays (Mbodhoghori Island and Hanesavo Harbour), the seagrass communities are dominated by *Cymodocea rotundata* and *Thalassia hemprichii*, with patches of *Halophila ovalis* and *Enhalus acoroides*. In these areas, the meadow is a relatively narrow band (50-100m wide), before mixing into the reef (e.g., *Porites*) proper. In the shallows, the sea cucumbers *Holothuria atra* and *H scarbra* were fairly common.

Savo is a cone shaped island on Iron Bottom Sound, off northern Guadalcanal Island. A dormant volcano dominates the island, and although it has a significant population (14 villages), its 31 km^2 shores have limited fringing reefs and a reputation to be shark-infested. A small patchy meadow of *Halophila minor* (unconfirmed identification) was observed at 25m during a dive off the island. It is likely that these deeper water meadows may be more extensive across the Sound and off the northern shore of Guadalcanal.

GUADALCANAL PROVINCE

Totally 5,302 km^2, Guadalcanal is the largest island in the Solomon's group (Figure 8). The northern coastal plain contrasts with the weathered southern coast. The southern coast is exposed to the south-easterly trade winds and heavy rainfall, associated with strong currents and large oceanic swells. The likelihood of seagrass persisting in such environments is very low.

Only 101.25 hectares of seagrass was mapped in 31 meadows in the province between 5 - 16 June 2004. 76 percent of seagrass meadows in the province were of continuous cover (Table 8) and restricted to the calmer bays and fringing reefs along the north western shores and the extensive reef complexes at the islands most easterly extent. In these locations the seagrass meadows were generally continuous in structure and predominately (57% of total seagrass area) *T. hemprichii* dominated communities.

Table 8. Meadow categories, total area (hectares) and numbers of intertidal/shallow subtidal meadows in Guadalcanal Province, Solomon Islands – June 2004.

CATEGORY	Cover (%)	Area in hectares (number of meadows)			Total (ha)
		Isolated seagrass patches	Aggregated seagrass patches	Continuous seagrass cover	
C. rotundata with *T. hemprichii*	67 ±13			0.67 (1)	0.67
C. rotundata with *T. hemprichii* & mixed species	59 ±7			9.8 (2)	9.8
C. rotundata/T. hemprichii	42 ±17		14.61 (1)		14.61
C. rotundata/T. hemprichii with mixed species	54 ±13			11.03 (3)	11.03
E. acoroides	15 ±4	0.06 (1)	0.81 (2)	3.21 (6)	4.08
E. acoroides with *T. hemprichii*	50 ±8			25.34 (3)	25.34
E. acoroides with *T. hemprichii/H. ovalis*	33 ±3			0.35 (1)	0.35
E. acoroides/T. hemprichii	52 ±6			3.18 (2)	3.18
H. uninervis with *Cymodocea* spp/*T. hemprichii* & mixed species	65 ±4		0.1 (1)		0.1
H. uninervis with *T. hemprichii* & mixed species	67 ±10			1.18 (1)	1.18
H. decipiens	6 ±2			1.12 (1)	1.12
H. minor with *H. uninervis*	24 ±3			5.12 (2)	5.12
H. ovalis with *E. acoroides*	28 ±3		3 (1)		3
H. ovalis with mixed species	61 ±7		0.49 (1)		0.49
T. hemprichii	16 ±3	0.18 (2)	4.4 (2)		4.58
T. hemprichii with *E. acoroides*	17 ±1		0.11 (1)	10.56 (1)	10.67
T. hemprichii with *E. acoroides* & mixed species	60 ±3			1.97 (1)	1.97

CATEGORY	Cover (%)	Area in hectares (number of meadows)			Total (ha)
		Isolated seagrass patches	Aggregated seagrass patches	Continuous seagrass cover	
T. hemprichii/C. rotundata with mixed species	63 ±15			3.96 (1)	3.96
Total		**0.24 (3)**	**23.52 (6)**	**77.49 (22)**	**101.25 (31)**

On the north west of Guadacanal, near Cape Esperance, the coast is semi-exposed and beaches form a uniform stretch of sloping black sand. Close to shore seagrass were mostly absent as these areas are characterized by high-energy wave-dominated forces that may inhabit colonization by seagrass seedlings or vegetative shoots. A moderate to dense stand of *Halodule uninervis* and *Halophila ovalis* followed the coastline inside the reef crest in shallow subtidal waters (1 to 5m deep). Here the reef crest is permanently subtidal and the coral reef slopes to >50m. These meadows provide dugong foraging habitat, which are known to inhabit the area. *Halophila decipiens* was found at 37 m and was observed in the 36-40m zone, an area with a flat shell sand substrate and low light penetration. Survival in very deep waters suggests that sufficient light is available for seagrass growth. The absence of seagrass in areas shallower than 40m and deeper than 5m is likely due to the lack of available sand substrate, and dominance of hard coral substrate unsuitable for seagrass growth.

