Gippsland Lakes Seagrass Mapping

Adrian Kitchingman - June 2016

The seagrass mapping component of this project commenced in early 2015. The mapping follows the previous aerial photography mapping by Roob and Ball in 1997 though with a reduced extent. Similar to Roob and Ball (1997), a combination of aerial photography and on-ground sampling were used to create maps of seagrass extent in the Gippsland Lakes.

Aerial imagery capture

Aerial photography, supplied by Monash University Engineering, was taken in various regions of the Gippsland Lakes (Figure 1) during January 2015 and March 2016. Images consisted of Red, Blue and Green (RGB) bands at around 20 cm resolution and were georectified for display in a GIS.

The 2015 imagery had issues with sun-glint (reflection of sunlight off the water surface) or lack of water clarity (suspended sediments from dredging) which lead to a second collection of imagery in 2016. The spatial coverage and quality of aerial imagery was greater in the 2016 . This lead to the majority of seagrass classifications being generated from 2016 imagery.

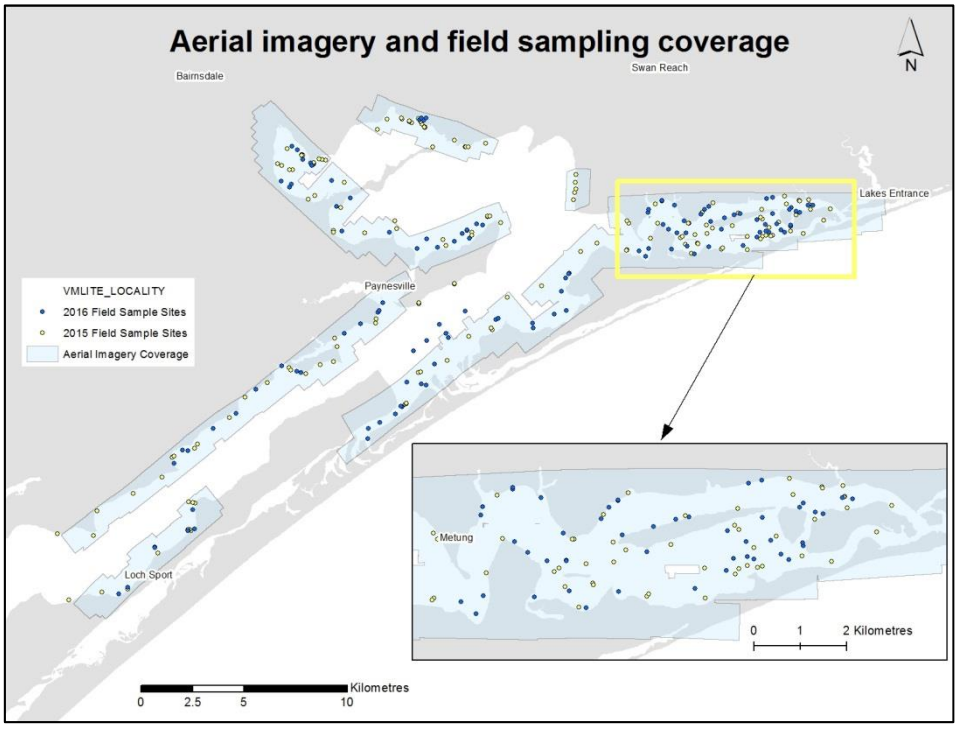


Figure 1: Coverage of aerial imagery (blue shading) and field ground truthing location points. Year of ground truthing represented by yellow and black points for 2015 and 2016 respectively.

Ground truthing

Ground truthing sites involved collecting images or video via a GoPro (Hero 3) mounted on the end of a long pole. Images are collected at 2 to 5 second intervals for approximately 20-30 seconds at each site. After selecting a site the pole is place on or as close as possible to the substrate below the boat. Several directions of images may be taken for a site. The coordinates of each site are recorded and linked to the images during post-processing. Depth of sites was generally less than 2m given the optimal growth zone for seagrass is usually in depths of 2m or less.

Initially field trips were aimed at ground truthing sites that required verification within the bounds of the aerial imagery. Due to a delay in the delivery of the aerial imagery, sites were located either by old DELWP imagery or by site selection while on the water. A total of 277 sites were ground-truthed in 2015 and 2016 (Table 1).

Table 1: Ground-truthing field trips

Field trip periods	No of Sites
March 4-5th 2015	58
April 21-23rd 2015	122
February 15-17th 2016	119

The collected seagrass photos and video where then combined with site locations and collated into a GoogleEarth layer for viewing and classification (Figure 2). This layer is supplied in the supplementary data package under the name *Gippsland_Lakes_Seagrass_Ground_Truthing_2015_2016.kml*.

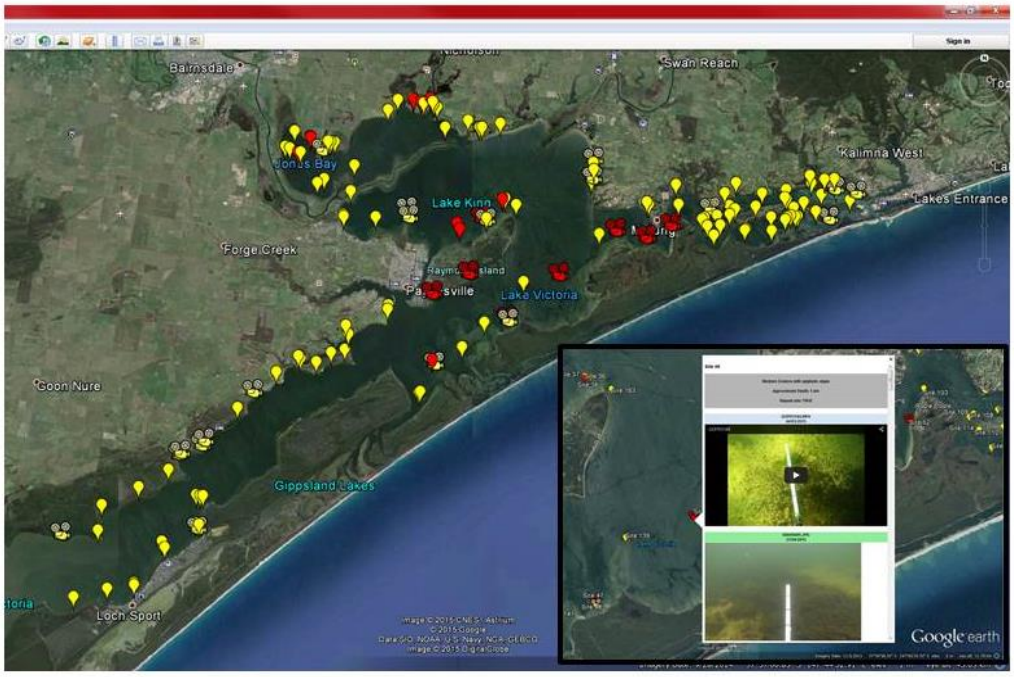


Figure 2: GoogleEarth view of sites combined with sampling images (inset).

Classification process

Seagrass classification was conducted twice. First ground-truthed data was classified, then later after delineating regions from imagery the resulting polygons were also classified. For continuity both classification process used the classes developed by Roob and Ball (1997; Table 2).

Ground truthing classifications involved the examination of between 1 to 42 images (average 15) or video per site to get a broad representative seagrass classification. All sites are given a degree of confidence in the assigned classification. Random selection of sites were forwarded to a second

classifier before initial classification to obtain blind mutual classifications. Discrepancies in the blind classifications were taken into account for the final classification for all sites.

Table 2: Seagrass classes developed by Rood and Ball (1997) and used for the 2016 classification

Seagrass Class
Dense Ruppia
Medium Ruppia
Sparse Ruppia
Dense Ruppia with epiphytic algae
Medium Ruppia with epiphytic algae
Sparse Ruppia with epiphytic algae
Dense Zostera
Medium Zostera
Sparse Zostera
Dense Zostera with epiphytic algae
Medium Zostera with epiphytic algae
Sparse Zostera with epiphytic algae
Dense Ruppia/Zostera mix
Medium Ruppia/Zostera mix
Sparse Ruppia/Zostera mix
Dense Ruppia/Zostera mix with epiphytic algae
Medium Ruppia/Zostera mix with epiphytic algae
Sparse Ruppia/Zostera mix with epiphytic algae
Undefined subtidal vegetation

Mapping of seagrass areas

Mapping was conducted via manual delineation. By overlaying classified ground truthing points with the aerial imagery, broad differences could be seen in seagrass coverage. These areas were defined into a polygon layer using ArcGIS. Delineation of seagrass areas were largely conducted on the projected aerial imagery conducted in early 2016. Initially polygons were digitised only using the aerial imagery as a reference. Classifications of the seagrass polygons (Appendix A) were made using intersecting ground truthing points or similarity to nearby areas with confident classifications. The final shapefile is supplied in the supplementary data package under the name *gippsland_lakes_seagrass_coverage_2016*.

Final assessment

The combination of manual delineation, point source ground truthing and the natural spatiotemporal variability of seagrass can only allow an indication of seagrass extent in the Lakes over those areas covered by aerial imagery (Figure 3). Other methods of delineation were investigated but options which involve semi-automated image classification require the collection of an infra-red band which is not available in the current imagery. While the 2016 imagery showed a marked improvement in quality, the issues of sun-glint and water clarity can still effect the ability to map some areas confidently. Overall the resulting mapped seagrass coverage is suitable for broad

investigations of seagrass coverage. Appendix B has some broad comparisons to the mapped seagrass coverage by Roob and Ball (1997).

