National Environmental Science Programme

An eco-narrative of Huon Marine Park – South-east marine region

Marine Park Eco-Narrative Series

Vanessa Lucieer, Jacquomo Monk, Zhi Huang, Scott Nichol, Karen Miller, Neville Barrett, Alan Williams

Project D1 – National data collation, synthesis and visualisation to support sustainable use, management and monitoring of marine assets

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Milestone 17 – Research Plan v4 (2018)

Final report on ecologically important features of selected Australian Marine Parks




UNIVERSITY of TASMANIA

Australian Government
Geoscience Australia

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Australian Institute of Marine Science

CSIRO

Enquiries should be addressed to:

Karen Miller
Australian Institute of Marine Science
Indian Ocean Marine Research Centre
Corner Fairway and Service Road 4
Crawley WA 6009

Scott Nichol
Geoscience Australia
PO Box 378
Symonston, ACT, 2601
scott.nichol@ga.gov.au

Project Leader's Distribution List

Parks Australia Department of the Environment & Energy	
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EXECUTIVE SUMMARY

This report is one in a series of eco-narrative documents that synthesise our existing knowledge of individual Australian Marine Parks. This series is a product of the National Environmental Science Program Marine Biodiversity Hub Project D1, which seeks to collate, synthesise and visualise biophysical data within the parks. These documents are intended to enable managers and practitioners to rapidly ascertain the ecological characteristics of each park, and to highlight knowledge gaps for future research focus.

Huon Marine Park is characterised by a diversity of seabed habitats, ranging from low profile reefs and sediment plains on the continental shelf to a cluster of seamounts on the continental slope and low gradient plains on the continental rise. The shelf reefs and seamounts are the better documented habitats within the park and are the focus of this initial characterisation of the park.

Recent opportunistic seafloor surveying and accumulated transit data from the Marine National Facility (MNF) has revealed an extensive rocky reef system in the north east corner of the park that extends from the reserve boundary (~53 m depth) to around the 100 m depth contour. Whilst there has been little biological survey effort to characterise these reef systems, some information is available from occasional IMOS Autonomous Underwater Vehicle (AUV) surveys and a small number of video tows. These data indicate a moderate to high-profile reef system that is generally deeper than the photic zone and is predominantly covered in a dense but low-profile mix of sessile invertebrates, including sponges, bryozoans, soft corals and seawhips. This sponge-dominated invertebrate community appears to be heavily “pruned” by the influence of high energy Southern Ocean swells (wave heights more than 10 m) that regularly impact this region which presumably remove the larger invertebrates due to drag and/or sand-blasting. In the shallower northern boundary region of the park there is sufficient light for some red algal growth, however, this is at the margins of photic depth and primarily restricted to a low cover of encrusting coralline algae. Overall, the surface waters of Huon Marine Park are characterised by moderate to high productivity, as shown by satellite-derived measures of chlorophyll-a that show the park is among the top 10 for productivity of all Australian Marine Parks. Satellite data also show the park is experiencing a clear trend of warming within its surface waters and is within the reach of marine heat waves through connectivity with the East Australian Current.

Despite the high wave energy environment, the shelf reef habitats of the Huon Marine Park appear to be quite productive. This productivity is evident on the shelf reefs, where a high-density lobster population is recorded, both from counts in AUV surveys (53-85 m depth) and the regular use by the Tasmanian lobster fishing

industry. Less is known about associated fish assemblages on these reefs, although from the limited video footage available, key species include schooling butterfly perch and rosy wrasse.

For the deep water habitats of the seamounts, a series of biodiversity voyages have documented a rich benthic fauna, notably across their upper slopes. The most recent benthic habitat survey was conducted on RV *Investigator* voyage IN2018-V06 during November-December 2018, titled “Status and recovery of deep-sea coral communities on seamounts in iconic Australian marine reserves” it included areas first surveyed 20 years ago, some of which were subsequently closed to trawling. The voyage found some indications of change among benthic fauna on seamounts that had been previously trawled and are now protected within the park.

