SEAGRASS SURVEY CALATAGAN

Conducted with the sponsorship of the CAP Oceans Foundation

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Between July 11th and 13th, 2012, we visited Calatagan to do a preliminary survey of its seagrass beds. We surveyed 5 full stations in the nearshore marine area of Quilitisan, Kambal, the Pier, and Pagapas Bay. The purpose of this work was to examine the differences in seagrass community health and seagrass ecosystem services around areas with and without marine protected areas, and with and without terrestrial protection for Angela L. Quiros's dissertation at the University of California, Santa Cruz.

Seagrasses are important because they protect against shoreline erosion and battering from storms, filter coastal waters, support diverse ecological communities, act as nursery grounds and habitat for local fisheries, and provide an estimated $19,004 per hectare per year in ecosystem services[1]. Establishing terrestrial and marine protected areas to regulate human use of the environment is one way to maintain healthy ecosystems. In this study we examine whether marine protected areas, terrestrial protected areas, or both types of protection combined are best for maintaining healthy seagrass communities and their ecosystem services.

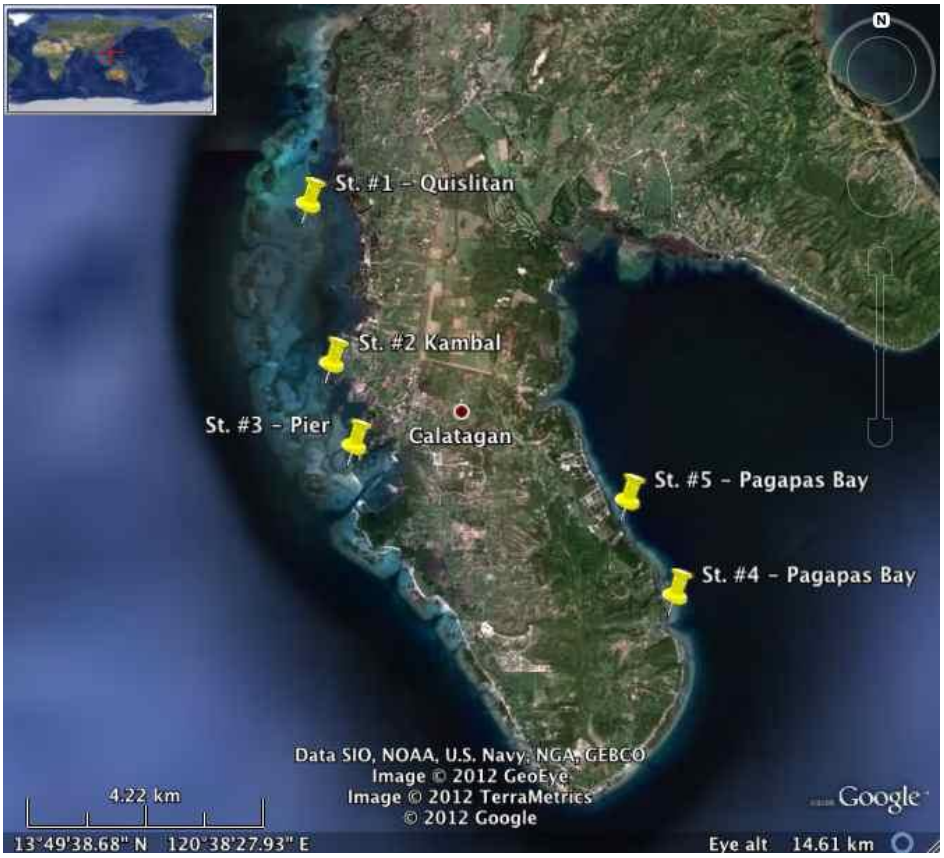
To quantify the health of each seagrass bed, we measured seagrass, invertebrate, and fish abundance and diversity. At each site, we created a 50m x 50m square station. Within each station, we extended two 50 meter transect lines; one in the shallow, island-ward side of the station and another 50m transect line in the deep, seaward part of the station. Along each transect line, we randomly selected 10 points and placed quarter meter quadrats on each of those points. We quantified seagrass abundance through percent cover photographs, shoot density counts, dry weight biomass, and canopy height measurements at each of those ten quadrats.

To quantify the ecosystem services provided by seagrasses within each 50 x 50 meter station, we conducted two 50-meter swims along each transect line, one along the deep and shallow lines to identify and count macroinvertebrates. We also conducted five 50-meter swims within each station to identify, count and estimate lengths of fish.