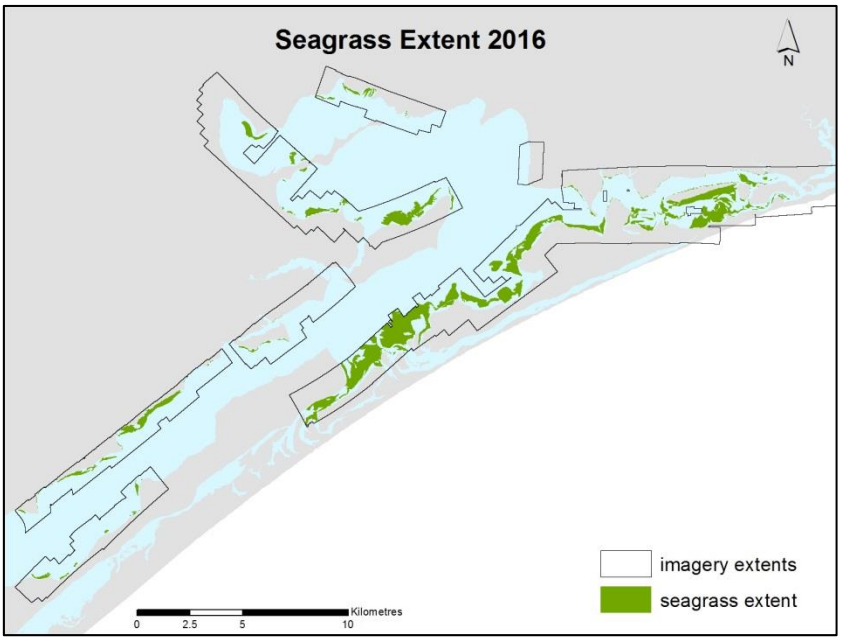


Figure 3: Mapped seagrass extent

During the mapping process imagery from 2006 and 2013 (DELWP Image Web Server) provided interesting comparisons over the years (Appendix C). There were differences in imagery coverage and quality but general comparisons are possible. Care should be taken as these older images have no ground-truthing which prevents accurate classifying and could lead to areas mistakenly being considered seagrass.

The data collected and the simplicity of the methods used to map seagrass lend themselves to potential monitoring regimes to examine seagrass coverages over time. With care in consistency of imagery quality and timing, temporal assessments should be relatively robust and quick. This would then allow the potential for rapid implementation of management strategies to investigate and possibly counter any unusually large degrees of variation in seagrass coverage.

Reference:

Roob, R. & Ball, D. (1997). Victorian Marine Habitat Database, Seagrass Gippsland Lakes. A report for Fisheries Victoria, Department of Natural Resources and Environment. Marine and Freshwater Resources Institute, Queenscliff.

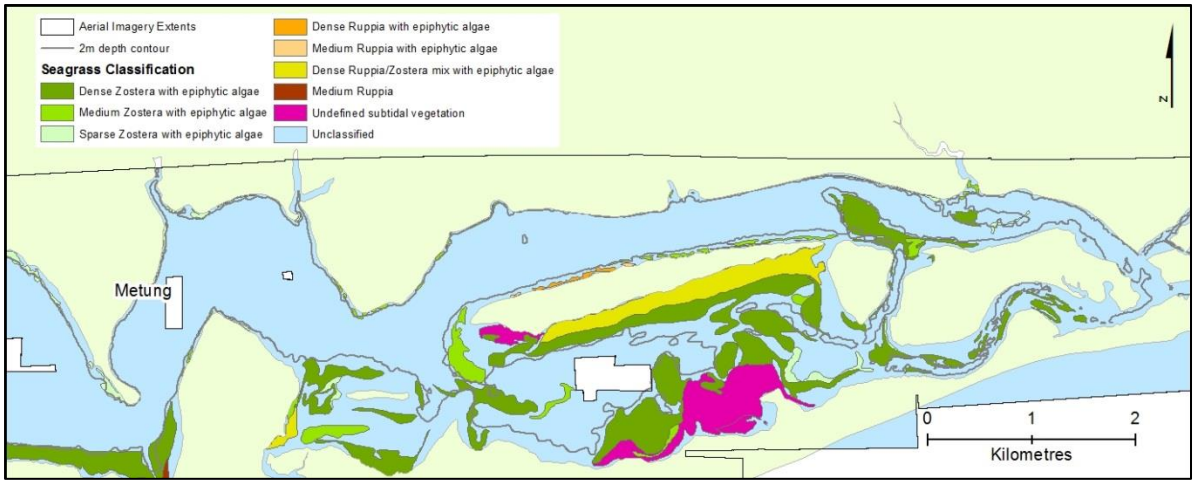
Supplementary Data

Gippsland_Lakes_seagrass_mapping_2016_Supplementary_Data.zip contains:

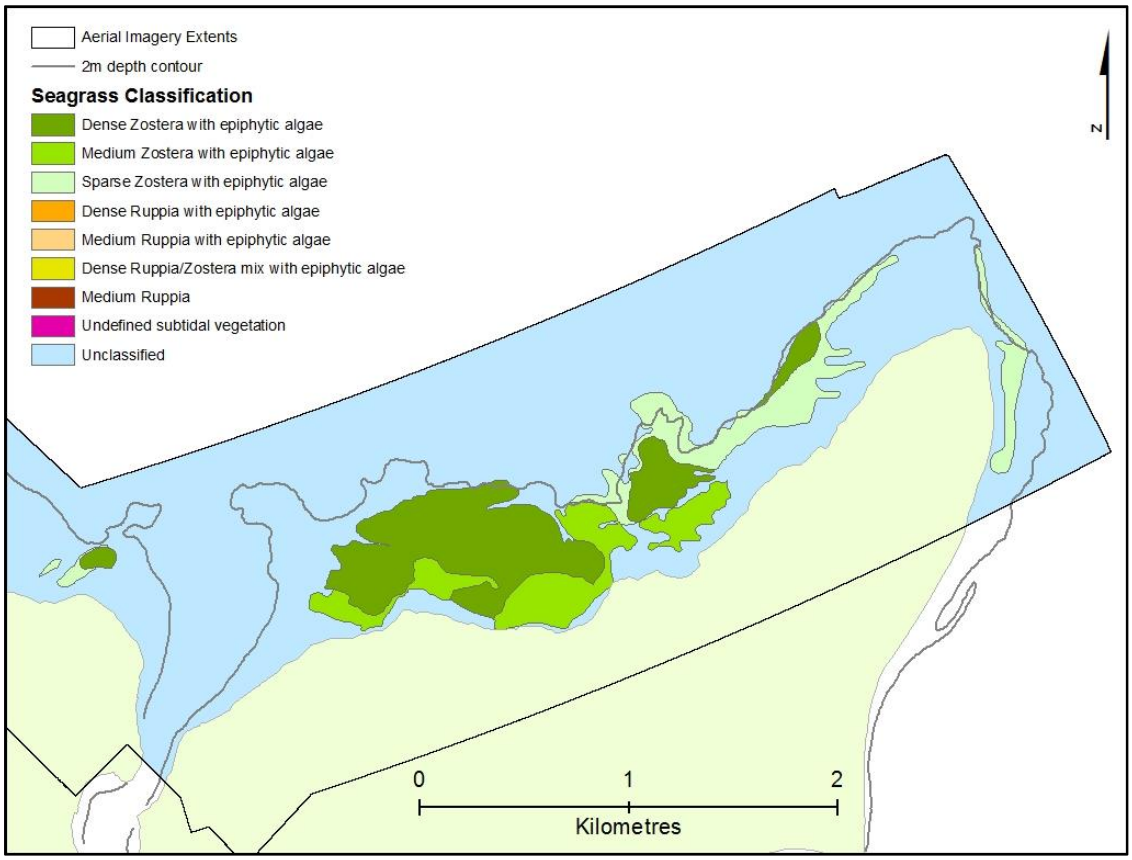
- Gippsland_Lakes_seagrass_coverage_2016 (ESRI shapefile; MGA55)
- Gippsland_Lakes_Seagrass_Ground_Truthing_2015_2016.kml (GoogleEarth)