In moderate wave action localities, such as Mamara and Kukum (west and east of Honiara respectively) on north-west Guadalcanal, the reef is narrow. Seagrasses have been reported from the Catholic Mission (Visale Village), west of Cape Esperance. In calm localities with a relatively wide lagoon (100-30m), such as Komimbo (north-west Guadalcanal) the sand-mud flats are generally dominated by *Thalassia hemprichii* shoreward and *Enhalus acoroides* seaward and often bordered by mangoves (*Avicennia, Rhizophora* and *Bruguiera*) when near rivers or streams (Womersley & Bailey 1969).

Marau Sound on the eastern tip of Guadalcanal has the island's largest expanse of fringing reef. Here fringing reefs were dominated by *Enhalus acoroides*/*Cymodocea rotundata* close to shore (0-10m from beach), *Thalassia hemprichii*/*Cymodocea rotundata* (20-50m from beach) and *Thalassia hemprichii*/*Halophila ovalis* (50+m from shore). Most meadows however, were only 30m wide fringing mangrove habitats and islands (e.g., Marapa Island). No seagrass was present in the channels between mainland and large islands, yet mangroves dominated the shoreline. Some fringing reef meadows extended 50-100m from smaller islands in the Marau Sound (e.g., Beura, Henera Islands). Sheltered bays on the southern mainland area of Marau Sound were dominated by *Enhalus acoroides*, *Thalassia hemprichii* and *Cymodocea rotundata*. Substrate consists of mainly sand, shell and coral reef with algal dominants including *Halimedia, Caulerpa, Dityota* and turf algae. No seagrass was found below 2-3 m.

MAKIRA PROVINCE

Makira (San Cristobal) Island is the largest landmass of the province (Figure 9). It is a mountainous island, with steep cliffs along its southern coast. The north-western coast of Marika Island is rugged. Elsewhere, the island has long black-sand beaches in its many bays, interspersed with mangrove forests.