Further research is needed to adequately describe the resident fish assemblages on shelf reef and sediments in the Huon Marine Park, as well as improving our understanding of shelf-break habitats and biological assemblages where there is currently very little available knowledge. This additional research could include a re-survey of the seamounts to monitor for recovery of previously trawled areas of the park.

1. INTRODUCTION

Huon Marine Park, located ~8 km offshore from southern Tasmania in the South-east Marine Region and extending up to 100 km offshore, was proclaimed in October 2017 (https://www.legislation.gov.au/Details/F2017C01036) (Figure.1). It represents a wide range of pelagic and seabed ecosystems, including mid-outer shelf reef and sediments, shelf-break and continental slope habitats, marine canyons, abyssal plains and seamounts. Recent observations show the park supports a high diversity of marine mammals and seabirds (Williams 2018) and spatial representations for some species are shown in the Biologically Important Area mapping tool (http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf). Huon Marine Park also represents a range of national Key Ecological Features (KEFs), including the “seamounts of the southern region of Tasmania”, “shelf rocky reefs and hard substrates” and the “east Tasmania subtropical convergence zone” (https://www.environment.gov.au/sprat-public/action/kef/search). The vast majority of Huon Marine Park is zoned Multiple Use (IUCN VI), but also includes a Habitat Protection Zone (IUCN IV) representing examples of southern seamounts (see internal Box in Figure 1). This eco-narrative provides an overview of the current knowledge of the marine park, including its oceanographic, geomorphic and biological characteristics.