Appendix A – 2016 Classified Seagrass Coverage

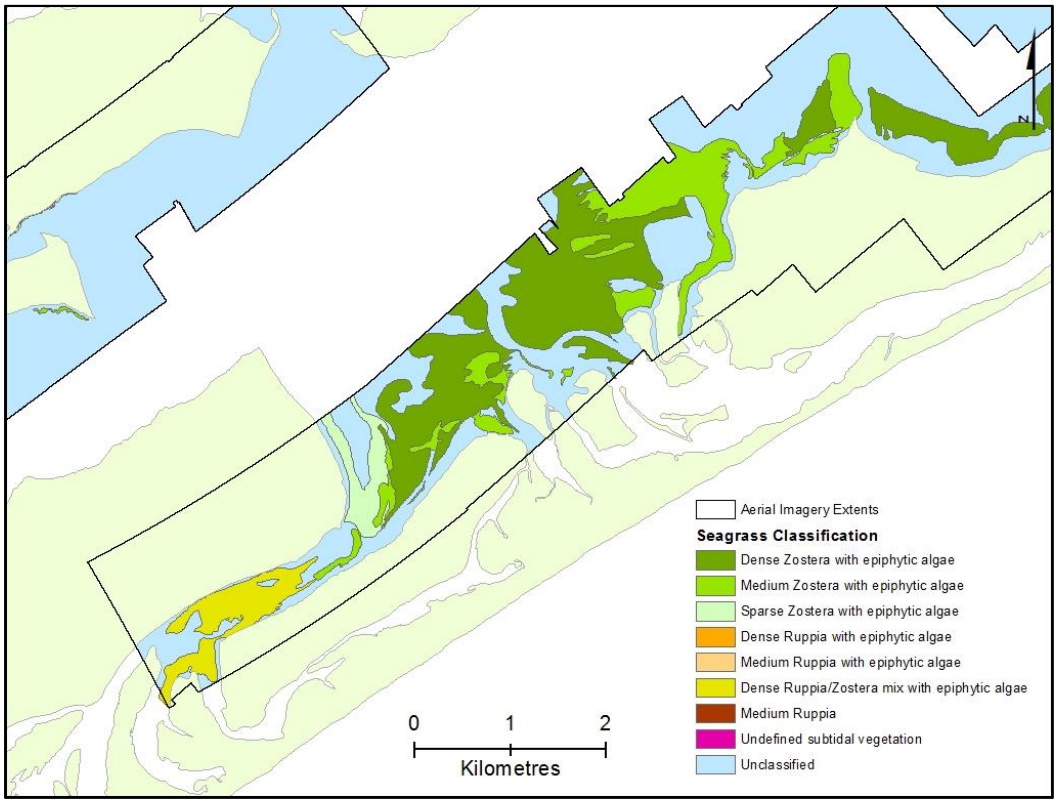
East of Metung



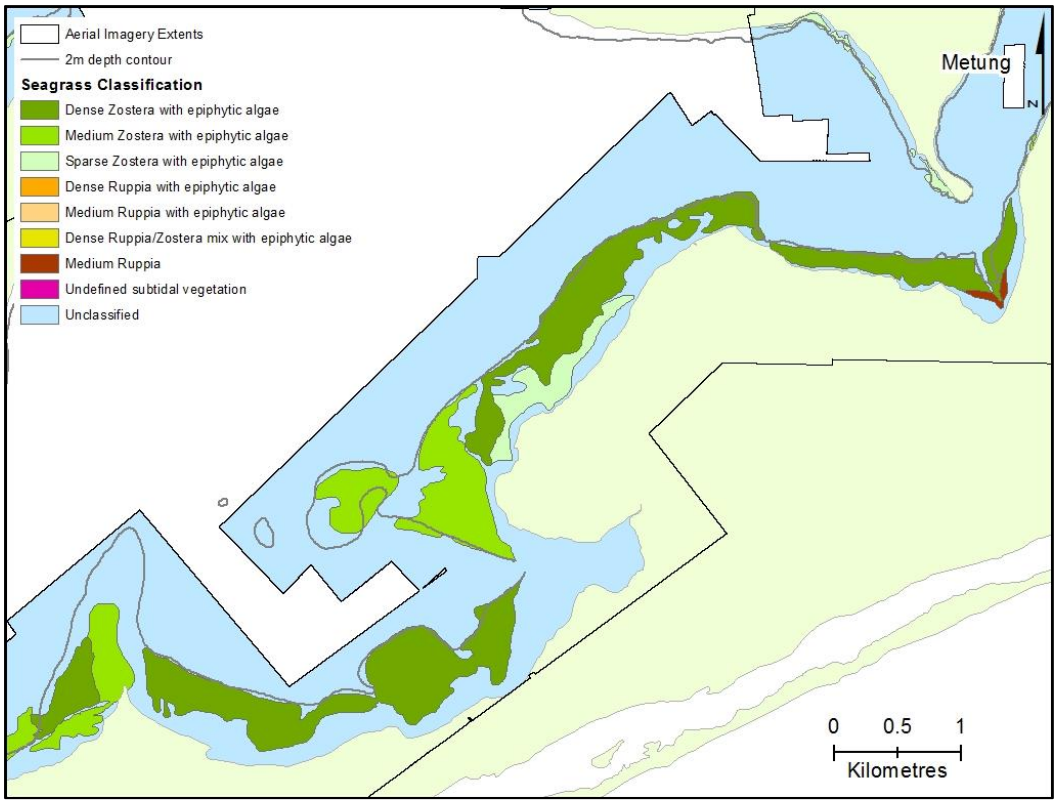
North Raymond Island



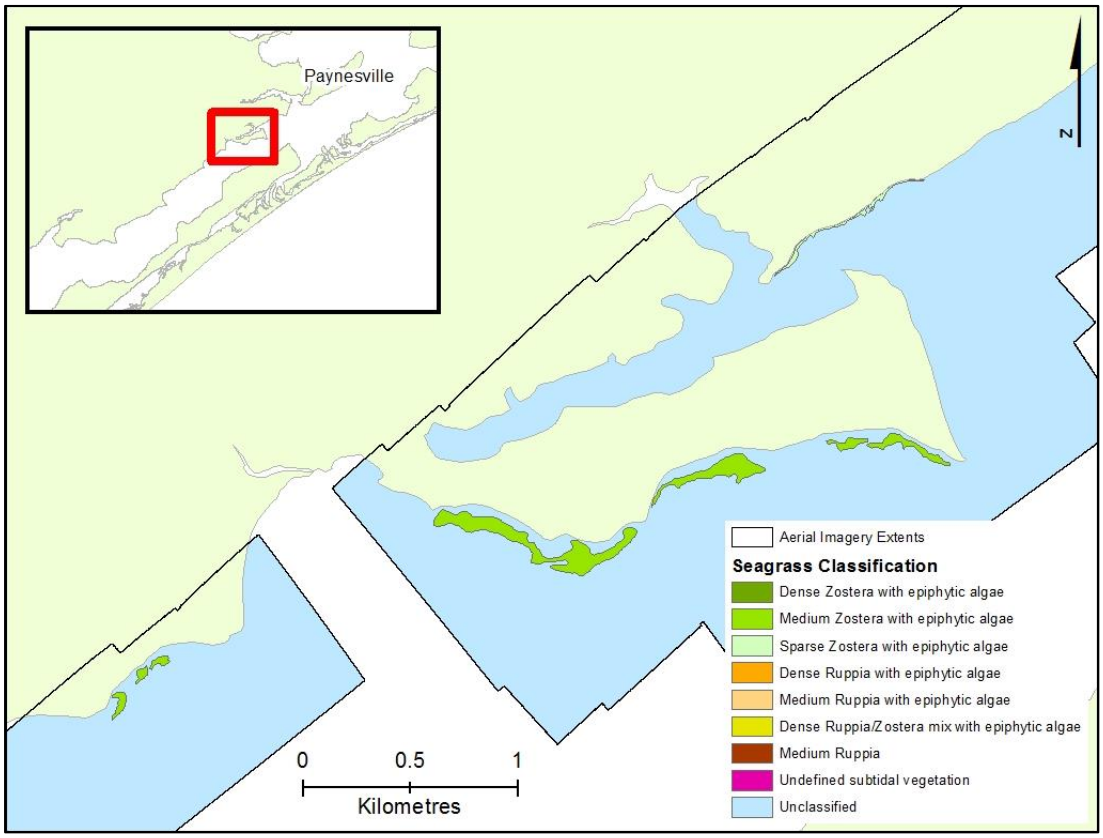
East of Sperm Whale Head



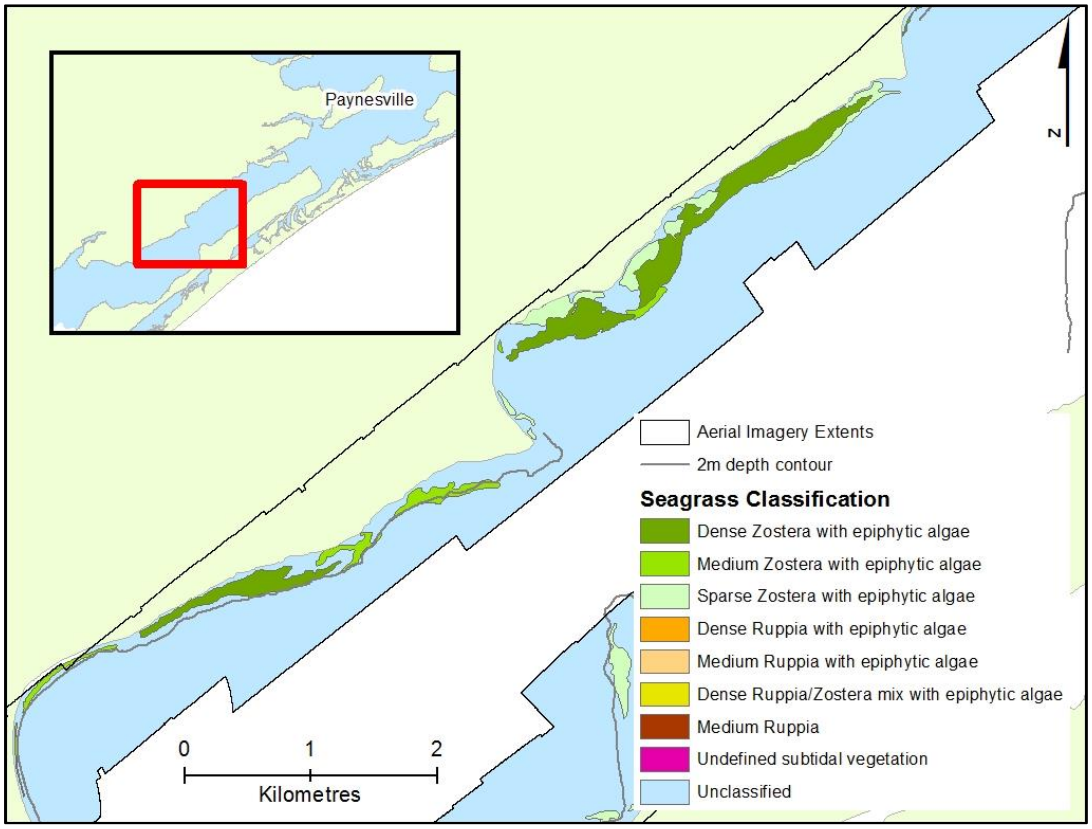
Wollaston Bay to Luderick Point



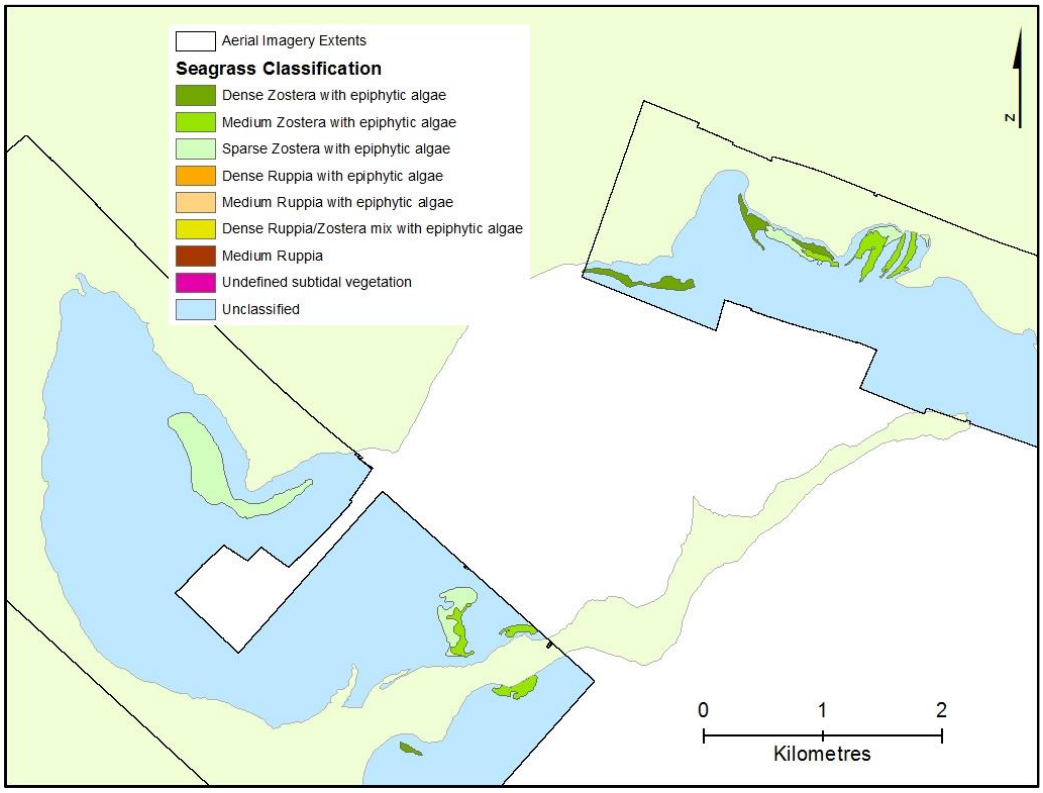
Mid North Shore of Lake Victoria, Baxter Peninsula