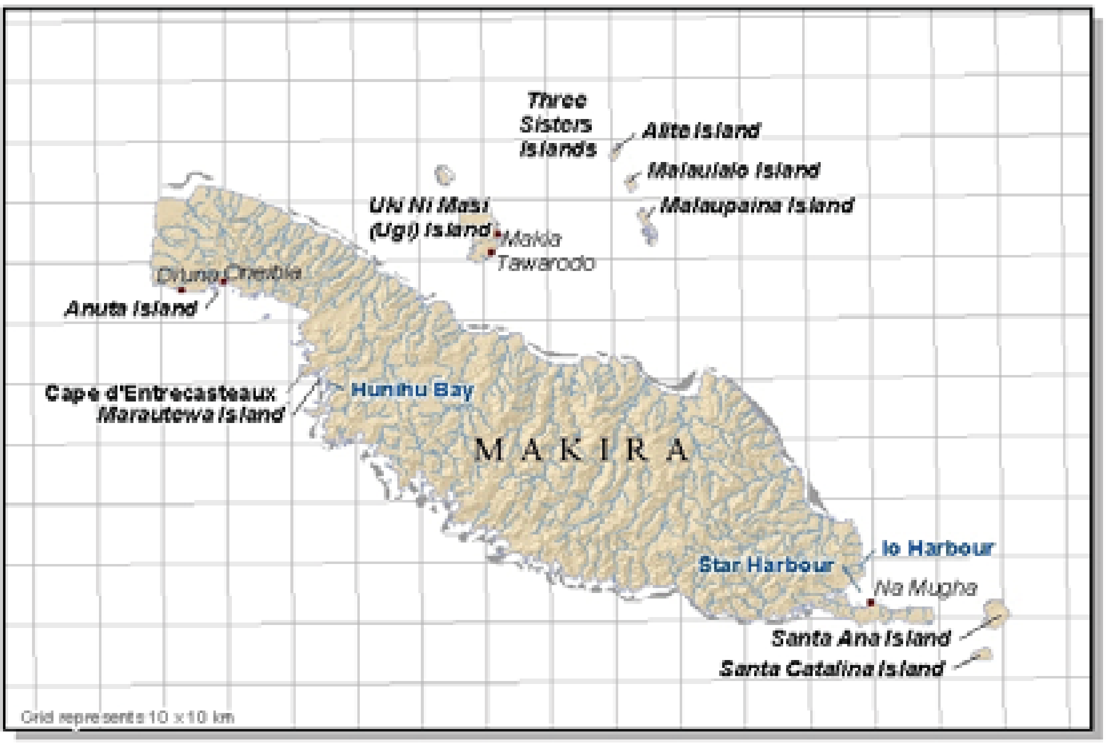


Figure 9. Makira Province

Off the southern eastern tip of Makira Island are the raised coral atolls of Santa Ana and Santa Catalina Islands. Santa Ana has beaches on its western side which support nesting sites for South West pacific Hawksbill turtle populations (Ian Bell QPWS pers comm.), however seas are too rough for this to occur on the island's eastern shore. These islands were not examined during this survey as information available indicated that the possibility of seagrass presence would be low.

229.05 hectares of seagrass was mapped in 52 meadows in the province between 6 - 9 June 2004. In general, Makira Province has large fringing reefs on the leeward or protected sides of land masses/islands, where continuous seagrass meadows of predominantly (58% of seagrass area) *Thalassia hemprichii* or *Cymodocea rotundata* (10% of seagrass area) communities dominated (Table 9). On the more exposed coastlines, seagrasses were generally absent, unless a significant reef crest was present.

On the north-western coast of Makira, along the exposed coast between Di'una and Oneibia, seagrass meadows in the lagoon (fringing reef) were dominated by *Enhalus acoroides, Cymodocea rotundata, Halodule uninervis* and *Cymodocea serrulata*, *Halophila ovalis* close to shore. Mid and edge of the lagoon was dominated by *Thalassia hemprichii* and *Halophila ovalis* with some *Cymodocea rotundata*. Sediment was white coarse sand and shell with reef.

Inside the bay, towards Oneibia, seagrass meadows were dominated by *Enhalus acoroides* and *Thalassia hemprichii* (shallow) and *Halophila ovalis* (2-3 m deep). As the coast extends towards Oneibia, the sediments were darker in color and of terrestrial origin with high mud and dark components. *Enhalus acoroides* dominated the sheltered regions of Anuta Island with some *Thalassia hemprichii* and *Halophila ovalis*. Dense stands of *Syringodium isoetifolium*, *Cymodocea rotundata* and *Halodule uninervis* dominated inside the reef crest on the western shores of Anuta Island. Meadows extended only 30-40 m from shore. *Halophila ovalis* was found at 26 and 37m on western shore of Anuta island. *Halimedia* and turf algae were abundant.

At Cape d'Entrecasteaux, small (30-50 m wide) reefs on the eastern side had some seagrasses, including *E. acoroides, C. rotundata, T. hemprichii, S. isoetifolium* and *H. ovalis*. Seagrass distribution was patchy and also found on the dark sediments of Marautewa Island (*E. acoroides* and *H. ovalis*). *E. acoroides* was found inside the mangrove lined inlets, particularly near the mouths, but generally did not penetrate far into the inlets. Instead, coral and algae were found dominating deep into the interior, with little or no freshwater influence. Despite the presence of extensive mangroves, seagrass habitat was restricted, possibly a consequence of high currents and steep sandy slopes with dark colored waters. In smaller bays (e.g., Hunihu) seagrass (*H. ovalis*, *H. uninervis*) was found on dark sediments with lots of algae (e.g., turf, *Halimeda*). The area however, was not extensively surveyed due to time and local community constraints.

Table 6. Meadow categories, total area (hectares) and numbers of intertidal/shallow subtidal meadows in Makira Province, Solomon Islands – June 2004.