The following pages include a comprehensive report for each station surveyed:

[1] Duarte C.M. (2002) "The future of seagrass meadows." Environmental Conservation **29**(2):192-206.

Stations Surveyed in Calatagan



Google Earth image of Calatagan and surveyed stations

Station 1: Quilitisan

Station 2: Kambal

Station 3: Pier

Station 4: Pagapas Bay

Station 5: Pagapas Bay

Calatagan Station 1: Quilitisan

Parameters:

GPS: 13.8601°N
120.61298°E

Sediment Type: Sand/Rubble
Tidal Stage: High Flow

Average Salinity: 32.3 ppt
Average Temperature: 31.3°C
Average Depth: 0.43 meter
Average Turbidity: 4.9 meters

Grazing Present: Yes
AVG. Canopy Height: 31.6cm
Fruit or Flower Present: Yes

Percent Cover Photo Quilitisan

Seagrass Abundance:

Species Present: *Thalassia hemprichii, Halophila ovalis, Cymodocea rotundata, Cymodocea serrulata, Enhalus acoroides, Halodule pinifolia, Halodule uninervis, Syringodium isoteifolium*

Average Percent Covers

Seagrass	67.1%
Sponge	0.2%
Coral	0.0%
Rock	0.0%
Algae	1.6%
Sand	31.1%

Seagrass species	AVG. % cover (1/4m^2)	Shoot Density (1/4m^2)	Biomass (g/16m^2)
T.hemprichii	28.40%	8.65	1.020
H. ovalis	3.45%	9.55	0.10
C. rotundata	12.30%	9.15	0.65
C. serrulata	6.55%	5.95	0.58
E. acoroides	2.50%	1.55	0.88
H. pinifolia	1.55%	4.25	0.060
H. uninervis	10.30%	37.40	1.030
S. isoeteifolium	2.35%	7.20	0.18

Common Fish of Quislitan

Species	Common Name	Family
Atherinomorus spp.	Silversides	Atherinidae
Apogon margaritophorus	Red-striped Cardinalfish	Apogonidae
Cryptocentrus singapurensis	Singapore Prawn Goby	Gobiidae
Plotosus lineatus	Striped-eel Catfish	Plotosidae
Parapercis cylindrica	Cylindrical Sandperch	Mugiloididae

Total # Observed Fish Spp. of Quislitan = 18

Common Invertebrates of Quislitan

Species	Common Name	Class
Echinometra mathaei	Common Rock Urchin	Echinoidea
Protoreaster nodosus	Chocolate Chip Seastar	Asteroidea
Synapta maculata	Spotted Sea Cucumber	Holothuroidea
Diadema paucispinum	Long-spined Urchin	Echinoidea

Total # Observed Invertebrate Spp. of Quislitan = 14

Calatagan Station 2: Kambal

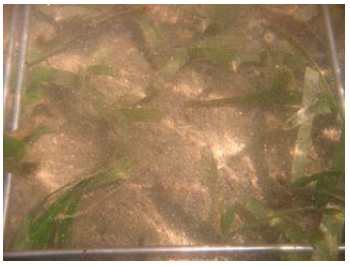
Parameters:

GPS: 13.83438°N
120.61685°E

Sediment Type: Mud
Tidal Stage: Low Slack

Average Salinity: 29.0 ppt
Average Temperature: 31.0°C
Average Depth: 0.87 meters
Average Turbidity: 3.3 meters

Grazing Present: Yes
AVG. Canopy Height: 40.2cm
Fruit or Flower Present: No



Percent Cover Photo Kambal

Seagrass Abundance:

Species Present: *Cymodocea rotundata, Cymodocea serrulata, Enhalus acoroides, Thalassia hemprichii*

Average Percent Covers

Seagrass	14.2%
Sponge	7.1%
Coral	1.5%
Rock	0.0%
Algae	31.6%
Sand	41.5%

Seagrass species	AVG. % cover (1/4m^2)	Shoot Density (1/4m^2)	Biomass (g/16m^2)
T.hemprichii	7.38%	1.20	0.28
C. rotundata	1.95%	0.050	0.0065
E. acoroides	7.38%	1.20	0.28

Common Fish of Kambal

Species	Common Name	Family
Atherinomorus spp.	Silversides	Atherinidae
Apogon sangiensis	Sangi Cardinalfish	Apogonidae
Apogon ceramensis	Ceram Cardinalfish	Apogonidae
Cryptocentrus spp.	Unidentified Goby	Gobiidae
Asterropteryx semipunctata	Starry Goby	Gobiidae