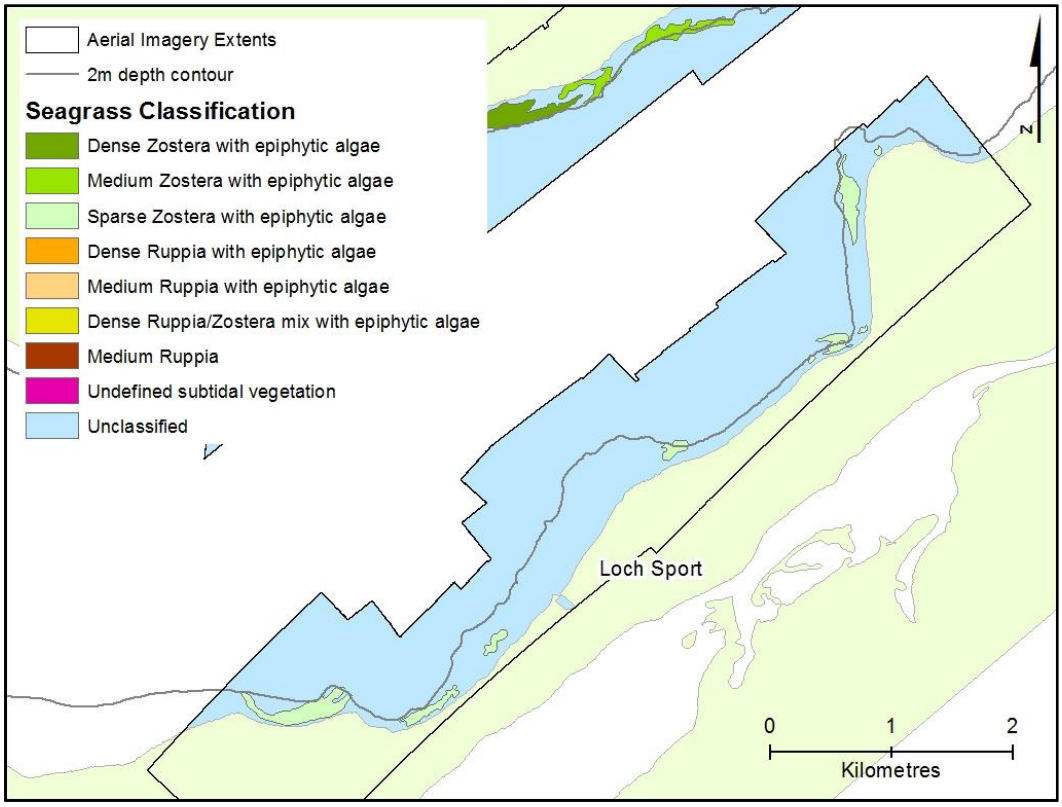
Mid North Shore of Lake Victoria, Waddy Point