CATEGORY	Cover (%)	Area in hectares (number of meadows)			Total (ha)
		Isolated seagrass patches	Aggregated seagrass patches	Continuous seagrass cover	
C. rotundata	68 ±9		0.6 (1)		0.6
C. rotundata with mixed species	52 ±9			2.78 (3)	2.78
C. rotundata with *T. hemprichii*	70 ±8			2.05 (2)	2.05
C. rotundata with *T. hemprichii* & mixed species	54 ±10			14.09 (4)	14.09
C. rotundata/H. uninervis with mixed species	27 ±0			0.13 (1)	0.13
C. rotundata/T. hemprichii with mixed species	43 ±10			3.38 (2)	3.38
E. acoroides	24 ±0			3.93 (3)	3.93
E. acoroides with *Cymodocea* spp & mixed species	42 ±15			3.15 (1)	3.15
E. acoroides with *H. ovalis*	31 ±8			1.61 (2)	1.61
E. acoroides with *T. hemprichii* & mixed species	72 ±3			0.49 (1)	0.49
E. acoroides with *T. hemprichii/Cymodocea* spp & mixed species	72 ±6			13.38 (1)	13.38
H. uninervis with *E. acoroides* & mixed species	14 ±1		0.36 (1)		0.36
H. uninervis with *H. ovalis* & mixed species	27 ±11		1.75 (1)		1.75
H. uninervis with *T. hemprichii* & mixed species	50 ±14			1.24 (2)	1.24
H. uninervis/H. ovalis	55 ±0			0.34 (1)	0.34
H. ovalis				1.89 (2)	1.89
S.isoetifolium with mixed species	74 ±14			8.39 (2)	8.39
T. hemprichii	36 ±5		5.25 (3)	32.14 (5)	37.39
T. hemprichii with *C. rotundata*	38 ±2	0.38 (1)	0.17 (1)		0.55
T. hemprichii with *C. rotundata* & mixed species	47 ±6			107.577 (4)	107.577
T. hemprichii with *E. acoroides*	77 ±6		0.66 (1)		0.66
T. hemprichii with *E. acoroides* & mixed species	59 ±14		0.01 (1)	8.22 (1)	8.23
T. hemprichii with *H. uninervis* & mixed species	58 ±14			0.96 (1)	0.96
T. hemprichii/C. rotundata with mixed species	55 ±7			6.21 (2)	6.21
T. hemprichii/E. acoroides with C. rotundata	71 ±0			6.79 (1)	6.79
T. hemprichii/H. ovalis	17 ±1			1.12 (1)	1.12
Total		**0.38 (1)**	**8.8 (9)**	**219.87 (42)**	**229.05 (52)**

At the east end of Makira Island is Star Harbour, the most secure anchorage in the region, which around Na Mugha has extensive fringing coral reefs. On the northern part of coast towards Io Harbour, the large fringing reefs were covered with *E. acoroides/C. rotundata* meadows immediately inshore, which changed to *C. rotundata/T. hemprichii/H. ovalis* mid-reef and *T. hemprichii/H. ovalis* on the seaward edge inside the reef crest. Meadows in shallow nearshore areas extended from the open coast into the mouth of Star Harbour. Meadows were 70-150m wide on the open coast but only 20-40m wide on north-western shores of Star harbour.

Further west into Star Harbour, away from the open coast, mangroves and beaches fringe the western mainland shore, however seagrass meadows were absent. Sediments were finer and of terrestrial origin (dark in color, high organic content) closer to shore, especially near villages, which may explain the paucity of seagrass. Corals and macro-algae (e.g., *Halimedia, Dictyota,*) were abundant.

Nevertheless, in the lower southern reaches of Star harbour, large expansive intertidal meadows of *E. acoroides/T. hemprichii* and *C. rotundata* dominated around reefs/islands and mangroves. Much (about 60—70%) of this U-shaped reef, opposite Na Mugha, was covered by seagrass, restricted to coarse sand and shell sediments and fringed by rocky/reef. The meadows were up to 500m long and 50-200m wide and restricted to shallow waters.

Along the sheltered mainland coast west of Na Mugha, seagrass was absent on the dark brown sediments, especially near to beaches and villages. However intertidal meadows dominated by *E. acoroides/T. hemprichii/C. rotundata* were found closer to Na Mugha adjacent to mangroves (*R. stylosa* and *Brugiera*) on the small fringing reefs. No seagrass was found inside the inlet near Na Mugha, as water clarity was low due to high suspended matter and tannin content. Mudflats exist deep inside the inlet and mangroves line the inlet in a continuous cover. East of Na Mugha point, a large expanse of intertidal reef is present and dominated in part by *Thalassia hemprichii* with *Enhalus acoroides* & mixed species (41-90% cover).