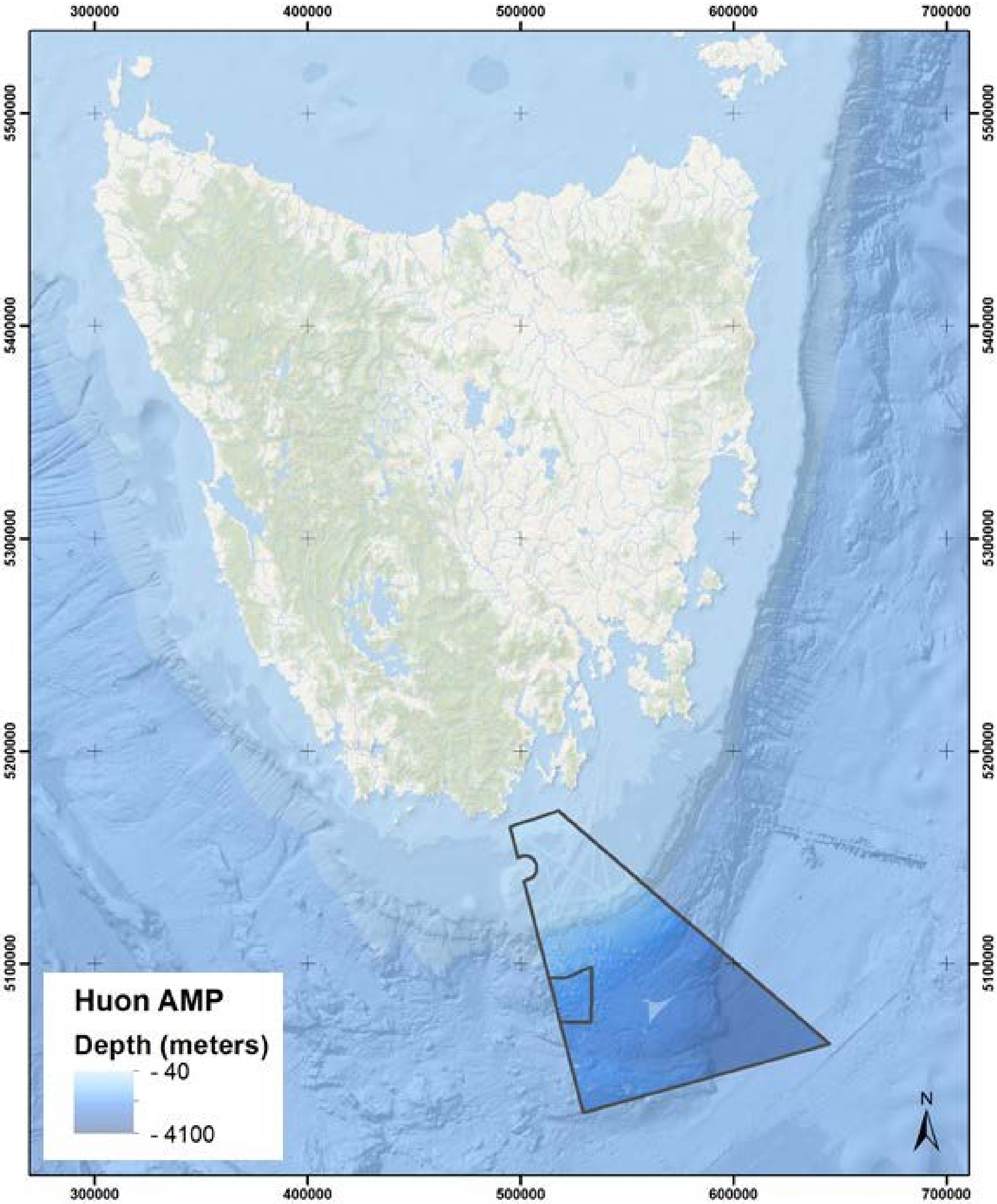

Figure 1: Location and extent of Huon Marine Park off south-eastern Tasmania. The internal box is a Habitat Protection Zone (IUCN IV).

2. PHYSICAL SETTING

The Huon Marine Park covers an area of 9,990 km^2 that spans the mid to outer continental shelf, continental slope and the lower continental rise. It is characterised by a gently sloping seafloor across the shelf, steepening dramatically at the shelf break at ~170 m depth, and remaining steep across the continental slope to depths of ~2000 m. It is located on the South Tasman Saddle (http://www.marineregions.org/gazetteer.php?p=details&id=25059) and characterised by rugged topography, with extensive rock exposure on the shelf and upper part of the slope, including clearly incised canyons (up to 250 m deep), and two clusters of volcanic cones (up to 600 m high) that form the Tasman Seamount group (Harris and Heap, 2005).

A key design element for the Huon Marine Park was the location of the Tasmanian Seamounts Marine Reserve (the habitat protection zone in Figure 1) that was declared in 1999 when the conservation significance of Australia's seamounts and the impact of commercial bottom trawl fishing was first recognized (Koslow and Gowlett-Holmes 1999). The seamounts in that early reserve were known to be part of Australia's largest known seamount cluster, and the Huon Marine Park now encloses the majority of them. Several others are enclosed by the Tasman Fracture Marine Park, also off southern Tasmania. The seamounts are the cone-shaped remnants of extinct volcanoes, up to 25 km across at the base, and rising 200-600 m from the seabed. The seamount area within the Huon Marine Park differs from all others identified in the Australian marine jurisdiction and the adjacent Tasman and Coral Seas, due to the large number of seamounts, their relatively shallow depth range (from base to summit), and the preponderance of cone-shape forms.

3. OCEANOGRAPHY

The Huon Marine Park sits at the confluence between the southerly extension of the East Australian Current (EAC) and the Zeehan Current that flows along the western margin of Tasmania. The interaction of these currents produces a mix of subtropical and subantarctic waters, respectively (Oliver et al. 2016). The relative influence of each current can vary seasonally, with the EAC incursion more pronounced in summer, bringing warmer sub-tropical waters. In the deeper waters of the park (> 50 m), winter circulation is dominated by the Zeehan Current across the marine park which extends along the Tasmanian east coast; in other seasons the EAC extension again influences the offshore areas of the marine park (Oliver et al. 2016). As a result of this mixing, the surface waters in Huon Marine Park are characterised by moderate to high primary productivity, especially within waters on the outer continental shelf at the northern end of the park (Figure 2). The long-term mean annual surface chlorophyll-a concentrations range from 0.5 – 2.2 mg/m^3, with a mean of 0.68 ± 0.16 mg/m^3 (Figure 2); autumn and winter levels are often slightly higher than during summer and spring (http://northwestatlas.org/node/27500). This mean chlorophyll-a value ranks 9th highest among all Australian marine parks.