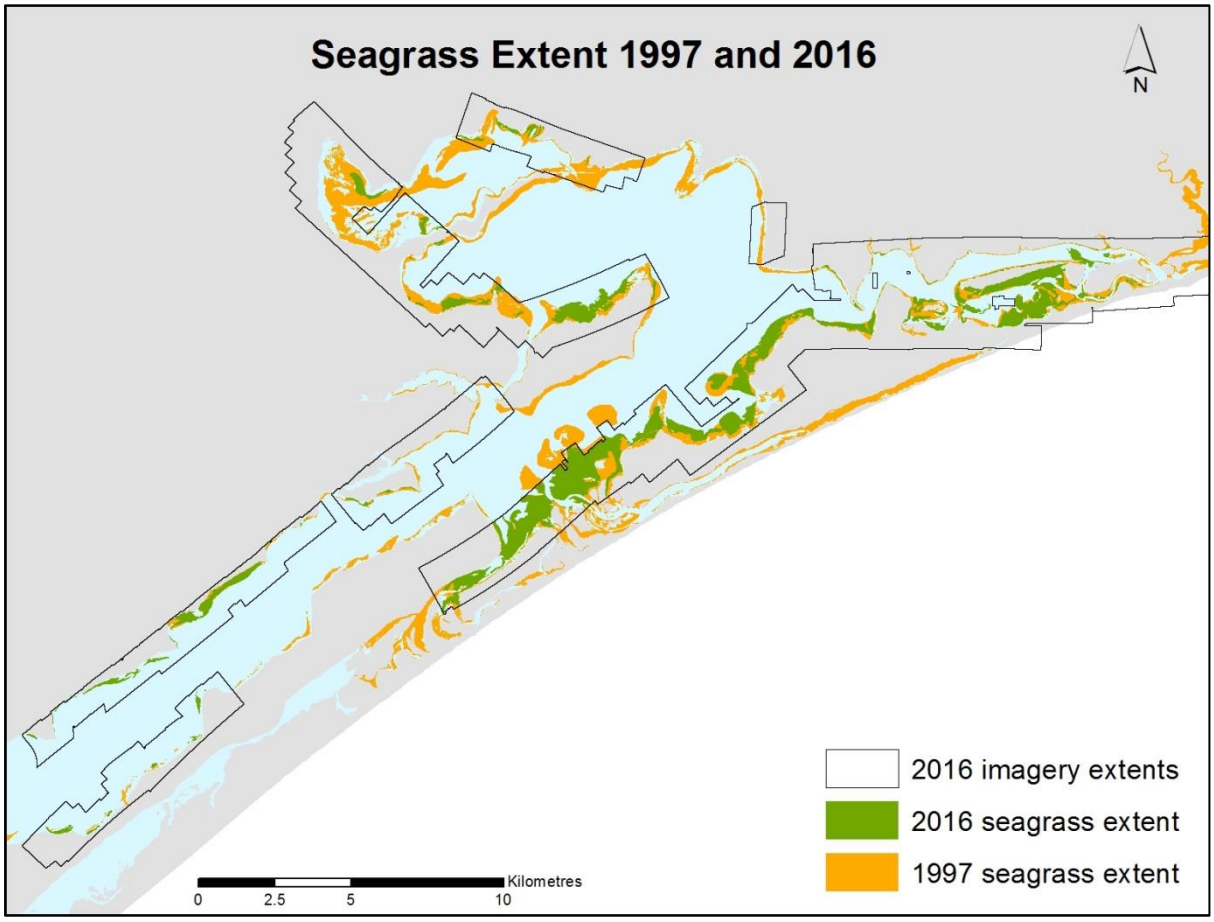
Jones Bay

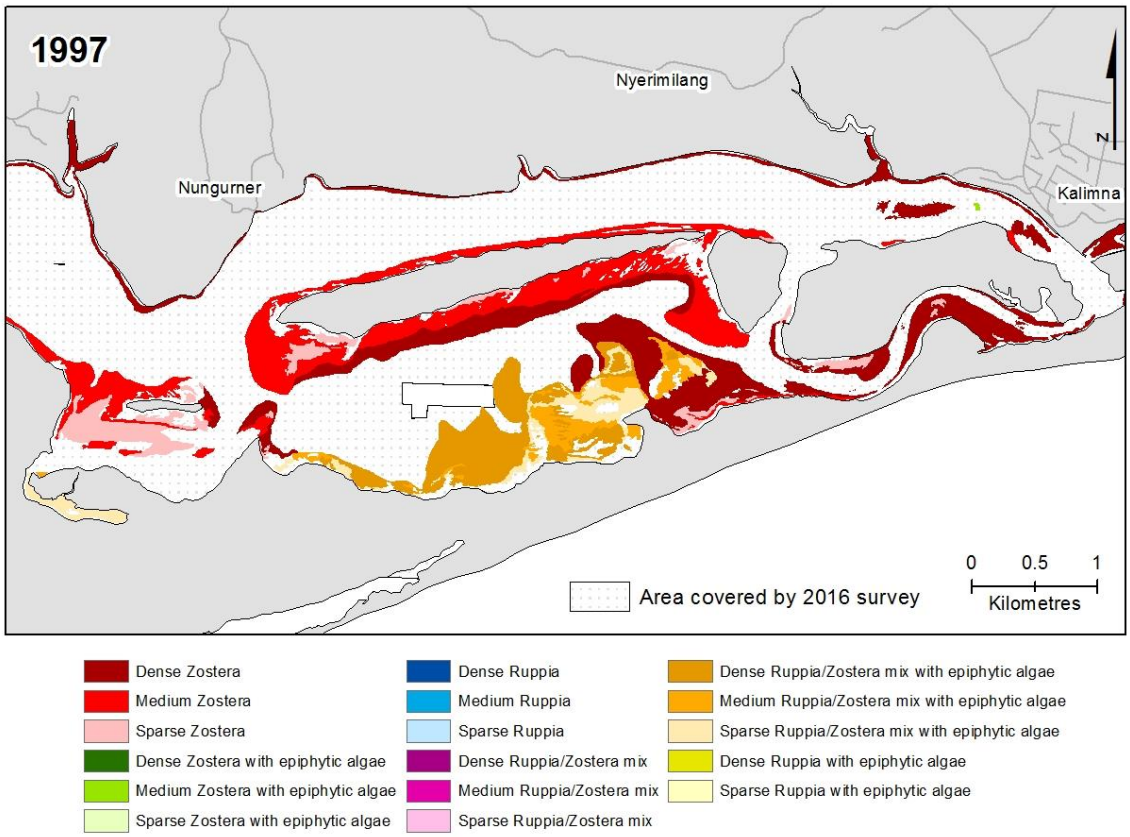


Loch Sport

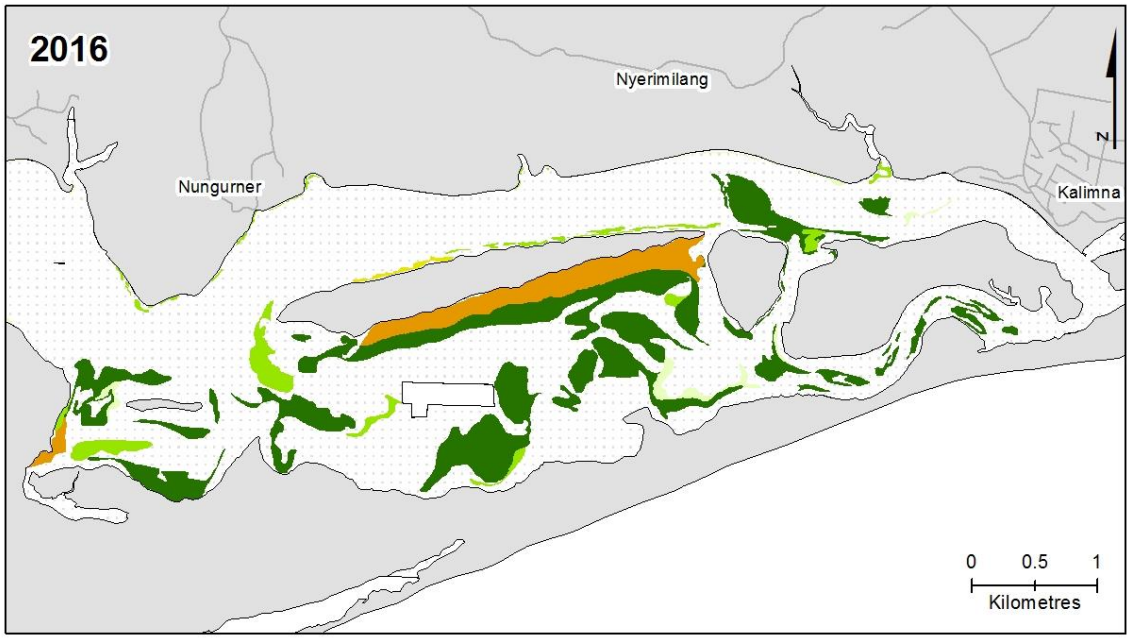


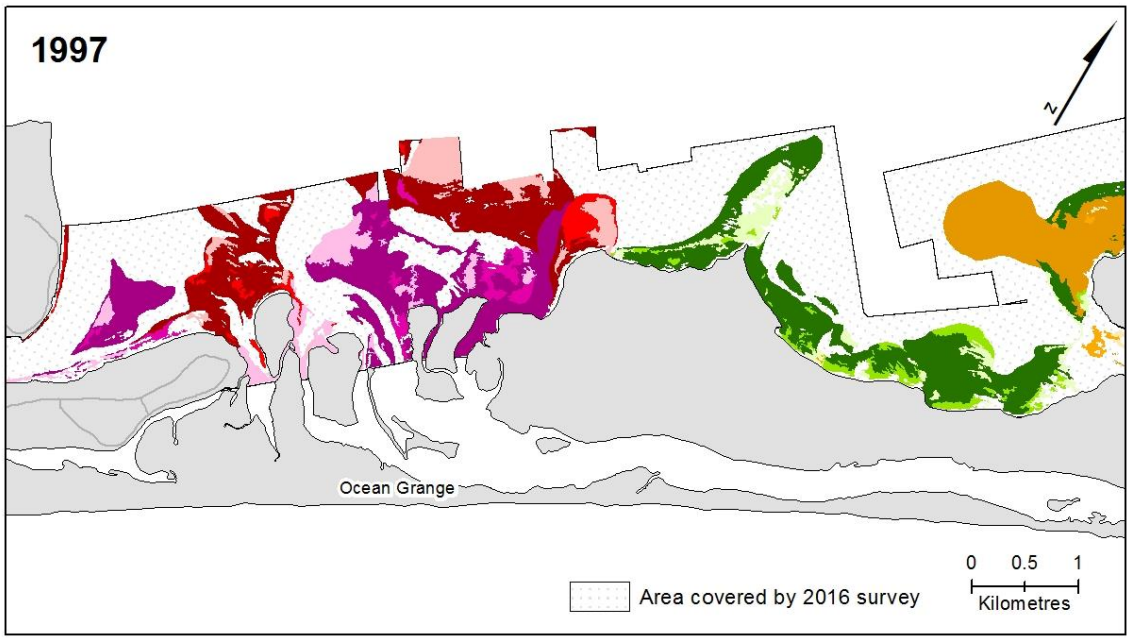
Appendix B – Comparisons of 1997 and 2016 seagrass classifications



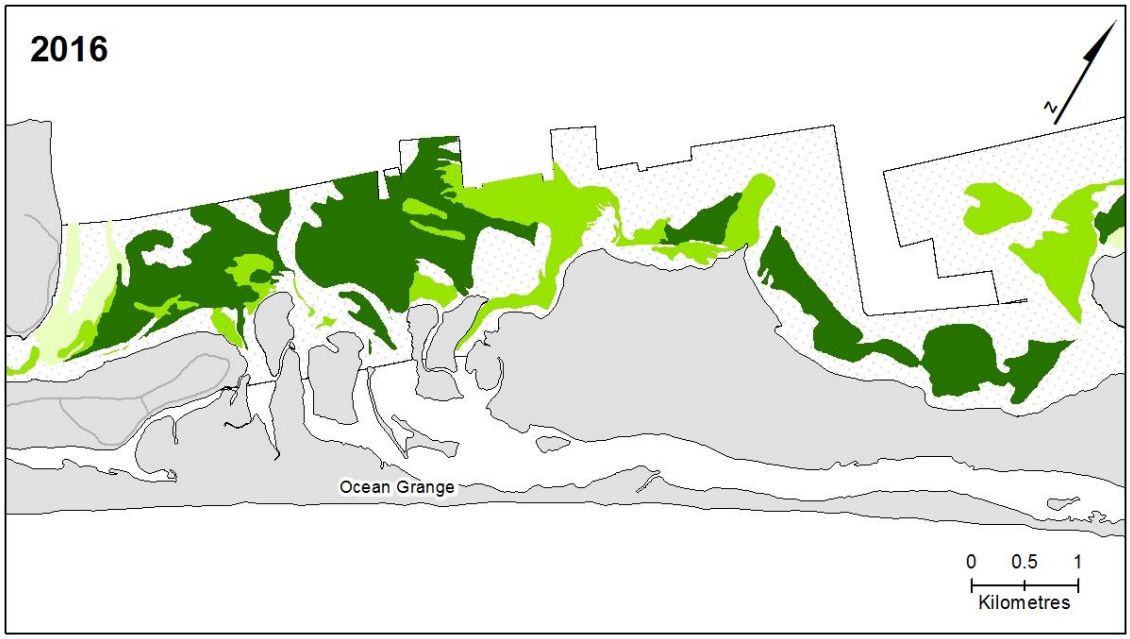

1997
Nyerimilang
Nungurner
Kalimna
N
Area covered by 2016 survey
0 0.5 1
Kilometres

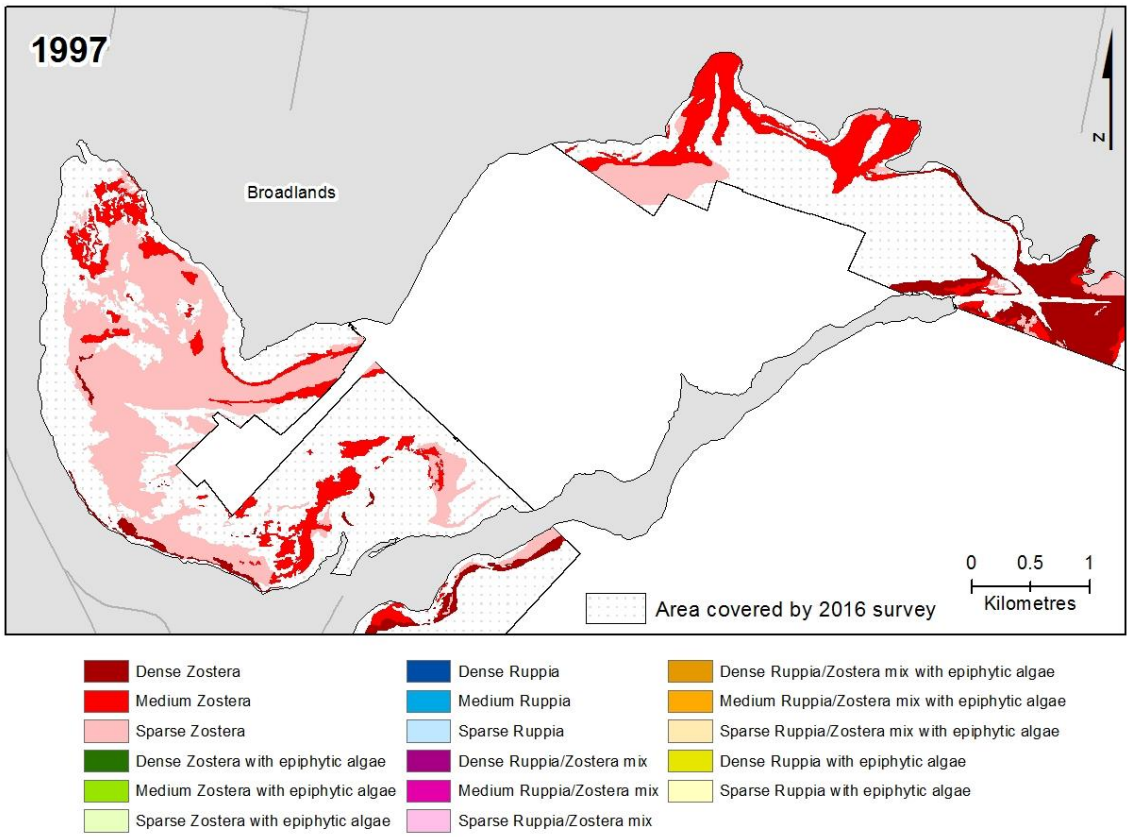
Dense Zostera
Medium Zostera
Sparse Zostera
Dense Zostera with epiphytic algae
Medium Zostera with epiphytic algae
Sparse Zostera with epiphytic algae
Dense Ruppia
Medium Ruppia
Sparse Ruppia
Dense Ruppia/Zostera mix
Medium Ruppia/Zostera mix
Sparse Ruppia/Zostera mix
Dense Ruppia/Zostera mix with epiphytic algae
Medium Ruppia/Zostera mix with epiphytic algae
Sparse Ruppia/Zostera mix with epiphytic algae
Dense Ruppia with epiphytic algae
Sparse Ruppia with epiphytic algae