Small islands within greater Star Harbour had some patchy *T. hemprichii* and isolated *Rhizophora* trees. These areas were more exposed to wave action and surrounded by coral reef and rocky outcrops. The coral reef was in poor to good condition and at one site *Lyngbya* was found smothering corals. The dark color of the inshore sediments and high abundance of mangroves suggests high nutrient availability which may promote *Lyngbya* and other macro-algal growth (80-90% cover).

Off the northern coast of Makira, are located a couple of islands groups; the Three Sister and Ugi Islands. Seagrass meadows exist on the leeward side of each Three Sister island, as the eastern shores were too rocky and exposed to waves. On Alite Island (the northern most), very patchy *T. hemprichii* was found on the western shore. On Malaulalo Island a more extensive meadow consisting of *T. hemprichii*, *C. rotundata* and *H. ovalis* was found extending the western shore inside the reef crest. This meadow was on coarse sand/shell and macro-alage (incl. *Halimeda*, turf, *Lyngbya*) was abundant. The north and southern most points had no seagrass. On Malaupaina Island (the southern most island), no seagrass was found on the exposed northern tip but *T. hemprichii*, *H. ovalis* and *C. rotundata* meadows dominated the bays along the western leeward shores. Inside the lagoon fringed by mangroves, seagrass meadows (20-30m wide) fringed the lagoon and were dominated by *E. acoroides, H. uninervis*, *C. rotundata* and *H. ovalis*. The sediments were coarse sand and meadows ranged from isolated patches to continuous stands and were associated with coral reef patches and macro-algae (e.g., *Halimeda*, turf). No seagrass was found south of the lagoon and no seagrass is likely to be found on the exposed eastern shores of the island.

The Uki Ni Masi Islands are two islands located west of the Three Sister Islands. Seagrass meadows were only present on the western leeward, protected, shores of Pio Island (the northern island). At the northern, southern and eastern shores of the island, the reefs are exposed to prevailing north and south easterly swells and dominated by surf beaches and rocky intertidal regions devoid of seagrass. Small, patchy, *T. hemprichii* meadows were found on the northwestern reef flats. Moving south, meadows approximately 20-40 m wide consisted of *C. rotundata* close to shore and mixed stands of *C. rotundata*, *T. hemprichii* and *H. ovalis* further offshore. These fringing reef meadows were constrained by a reef crest relatively close to shore (<200m).

The larger island of the two, Uki Ni Masi island, has extensive seagrass meadows along its western border and south-eastern coast. Typically these meadows are dominated by *C. rotundata*, *T. hemprichii*, and *H. ovalis* along the fringing reef coast. On the south-western coast, characterised by a large embayment, meadows are patchy and very narrow (10-20 m). *H. uninervis* was present within *T. hemprichii*/*C. rotundata* meadows, which were interspersed with coral reef that reaches the shore and precludes seagrass growth. Further south inside the fringing reef, seagrass meadows persisted in narrow bands around the southern sections of the main island. On the south-eastern coast the reef crest lies approximately 400m off the coast and an extensive fringing reef/lagoon area exited shoreward of this reef. Extending from the south for approximately 1-2km past the village of Makia, and north up to the village of Tawarodo, exited a large (50-60m wide) meadow of *C. rotundata*, *T. hemprichii* and *H. ovalis*. This coast is exposed to strong prevailing winds and wave action, yet the reef crest approximately 400m from shore protects the seagrass meadows. At Tawarodo village, *S. isoetifolium* was found within a boat access channel (approx 200m long, <1m deep), which had been created by destroying 1-2 m of coral reef. Further along the north-eastern coast of Uki Ni Masi Island, the coast is dominated by rocky platforms close to shore and open sandy beaches. Wave action is close to shore and not inhibited by a reef crest making this coast unsuitable for seagrass growth.

Discussion

Seagrass

This survey was the first detailed assessment of the seagrasses in the Solomon Islands. Most Solomon Islands seagrasses are found in water less than 10m deep and meadows may be monospecific or consist of multispecies communities, with up to 6 species present at a single location. The number of seagrass species identified is within the range expected.