Since 2002, satellite remote-sensing (MODIS) derived sea surface temperatures within Huon Marine Park display a strong warming trend at an annual rate of 0.09^o C (Figure 3a). This rate is the highest among all Australian Marine Parks and is twice the rate of the overall average across the south east marine park network of 0.043 ± 0.02 ^{o}C (Figure 3b). This annual rate for the Huon is consistent with the longer 25 year record (1992-2016) published in the SST Atlas of Australian Regional Seas (SSTAARS), which records a decadal warming rate in Huon Marine Park of 0.983^{o}C (Wijffels et al. 2018). According to the SSTAARS, this is the third highest decadal rate among all Australian marine parks. Huon Marine Park is also impacted by marine heat waves (MHWs). In the past 16 years (2002-2018), the marine park has experienced 4.6 MHW events per year on average, with a mean intensity of 0.77^{o}C above the 90% percentile climatology. The most notable being an unprecedented event in 2015-16 (Figure 3c), which was forced by a record El Nino event (Oliver et al. 2017). The 2015-16 MHW lasted through summer and autumn and peaked in March when SST reached 3.0^{o}C above average across the entire park (Figure 3c&d)[1].

[1] A MHW also occurred in the southeast region during the 2018/19 summer and was recorded by the Himawari-8 satellite. At the time of writing, this new data had not been analysed to understand the spatial extent or intensity of that MHW in relation to the Huon Marine Park.