2016
Nyerimilang
Nungurner
Kalimna
N
0 0.5 1
Kilometres

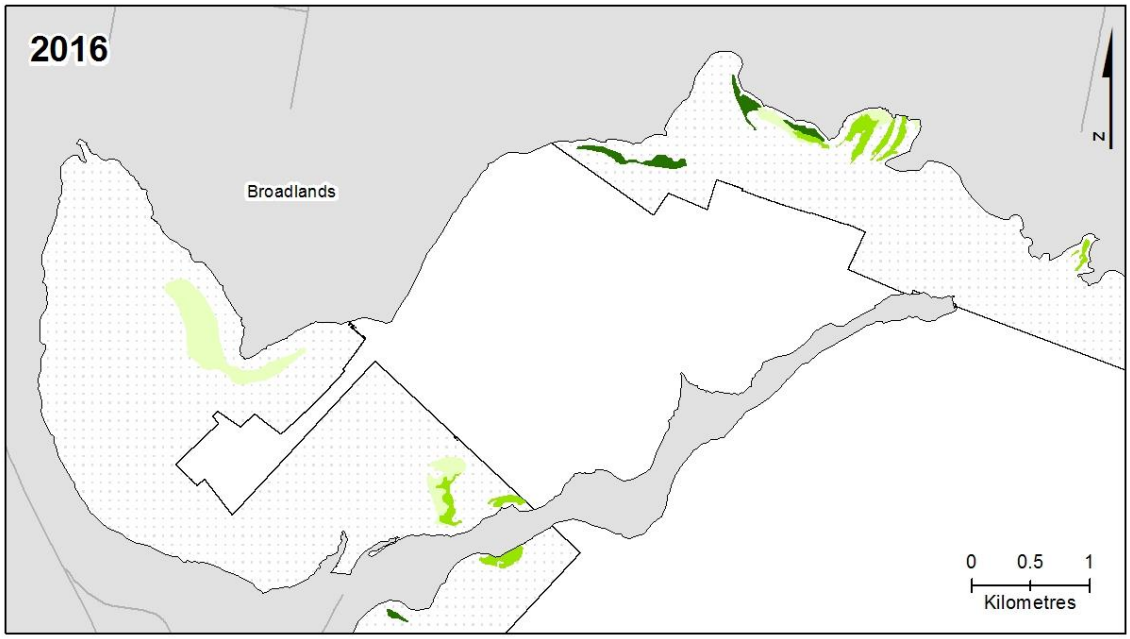

1997
N
Ocean Grange
Area covered by 2016 survey
0 0.5 1
Kilometres

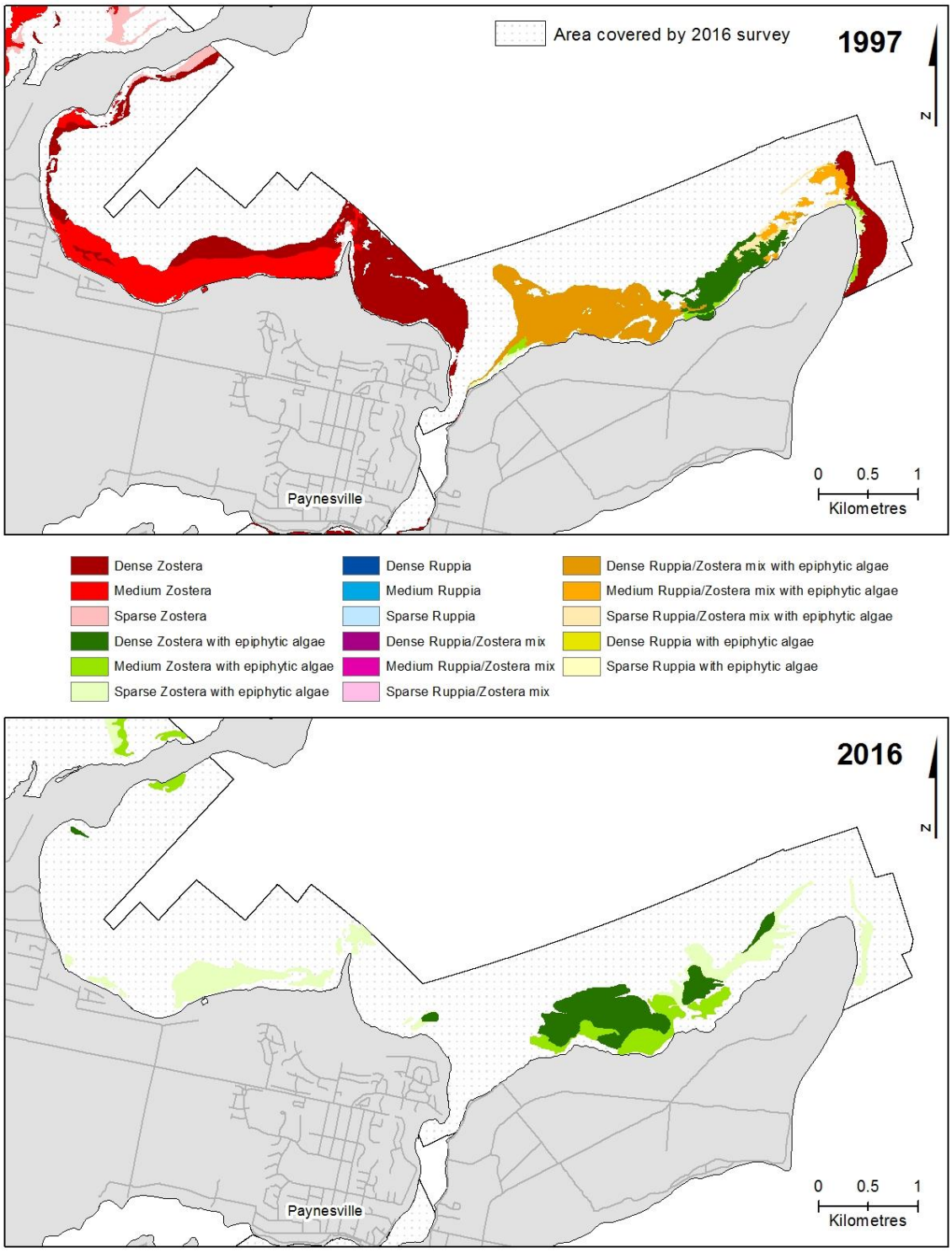

Dense Zostera
Medium Zostera
Sparse Zostera
Dense Zostera with epiphytic algae
Medium Zostera with epiphytic algae
Sparse Zostera with epiphytic algae
Dense Ruppia
Medium Ruppia
Sparse Ruppia
Dense Ruppia/Zostera mix
Medium Ruppia/Zostera mix
Sparse Ruppia/Zostera mix
Dense Ruppia/Zostera mix with epiphytic algae
Medium Ruppia/Zostera mix with epiphytic algae
Sparse Ruppia/Zostera mix with epiphytic algae
Dense Ruppia with epiphytic algae
Sparse Ruppia with epiphytic algae


2016
N
Ocean Grange
0 0.5 1
Kilometres


1997
Broadlands
N
0 0.5 1
Kilometres
Area covered by 2016 survey

Dense Zostera
Medium Zostera
Sparse Zostera
Dense Zostera with epiphytic algae
Medium Zostera with epiphytic algae
Sparse Zostera with epiphytic algae
Dense Ruppia
Medium Ruppia
Sparse Ruppia
Dense Ruppia/Zostera mix
Medium Ruppia/Zostera mix
Sparse Ruppia/Zostera mix
Dense Ruppia/Zostera mix with epiphytic algae
Medium Ruppia/Zostera mix with epiphytic algae
Sparse Ruppia/Zostera mix with epiphytic algae
Dense Ruppia with epiphytic algae
Sparse Ruppia with epiphytic algae

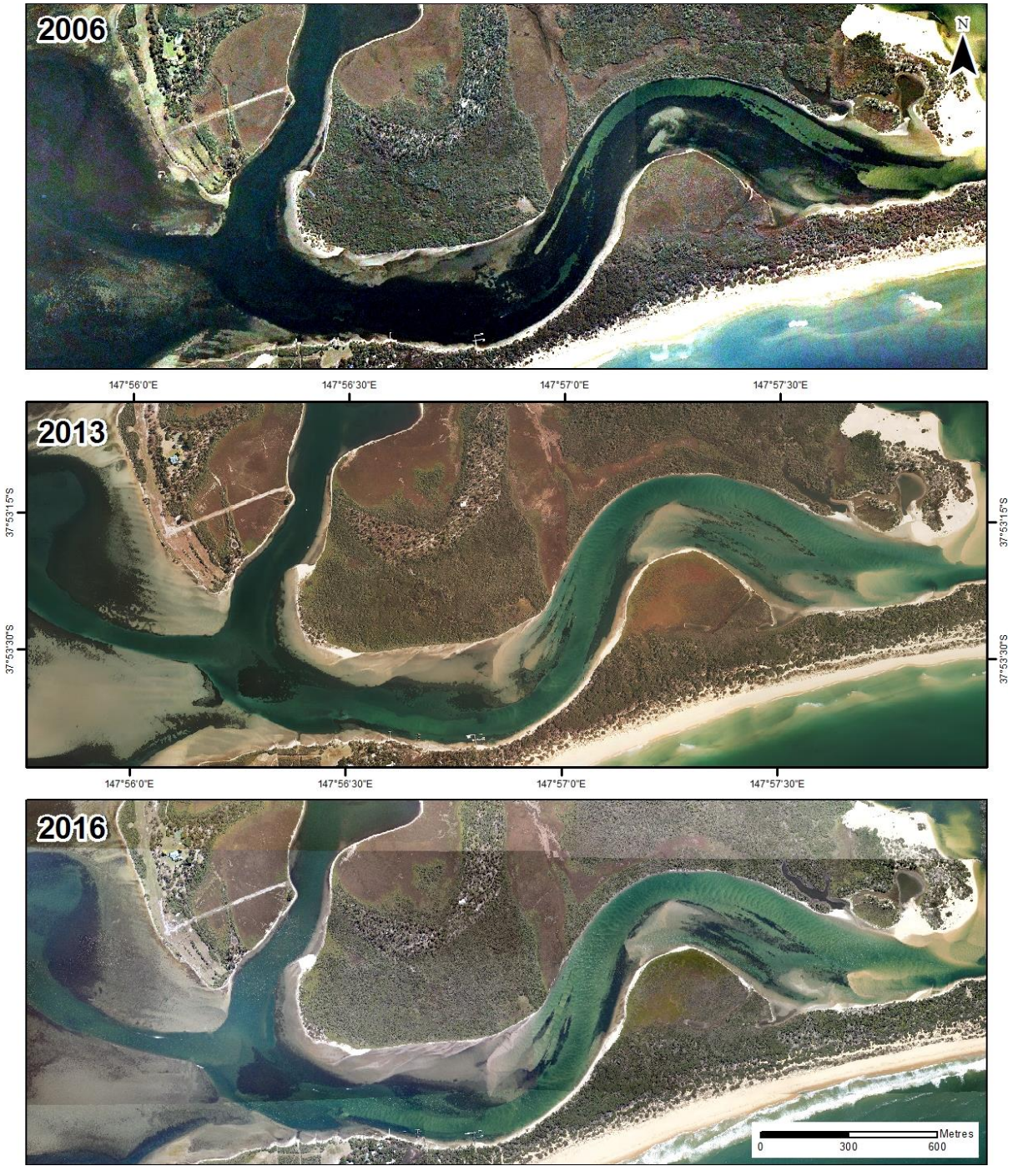

2016
Broadlands
N
0 0.5 1
Kilometres


Area covered by 2016 survey
1997
N
Paynesville
0 0.5 1
Kilometres
Dense Zostera
Medium Zostera
Sparse Zostera
Dense Zostera with epiphytic algae
Medium Zostera with epiphytic algae
Sparse Zostera with epiphytic algae
Dense Ruppia
Medium Ruppia
Sparse Ruppia
Dense Ruppia/Zostera mix
Medium Ruppia/Zostera mix
Sparse Ruppia/Zostera mix
Dense Ruppia/Zostera mix with epiphytic algae
Medium Ruppia/Zostera mix with epiphytic algae
Sparse Ruppia/Zostera mix with epiphytic algae
Dense Ruppia with epiphytic algae
Sparse Ruppia with epiphytic algae
2016
N
Paynesville
0 0.5 1
Kilometres