Seagrass distribution appears to be primarily influenced by the degree of wave action (exposure) and nutrient availability. Where wave action is slight to moderate the widest fringing reefs occur, commonly with either sand-debris beach at their rear or sand-mud areas of mangroves when near rivers. Under conditions of heavy wave action the reef is usually narrower (10-20m), and there is little or no sediment depth in the lagoon. Seagrasses frequently grow on protected intertidal reef platforms and coastal/estuarine mud flats influenced by pulses of sediment laden, nutrient rich freshwater, resulting from high volume seasonal summer rainfall. On reef platforms and in lagoons the presence of water pooling at low tide prevents drying out and enables seagrass to survive tropical summer temperatures. Often, the sediments are unstable and their depth on the reef platforms can be very shallow, restricting growth and distribution. Seagrass habitats in the Solomon Islands are disturbed by factors that vary between regions and between seasons. A complex set of interactions may impact a single region including the type of habitat, the time of year and the species growing there. There is however, little known about long-term natural cycles in the abundance and distribution of seagrasses in the Solomon Islands.

An extensive and diverse assemblage of seagrass habitats exists along the coastlines of the Solomon Islands and associated reefs. These can be generally categorised into four main habitats (Table 10), similar to those in tropical northern Australia (see Carruthers *et al.* 2001). In their natural state, these habitats are characterised by very low nutrient concentrations, are primarily nitrogen limited and are influenced by seasonal and episodic coastal runoff. Among these four seagrass habitat types in the Solomon Islands, both estuarine (incl. large shallow lagoons) and coastal seagrass habitats are of primary concern with respect to water quality due to their location immediately adjacent to catchment inputs.

In general seagrass growth is limited by light, disturbance and nutrient supply, and changes to any or all of these limiting factors may cause seagrass decline. All seagrass habitats in the Solomon Islands are influenced by high disturbance and are both spatially and temporally variable. However, the spatial and temporal dynamics of the different types of seagrass habitat are poorly understood.

Episodic terrigenous runoff events result in pulses of increased turbidity, nutrients and a zone of reduced salinity in nearshore waters. Seagrasses, especially structurally large species, affect coastal and reefal water quality by absorbing nutrients and trapping sediments acting as a buffer between catchment inputs and reef communities. Unlike neighbouring Australia, where small species (e.g. *Halodule* and *Halophila*) comprise the majority of the coastal nearshore seagrass meadows, Solomon Island seagrass are dominated by structurally large seagrasses (*Thalassia, Enhalus, Cymodocea*). Seagrasses have the ability to act as a bio-sink for nutrients, sometimes containing high levels of tissue nitrogen and phosphorous. They also provide food and shelter for many organisms, and are a nursery grounds for commercially important prawn and fish species. Macro-grazers, dugongs (*Dugong dugon*) and green sea turtles (*Chelonia mydas*) may also be an important feature in structuring seagrass communities in the Solomon Islands.

Table 10. Summary of seagrass habitats of the Solomon Islands.

Habitat	Limiting factor	Seagrass species	Feature/threats
Estuaries *(incl. large shallow lagoons)*	Terrigenous runoff	*Cymodocea rotundata* *Cymodocea serrulata* *Halodule uninervis* *Enhalus acoroides* *Halophila minor* *Halophila ovalis*	Highly productive High denisity, low diversity Often associated with mangroves Highly threatened
Coastal (*incl. Fringing reef*)	Physical disturbance	*Cymodocea rotundata* *Cymodocea serrulata* *Halodule uninervis* *Syringodium isoetifolium* *Enhalus acoroides* *Halophila ovalis* *Thalassia hemprichii*	Very diverse Highly productive Important for fisheries Supports dugongs Dynamic Threatened by development
Deep-water	Low light	*Halophila decipiens* *Halophila minor* *Halophila ovalis*	>10m deep Monospecific High turnover Least known habitat Threats unknown
Reef *(e.g., barrier or isolated)*	Low nutrients	*Cymodocea rotundata* *Halodule uninervis* *Syringodium isoetifolium* *Thalassodendron ciliatum* *Halophila ovalis* *Thalassia hemprichii*	Support high biodiversity Shallow unstable sediment Variable physical environment Little studied Least threatened

Globally, seagrass loss has generally been linked to declining water quality. Seagrass growth in general is limited by light, disturbance and nutrient supply, and changes to any or all of these limiting factors may cause seagrass decline. The most common cause of seagrass loss being from the reduction of light availability due to chronic increases in dissolved nutrients leading to proliferation of algae reducing the amount of light reaching the seagrass (e.g. phytoplankton, macroalgae or algal epiphytes on seagrass leaves and stems) or chronic and pulsed increases in suspended sediments and particles leading to increased turbidity (Schaffelke *et al.* 2005). In addition, changes of sediment characteristics may also play a critical role in seagrasses loss.