Total # Observed Fish Spp. of Kambal = 14

Common Invertebrates of Kambal

Species	Common Name	Class
Unidentified	Brown Anemone	Anthozoa
Cassiopea andromeda	Upside-down Jellyfish	Scyphozoa

Total # Observed Invertebrate Spp. of Kambal = 9

Calatagan Station 3: Pier

Parameters:

GPS: 12.82116°N
120.62054°E

Sediment Type: Mud/Rubble
Tidal Stage: Low Slack

Average Salinity: 31 ppt
Average Temperature: 32°C
Average Depth: 0.5 meters
Average Turbidity: 1.7 meters

Grazing Present: Yes
AVG. Canopy Height: 30.6cm
Fruit or Flower Present: Yes


Percent Cover Photo Pier

Seagrass Abundance:

Species Present: *Enhalus acoroides, Halophila ovalis, Thalassia hemprichii*

Average Percent Covers

Seagrass	13.9%
Sponge	0.3%
Coral	0.0%
Rock	0.3%
Algae	9.7%
Sand	75.9%

Seagrass species	AVG. % cover (1/4m^2)	Shoot Density (1/4m^2)	Biomass (g/16m^2)
T.hemprichii	6.15%	2.10	0.42
H. ovalis	4.03%	19.55	0.16
E. acoroides	6.15%	1.50	1.30

Common Fish of the Pier

Species	Common Name	Family
Atherinomorus spp.	Silversides	Atherinidae
Apogon ishigakienses	Ishigaki Cardinalfish	Apogonidae
Cryptocentrus caeruleomaculatus	Blue-speckled Prawn Goby	Gobiidae
Apogon margaritophorus	Red-striped Cardinalfish	Apogonidae
Cryptocentrus singapurensis	Singapore Prawn Goby	Gobiidae

Total # Observed Fish Spp. of the Pier = 14

Common Invertebrates of the Pier

Species	Common Name	Class
Diadema paucispinum	Long-spined Urchin	Echinoidea
Tripneustes gratilla	Hairy Pincushion Urchin	Echinoidea
Protoreaster nodosus	Chocolate Chip Seastar	Asteroidea
Synapta maculata	Spotted Sea Cucumber	Holothuroidea

Total # Observed Invertebrate Spp. of the Pier = 13

Calatagan Station 4: Pagapas Bay

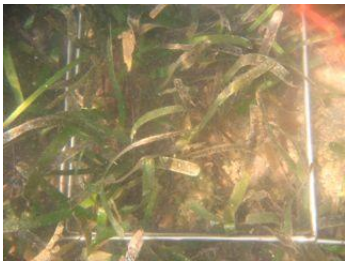
Parameters:

GPS: 13.79707°N
120.66582°E

Sediment Type: Sand/Rubble
Tidal Stage: High Ebb

Average Salinity: 31.7 ppt
Average Temperature: 30.3°C
Average Depth: 0.6 meters
Average Turbidity: 5.4 meters

Grazing Present: Yes
AVG. Canopy Height: 25.0cm
Fruit or Flower Present: No



Percent Cover Photo Pagapas Bay

Seagrass Abundance:

Species Present: *Cymodocea rotondata, Cymodocea serrulata, Enhalus acoroides, Halophila ovalis, Thalassia hemprichii*

Average Percent Covers

Seagrass	36.3%
Sponge	0.0%
Coral	2.6%
Rock	7.6%
Algae	18.8%
Sand	33.1%

Seagrass species	AVG. % cover (1/4m^2)	Shoot Density (1/4m^2)	Biomass (g/16m^2)
T.hemprichii	20.38%	9.60	1.18
H. ovalis	2.63%	3.25	0.020
C. rotundata	11.93%	5.30	0.20
C. serrulata	0.05%	0.050	0.0040
E. acoroides	1.45%	0.85	0.23

Common Fish of Pagapas Bay

Species	Common Name	Family
Atherinomorus spp.	Silversides	Atherinidae
Pomacentrus tripunctatus	Three-spot Damselfish	Pomacentridae
Cryptocentrus singapurensis	Singapore Prawn Goby	Gobiidae