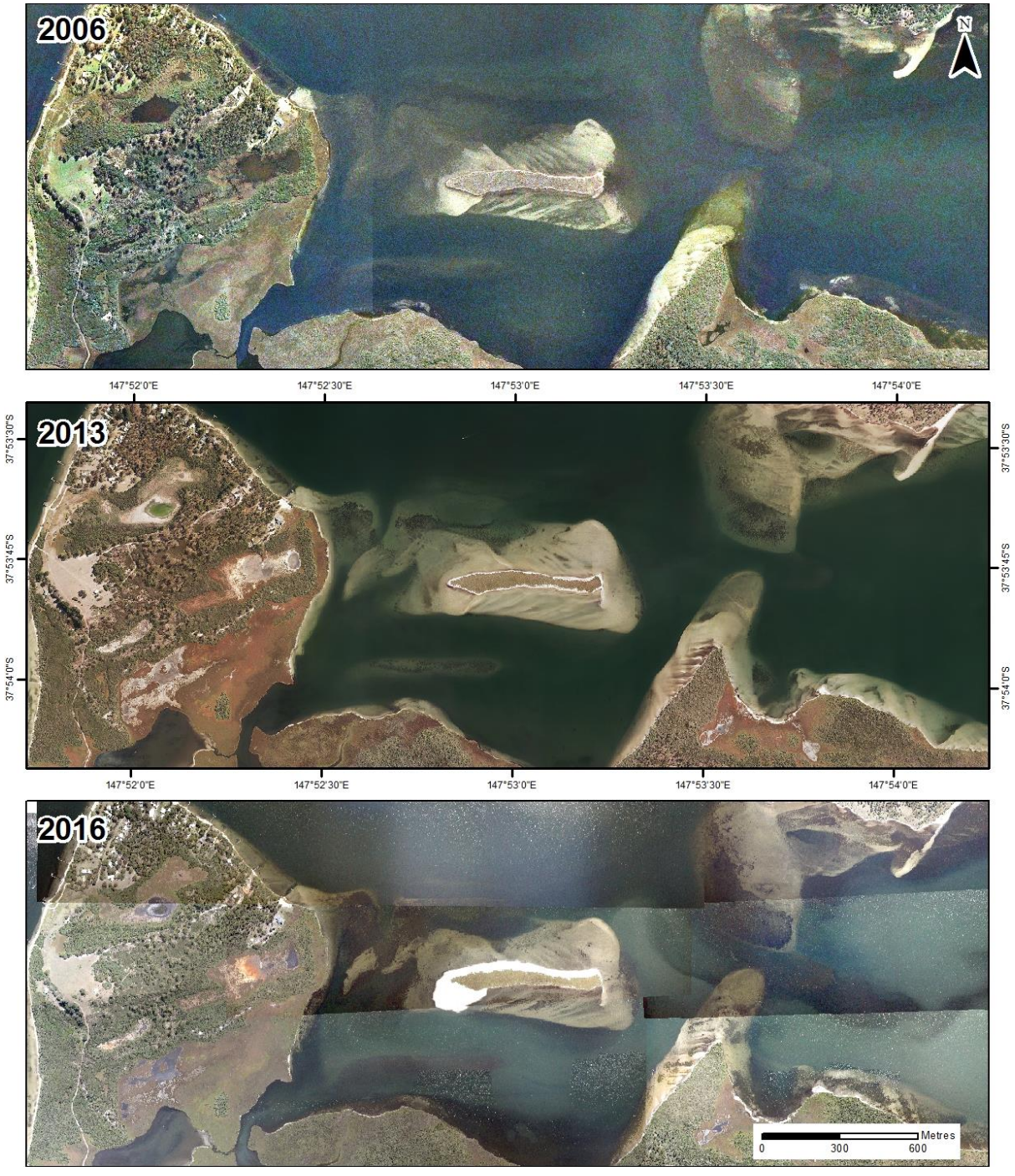
Appendix C – Imagery comparisons (2006, 2013, 2016)