There were no indications during the present survey that nutrients appear to be having a negative effect on seagrass growth and distribution throughout the Solomon Islands. This is not an unexpected observation as the region as a whole is in relatively healthy condition compared to many other regions globally. There was, however, evidence (supported by a number of anecdotal reports) that the delivery of sediments into coastal waters has increased at some locations, primarily the result of logging activities (esp. Marovo Lagoon). These sediments settle out of the water column, particularly in the protected nearshore areas where seagrasses are most likely to be found. Thus coastal seagrass habitats are vulnerable to changes in water quality as they are directly exposed to increased sediment loads. These additional sediments usually reduce habitat quality as a result of the combined effects of additional sediments and nutrients locally.

Loss of seagrass due to storms, flooding and cyclones has undoubtedly occurred in the Solomon Islands from time to time due to the influx of freshwater and sediment in the water which cuts light penetration underwater. However, without an adequate baseline (until now) to compare, these large-scale changes would occur relatively undetected. Fortunately tropical seagrasses are relatively resilient, having evolved and adapted to such natural impacts/change.

Defined habitats contain a large range of life history strategies, which provides some insight into the dynamic but variable physical nature of Solomon Island seagrass habitats. *E. acoroides* is a slow turnover, persistent species with low resistance to perturbation (Walker *et al.,* 1999), suggesting that there are some coastal habitats that are quite stable over time. *Cymodocea* and *Syringodium* are seen as intermediate genera that can survive a moderate level of disturbance, while *Halophila* and *Halodule* are described as ephemeral species with rapid turnover and high seed set, well adapted to high disturbance and high rates of grazing (Walker *et al.,* 1999). Therefore the species present in the different habitats reflect the observed physical and biological impacts, suggesting that reef, deep water and coastal environments are particularly variable and dynamic, while estuarine/lagoonal habitats have stable areas but are extremely harsh.

The capacity of seagrasses to recover requires either recruitment via seeds or through vegetative growth. The recovery of tropical seagrasses depends on the species and location. Some plants are fairly resilient in unstable environments. The ability of seagrass meadows to recover from large scale loss of seagrass cover observed during major events such as cyclones will usually require regeneration from seed bank (Campbell & McKenzie 2004). Chronic levels of sediment as well as higher exposure levels during river flood events may reduce growth and reproductive effort, important processes in the recovery of seagrass meadows after disturbance by turbidity and freshwater runoff (Waycott *et al.* 2005).

In many areas, it is difficult to estimate changes in seagrass because the maps of the distribution of seagrasses area and biomass are still imprecise. Support for continued extensive mapping of seagrasses studies similar to the present one is commendable. This will help to better understand the anthropogenic and climatic factors that drive changes in seagrass meadows. Precise mapping of seagrass meadow parameters (at appropriate scales) will enable changes to be more accurately measured and tracked.

All identified seagrass habitats have high ecological and/or economic value, whether supporting fisheries or biodiversity. Estuary/lagoonal and coastal habitats are considered to be the most threatened, due to extensive coastal development, however the limited knowledge of deeper water seagrass habitats suggests that impacts to these habitats are extremely difficult to determine.

MANGROVES

Rhizophora stylosa had the most extensive distribution, was the most abundant species and tended to dominate habitat types along the coastlines. Generally, *Rhizophora stylosa* is a pioneering species that is often found on mud flats and on islands in tidal estuaries. Bunt and

Williams (1980) found that *Rhizophora* spp. emerged as predominant close to the lower tidal limit. *Rhizphora stylosa* is often associated with *Avicennia, Ceriops* and *Bruguiera* (Claridge and Burnett 1993), as was found in the present survey. *Lumnitsera* was also found associated with *Rhizophora* spp.

Rhizophora spp. contributes greatly to primary productivity in estuaries through litter fall, and secondary productivity, with prop roots contributing complex structural habitat, or “snags”. Snags provide suitable habitat for many juvenile fish (protection from predatory fish) and adult fish (hiding spaces for ambush).

Avicennia marina was not common and was found at northern Isabel sites. *A. marina* has efficient salt secreting mechanisms and tends to be more dominant in higher salinity areas (Scholander *et al.* 1962; Waisel, *et al*. 1986). The closed *Rhizophora stylosa* forest that dominated much of the coastlines may have inhibited the establishment of *A. marina*.