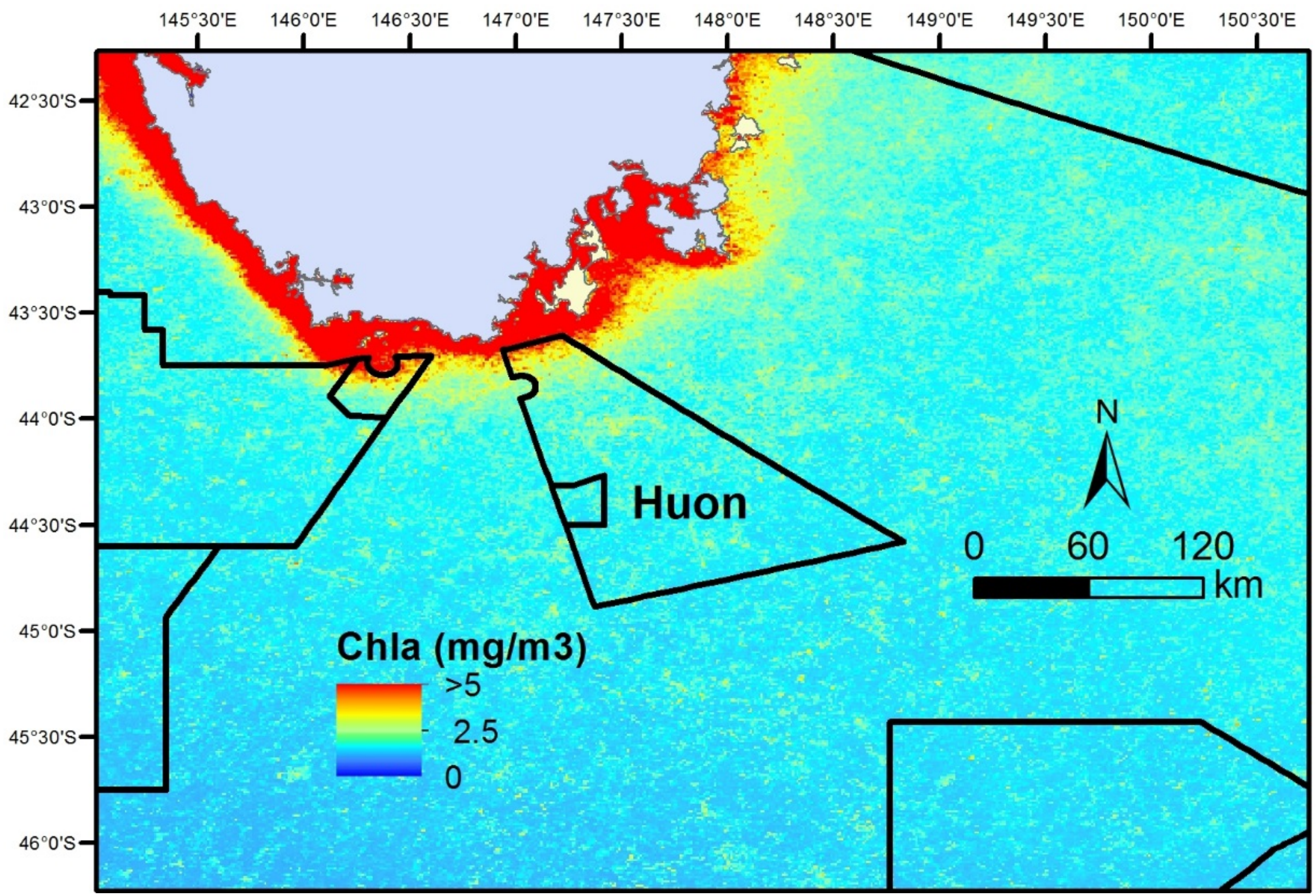

Figure 2. Mean annual chlorophyll-a concentrations over the Huon Marine Park (0.68±0.16 mg/m3), derived from MODIS satellite imagery for the period 2003 to 2017