Total # Observed Fish Spp. of Pagapas Bay = 16

Common Invertebrates of Pagapas Bay

Species	Common Name	Class
Tripneustes gratilla	Hairy Pincusion Urchin	Echinoidea
Cassiopea andromeda	Upside-down Jellyfish	Scyphozoa
Echinometra mathaei	Common Rock Urchin	Echinoidea
Diadema paucispinum	Long-spined Urchin	Echinoidea
Ophiomastix variabilis	Elegant Brittle Star	Ophiuroidea

Total # Observed Invertebrate Spp. of Pagapas Bay = 19

Calatagan Station 5: Pagapas Bay

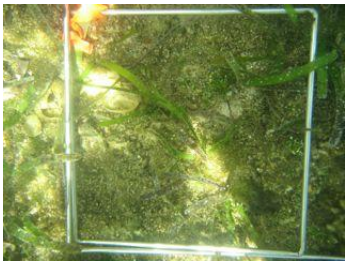
Parameters:

GPS: 13.81236°N
120.66582°E

Sediment Type: Sand/Rubble
Tidal Stage: Low Flow

Average Salinity: 32 ppt
Average Temperature: 31.7 °C
Average Depth: 0.53 meters
Average Turbidity: 4.5 meters

Grazing Present: Yes
AVG. Canopy Height: 19.7cm
Fruit or Flower Present: Yes


Percent Cover Photo Pagapas Bay

Seagrass Abundance:

Species Present: *Cymodocea rotondata, Cymodocea serrulata, Enhalus acoroides, Halodule pinifolia, Halodule uninervis, Halophila ovalis, Syringodium isoteifolium, Thalassia hemprichii*

Average Percent Covers

Seagrass	11.5%
Sponge	0.9%
Coral	4.5%
Rock	0.0%
Algae	39.4%
Sand	11.5%

Seagrass species	AVG. % cover (1/4m^2)	Shoot Density (1/4m^2)	Biomass (g/16m^2)
T.hemprichii	29.40%	33.55	1.79
H. ovalis	0.73%	1.35	0.22
C. rotundata	7.88%	2.10	0.069
C. serrulata	0.23%	0.20	0.0075
E. acoroides	2.65%	1.35	0.22
H. pinifolia	2.05%	1.45	0.0090
H. uninervis	0.60%	0.70	0.0055
S. isoeteifolium	0.50%	0.40	0.00050

Common Fish of Pagapas Bay

Species	Common Name	Family
Atherinomorus spp.	Silversides	Atherinidae
Gerres spp.	Unidentified Water Strider	Gerridae
Halichoeres scapularis	Zig-zag Wrasse	Labridae

Total # Observed Fish Spp. of Pagapas Bay = 13

Common Invertebrates of Pagapas Bay

Species	Common Name	Class
Tripneustes gratilla	Hairy Pincusion	Echinoidea
Ophiomastix variabilis	Elegant Brittle Star	Ophiuroidea
Diadema paucispinum	Long-spined Urchin	Echinoidea
Unidentified	Feather-duster Worm	Sabellidae
Echinometra mathaei	Common Rock Urchin	Echinoidea

Total # Observed Invertebrate Spp. of Pagapas Bay = 19

Appendix A
Common Seagrasses

A total of eight different species of seagrasses were found in Calatagan. The following are photos of all eight species observed in the five sites mentioned previously.

Cymodocea rotondata

Cymodocea serrulata

Enhalus acoroides

Halodule pinifolia

Halodule uninervis

Halophila ovalis

Syringodium isoteifolium

Thalassia hemprichii

Appendix B
Common Fishes

Apogon ceramensis

Apogon margaritophorus

Apogon sangiensis

Aterropteryx semipunctata

Atherinomorous spp.

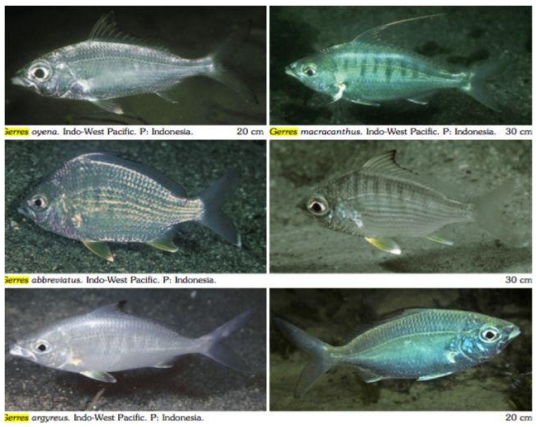
Cryptocentrus spp.

Cryptocentrus singapurensis

Cryptocentrus caeruleomaculatus

Halichoeres scapularis

Appendix B
Common Fishes



Gerres spp.