Other remaining species known from the Solomon Islands mangrove species were not encountered as they are found more commonly further upstream in estuaries. The upstream environment is more protected from wave energy and currents, and most of these species require some freshwater input, or grow along the landward edge or margin of mangrove forests (Claridge & Burnett 1993; Dowling & McDonald 1982).

Youssef & Saenger (1999) suggested that specific segregation of species is the outcome of the cumulative interaction between different environmental gradients on one-hand and tolerance boundaries of each species to each particular gradient on the other. Zones of mangroves species are a response of individual mangrove species to the gradients of inundation frequency, waterlogging, nutrient availability and soil salt concentrations across the intertidal area (Hutchings & Saenger, 1987).

The number of mangrove species recorded in this survey was low compared with previous records, as only the fringing mangroves of coastlines were surveyed, so mangrove species growing along the more landward edges of wide bands of mangrove forests or high tide regions were missed. While this survey indicates that the riparian zone appears to be relatively healthy, the area is subject to several threats. Human activities that may affect water quality and mangrove health.

Threats

The major changes in Solomon Island seagrass meadows would have occurred post World War Two and are related to coastal development, agricultural land use, or population growth. In general though there is insufficient information and no long-term studies from which to draw direct conclusions on historic trends. Munro (1999) reported that 2000 year old mollusc shell middens in neighbouring PNG have basically the same composition as present day harvests suggesting indirectly that the habitats including seagrass habits and their faunal communities are stable and any changes occurring are either short term or the result of localised impacts. It can be assumed that the same could be concluded for the Solomon Islands.

These localised impacts are likely to be from soil erosion related to coastal agriculture (e.g., coconut plantations), land clearing (e.g., logging and mining) and bush fires. Other effects include sewage discharge (human and agriculture), industrial pollution, port/village infrastructure/dwellings and overfishing. Most of these impacts can be managed with appropriate environmental guidelines, however climate change and associated increase in storm activity, water temperature and/or sea level rise has the potential to damage seagrasses in the region or to influence their distribution. Sea level rise and increased storm activity could lead to large seagrasses losses. Mangrove swamps, particularly those of low islands, are likely to be sensitive to sea-level rise. The response of mangroves to climate change is uncertain, and research and monitoring is required.

To provide an early warning of change, long-term monitoring sites have been established near Gizo as part of Seagrass-Watch, Global Seagrass Monitoring Network (www.seagrasswatch.org McKenzie *et al.* 2005). The program hopes to expand to include other regions of the Solomon Islands. By working with both scientists and local communities, it is hoped that many anthropogenic impacts on seagrass meadows which are continuing to destroy or degrade these coastal ecosystems and decrease their yield of natural resources can be avoided.

Recommended Actions

- Promote seagrass and mangrove conservation in the Pacific Islands as they have had a low priority in conservation programs in the region.
- More protected areas to be established, to ensure that examples of seagrass and mangrove ecosystem remain in the Solomon Islands for use by future generations
- Legislation for the protection of mangroves needs to be enforced.
- Seagrass and mangrove conservation values need to be enhanced by development of education resource materials, to be used in schools and community groups
- A Pacific Island monitoring program of seagrass and mangrove ecosystem health needs to be established. This could be linked to existing region/global monitoring programs (e.g., Seagrass-Watch, www.seagrasswatch.org) for monitoring climate change/sea level rise impact.
- Detailed maps of seagrasses are needed in locations which are highly threatened by poor water quality (e.g., Marovo Lagoon).
- Detailed surveys and studies on dugong/turtle-seagrass distribution based on the known seagrass habitats identified in this survey.
- Studies on importance, ecology, and population dynamics of subsistence fisheries (e.g., rabbit fish) which seagrass/mangrove ecosystems support

Acknowledgements

We are grateful to Louise Goggin (CRC Reef), Ivan Rotu Peoko and Tingo Leve for their assistance in the field surveys. We thank Stu Shepard (TNC) for providing the basemaps and GIS support, the crew of the “FeBrina” – skipper Russell Slater, and our boatman Elijah for his boating skills and patience. We also thank Rudi Yoshida for his assistance with data entry/ management.

This survey was funded by TNC and the David & Lucile Packard Foundation and supported by CRC Reef and the Department of Primary Industries & Fisheries, Queensland.

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