Reeves Chanel

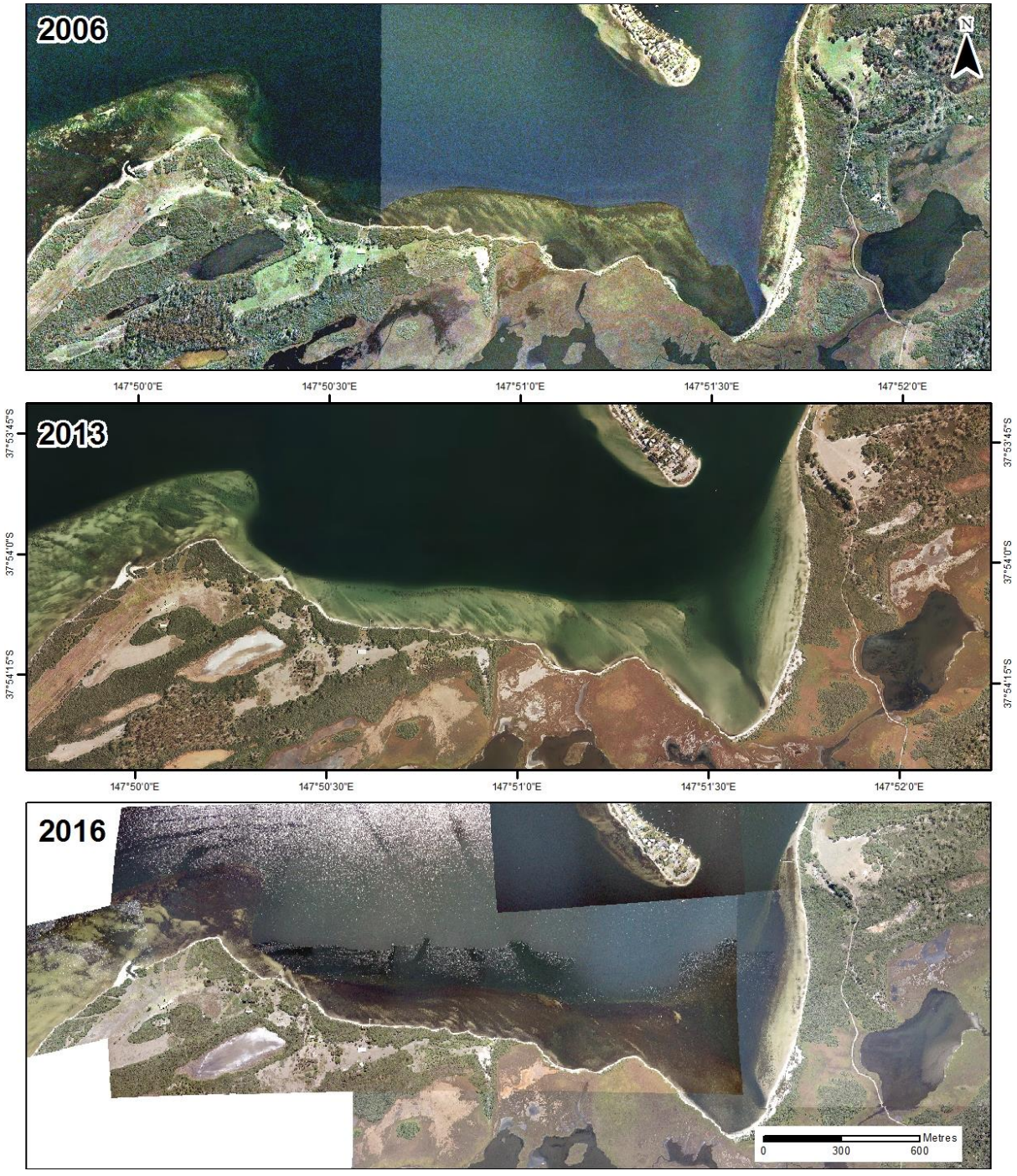
Hopetoun Channel



Baxter Island



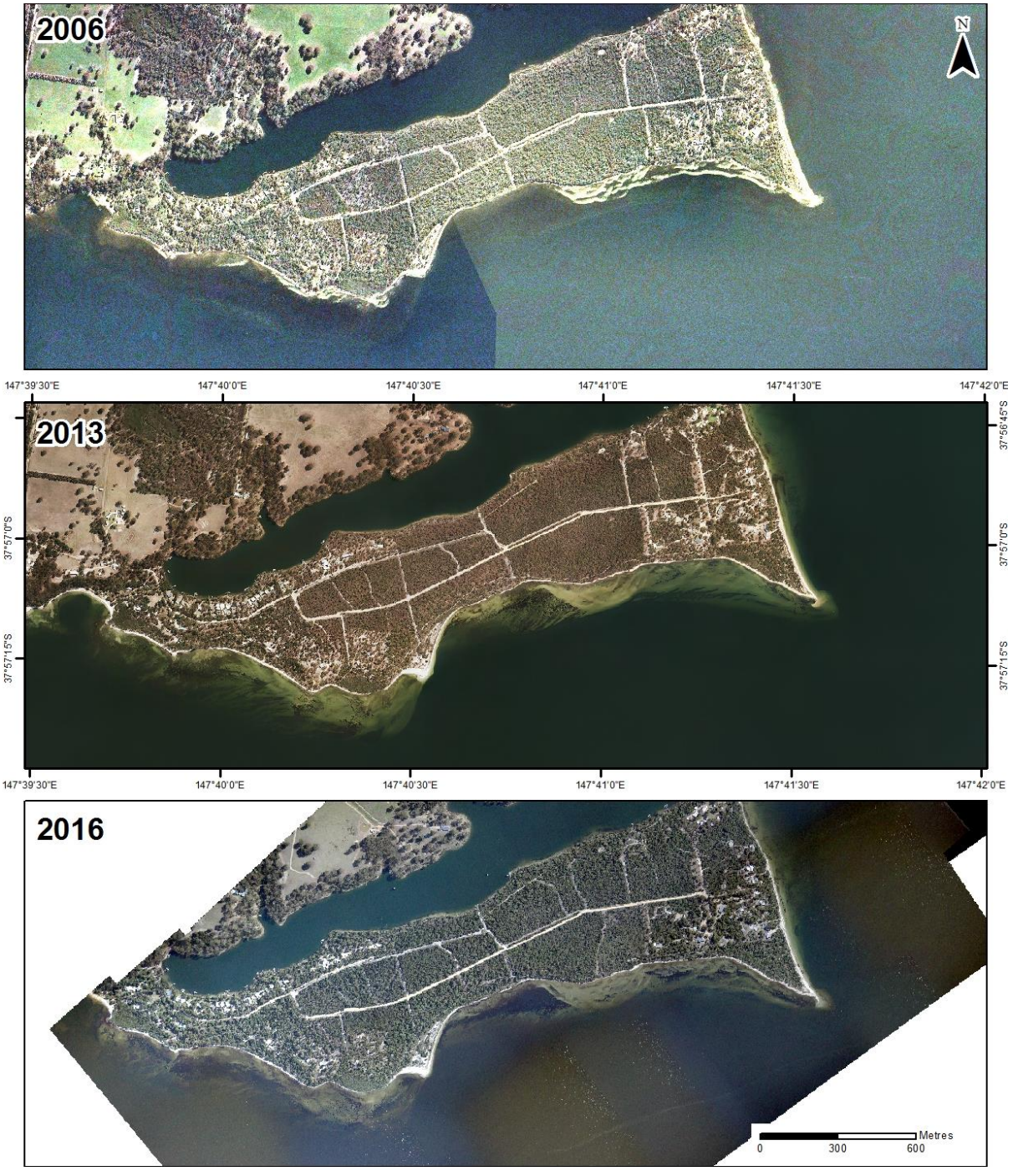
South Metung



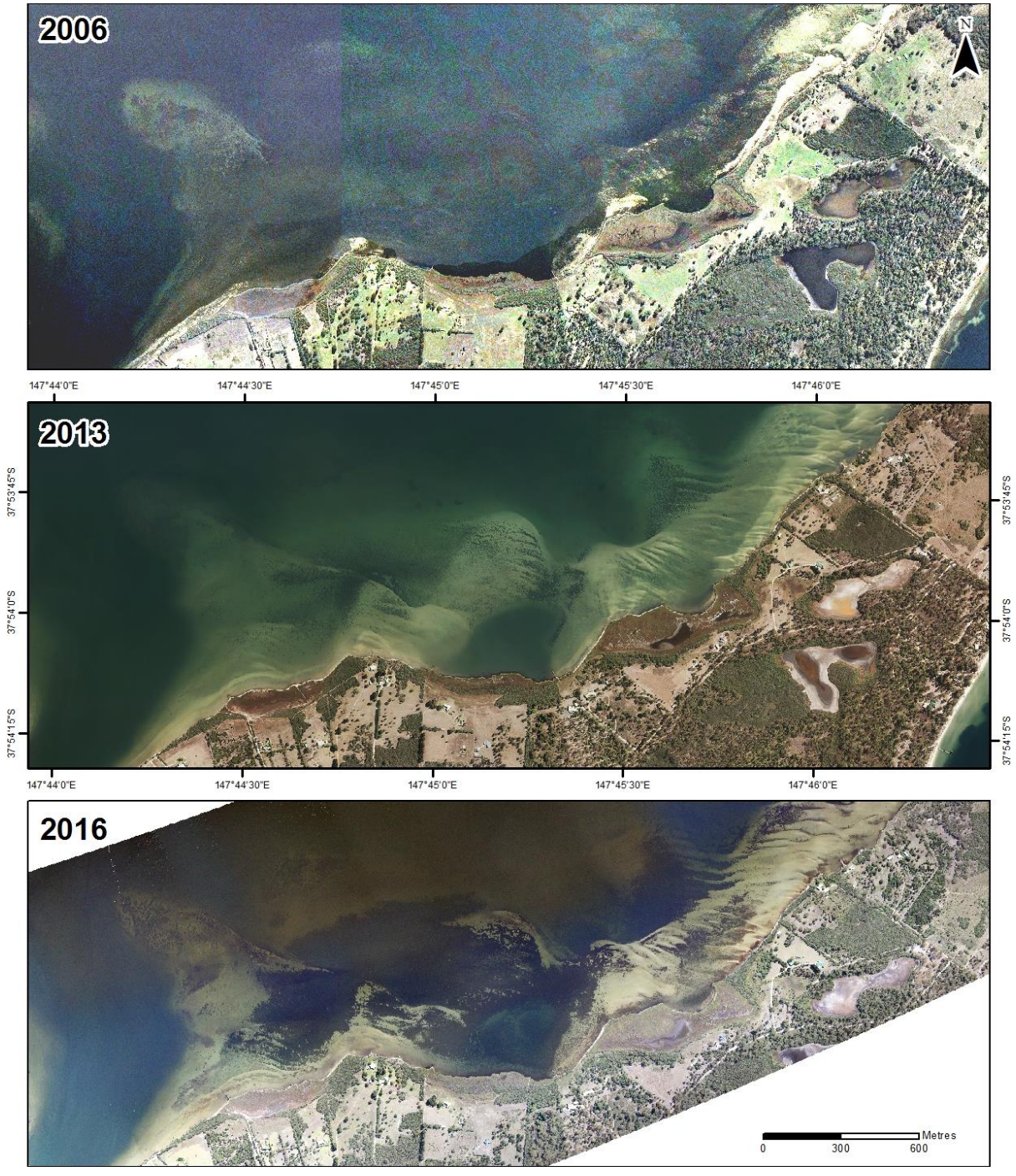
The Grange


147°44'30"E
147°45'0"E
147°45'30"E
147°46'0"E
37°56'15"S
37°56'30"S
37°56'45"S
37°57'0"S
2006
N
2016
Metres
0
300
600

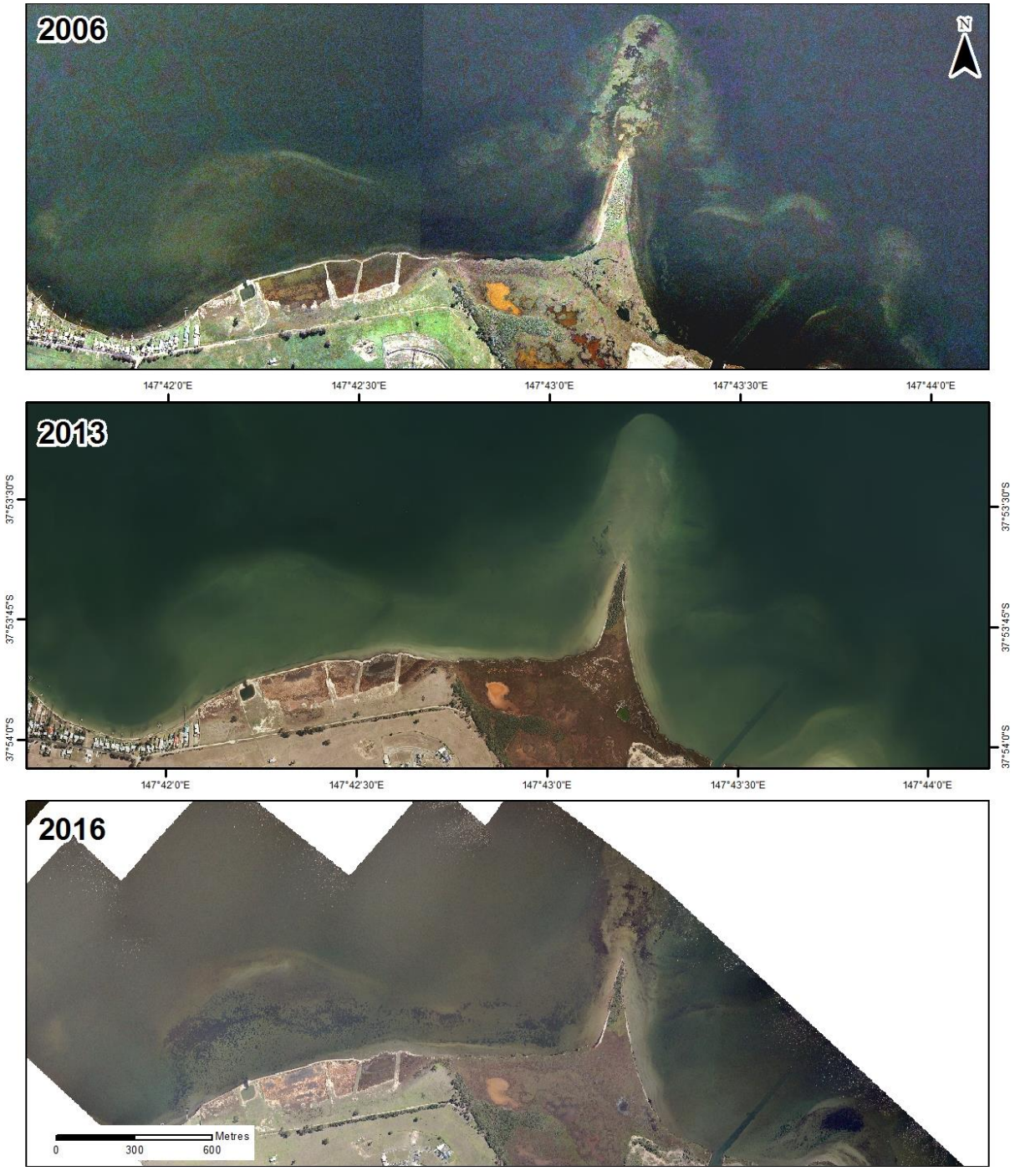
Banksia Peninsula



North Raymond Island



Point Fullerton



North Eagle Bay