Parapercis cylindrical

Plotosus lineatus

Pomacentrus tripuncatatus

Appendix C
Common Invertebrates

Tripneustes gratilla

Ophiomastix variabilis

Diadema paucispinum

Unidentified feather duster worm

Ehinometra mathaei

Cassiopea Andromeda

Protoreaster nodosus

Synapta maculata

Unidentified brown anemone

Appendix D- Seagrass Abundance Calatagan

Station 1 Quilititsan:
Shallow transect – 10 quadrats

Species	Percent Cover mean	Percent Cover SD	Shoot Density mean	Shoot Density SD	Shoot Biomass mean	Shoot Biomass SD
C. rotundata	16.5%	7.8916%	56.7	30.4267	0.766g	0.2653g
C. serrulata	12.8888%	15.9874%	25	29.5935	1.414g	0.5580g
E. acoroides	1.9%	2.4698%	7.7	9.7530	0.862g	1.4116g
H. pinifolia	0%	0%	0	0	0g	0g
H. uninervis	0%	0%	0	0	0g	0g
H. ovalis	4.6%	5.5417%	73.1	99.9582	0.368g	0.3870g
S. isoteifolium	0%	0%	0	0	0g	0g
T. hemprichii	33.4%	11.5873%	139.6	65.6035	3.886g	1.0903g

Deep transect – 10 quadrats

Species	Percent Cover mean	Percent Cover SD	Shoot Density mean	Shoot Density SD	Shoot Biomass mean	Shoot Biomass SD
C. rotundata	8.1%	8.8625%	68.4	80.4089	1.818g	2.0334g
C. serrulata	1.5%	2.2730%	11.5555	24.9354	0.906g	1.1512g
E. acoroides	3.1%	4.5813%	5.9	8.2387	2.672g	3.8133g
H. pinifolia	3.1%	3.9846	118.5	231.5038	0.244g	0.3656g
H. uninervis	20.6%	27.2404%	288.5	388.2127	4.124g	2.4897g
H. ovalis	2.3%	1.6363%	26.9	27.1393	0.04g	0.0380g
S. isoteifolium	4.7%	7.0403%	74.4	117.0177	0.73g	0.9046g
T. hemprichii	23.4%	25.4610%	135.1	142.4331	0.18g	0.4024g

Station 2 Kambal :
Shallow transect – 10 quadrats

Species	Percent Cover mean	Percent Cover SD	Shoot Density mean	Shoot Density SD	Shoot Biomass mean	Shoot Biomass SD
C. rotundata	0.15%	0.3374%	0.2	0.4216	0.026g	0.0581g
C. serrulata	3.9%	10.9994%	6.7	20.1552	N/A	N/A
E. acoroides	5.2%	2.9363%	5.7	3.3025	1.068g	1.4809g
H. pinifolia	0%	0%	0	0	0g	0g
H. uninervis	0%	0%	0	0	0g	0g
H. ovalis	0%	0%	0	0	0g	0g
S. isoteifolium	0%	0%	0	0	0g	0g
T. hemprichii	13.55%	11.0061%	20.7	18.4273	0.026g	0.0581g

Deep transect – 10 quadrats

Species	Percent Cover mean	Percent Cover SD	Shoot Density mean	Shoot Density SD	Shoot Biomass mean	Shoot Biomass SD
C. rotundata	0%	0%	0	0	0g	0g
C. serrulata	0%	0%	0	0	0g	0g
E. acoroides	4.3%	6.0009%	6.2	7.7574	3.072g	3.9519g
H. pinifolia	0%	0%	0	0	0g	0g
H. uninervis	0%	0%	0	0	0g	0g
H. ovalis	0%	0%	0	0	0g	0g
S. isoteifolium	0%	0%	0	0	0g	0g
T. hemprichii	1.2%	3.7947	1.8	5.6920	N/A	N/A

Station 3 Pier :
Shallow transect – 10 quadrats

Species	Percent Cover mean	Percent Cover SD	Shoot Density mean	Shoot Density SD	Shoot Biomass mean	Shoot Biomass SD
C. rotundata	0%	0%	0	0	0g	0g
C. serrulata	0%	0%	0	0	0g	0g
E. acoroides	2.9%	3.0349%	5.9	6.9514	2.234g	2.5427g
H. pinifolia	0%	0%	0	0	0g	0g
H. uninervis	0%	0%	0	0	0g	0g
H. ovalis	8.33%	6.2469%	204.6	202.5532	0.632g	0.3911g
S. isoteifolium	0%	0%	0	0	0g	0g
T. hemprichii	0.1%	0.2108%	0.2	0.4216	N/A	N/A

Deep transect – 10 quadrats

Species	Percent Cover mean	Percent Cover SD	Shoot Density mean	Shoot Density SD	Shoot Biomass mean	Shoot Biomass SD
C. rotundata	0%	0%	0	0	0g	0g
C. serrulata	0%	0%	0	0	0g	0g
E. acoroides	4.6%	3.2472%	10.5	6.9960	2.958g	2.3285g
H. pinifolia	0%	0%	0	0	0g	0g
H. uninervis	0%	0%	0	0	0g	0g
H. ovalis	0%	0%	0	0	0g	0g
S. isoteifolium	0%	0%	0	0	0g	0g
T. hemprichii	12.2%	7.9028%	42.2	26.4289	1.696g	0.9962g

Pagapas Bay, Station 4:
Shallow transect – 10 quadrats

Species	Percent Cover mean	Percent Cover SD	Shoot Density mean	Shoot Density SD	Shoot Biomass mean	Shoot Biomass SD
C. rotundata	11.6%	10.0133%	51	54.3609	0.79g	1.0240g
C. serrulata	0.1%	0.31622%	0.1	0.31622	0.016g	0.0357g
E. acoroides	0.7%	1.6363%	1.6	3.5023	0.504g	1.1269g
H. pinifolia	0%	0%	0	0	0g	0g
H. uninervis	0%	0%	0	0	0g	0g
H. ovalis	5.2%	4.3665%	43.3	51.4523	0.1705g	0.135g
S. isoteifolium	0%	0%	0	0	0g	0g
T. hemprichii	23.4%	12.8426%	99.8	51.5381	2.852g	2.4203g

Deep transect – 10 quadrats

Species	Percent Cover mean	Percent Cover SD	Shoot Density mean	Shoot Density SD	Shoot Biomass mean	Shoot Biomass SD
C. rotundata	12.25%	11.5932%	78.2	78.6524	0.23	0.1829
C. serrulata	0%	0%	0	0	0g	0g
E. acoroides	2.2%	2.4404%	6	6.5659	0.918g	1.4010g
H. pinifolia	0.05%	0.1581%	0.4	1.2649	N/A	N/A
H. uninervis	0%	0%	0	0	0g	0g
H. ovalis	0.05%	0.1582%	1.4	4.4271	0.1075g	0.135g
S. isoteifolium	0%	0%	0	0	0g	0g
T. hemprichii	17.35%	11.6334	102.1	44.2378	1.884g	0.6840g

Pagapas Bay, Station 5:
Shallow transect – 10 quadrats

Species	Percent Cover mean	Percent Cover SD	Shoot Density mean	Shoot Density SD	Shoot Biomass mean	Shoot Biomass SD
C. rotundata	13.45%	14.3613%	93	130.3482	0.274g	0.0770g
C. serrulata	0.45%	0.9559%	2.9	5.9338	0.03g	0.0670g
E. acoroides	5.3%	2.7507%	15.3	12.1018	0.374g	0.5902g
H. pinifolia	4.1%	4.2018%	81.2	110.6273	0.036g	0.0804g
H. uninervis	1.2%	1.8135%	12.4	18.8985	0.022g	0.0491g
H. ovalis	1.2%	2.5733%	8.4	17.9332	0.075g	0.0525g
S. isoteifolium	1%	2.1081%	9.2	19.6004	0.0025g	0.005g
T. hemprichii	45.5%	19.9847	325.2	118.5100	5.0275g	0.8309g

Deep transect – 10 quadrats

Species	Percent Cover mean	Percent Cover SD	Shoot Density mean	Shoot Density SD	Shoot Biomass mean	Shoot Biomass SD
C. rotundata	2.3%	7.2732%	9.3	29.4091	N/A	N/A
C. serrulata	0%	0%	0	0	0g	0g
E. acoroides	0%	0%	0	0	0g	0g
H. pinifolia	0%	0%	0	0	0g	0g
H. uninervis	0%	0%	0	0	0g	0g
H. ovalis	0.25%	0.6346%	4.2	10.2610	N/A	N/A
S. isoteifolium	0%	0%	0	0	0g	0g
T. hemprichii	13.3%	12.4168%	94.1	94.4003	3.126g	0.7219g