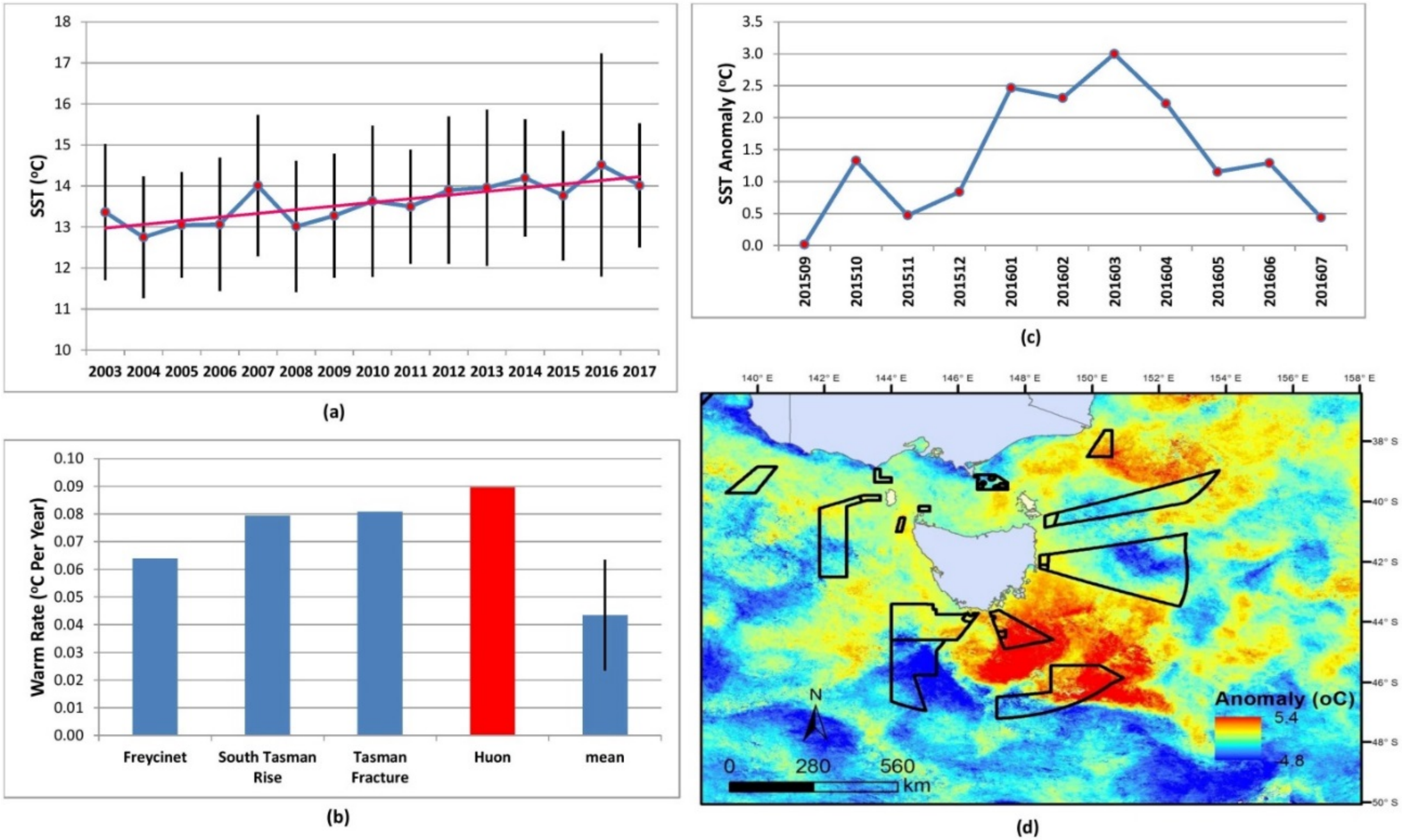

Figure 3. Sea Surface Temperature (SST) trends within Huon Marine Park derived from MODIS satellite imagery for the period 2003-2017, showing: a) Annual average (blue line) with standard deviation (vertical bars); b) Warming rate (º C per year) for Huon Marine Park and three other marine parks in the south-east region against the national mean for all marine parks; c) Monthly SST anomalies in Huon Marine Park during the 2015-16 marine heat wave event; d) SST anomaly map for the marine heatwave of March 2016.

4. GEOMORPHOLOGY AND POTENTIAL HABITATS

The data utilised for this analysis of seabed features in Huon Marine Park is focused on the continental slope and deeper where bathymetry data was collected by the Marine National Facility, RV *Southern Surveyor* in 1997 for the Australian seamount research project funded by Environment Australia and the Fisheries Research and Development Corporation (Williams et al. 2007). A new seafloor mapping scheme, has been applied to these data (Nanson and Nichol 2018). Linking the seafloor morphology to geomorphic process and substratum types in this way provides a consistent basis for describing the potential habitats in the Huon Marine Park and comparing them with other areas. Additional data were collected in 2018 and combined with the historical data to produce the updated general bathymetry maps shown in Figure 8.

The Provinces level of the mapping scheme classifies 17.6% of the Huon Marine Park into the continental shelf category, 66.8 % into the continental slope category and 15% into the continental rise category (Figure 4). Across the mapped area of the park, the seafloor divides into three Surface level categories that represent broad habitat settings. Thus, 26% is classed as low gradient *Planes* of < 2°, 56% as *Slopes* of 2-10° and 16% as *Escarpments* steeper than 10° (Figure 5).

4.1 Continental slope to rise

On the continental slope, the seabed is dominantly gently sloping (2-10º) and is further classified into finer morphological features. These include, seamounts (1.98 % of mapped area), terraces (0.18%), ridges (0.17%), knolls (0.48%), depressions (17.58%) and channels (0.88%) (Figure 6). Most of the seafloor depressions occur around and between the base of the seamounts. Although the seamounts represent a small area due to their conical shape, they are still a dominant morphological feature of this park. The terrace area on the continental slope is characterised by exposed rock faces that provide ideal substrate for sessile biological communities. The continental rise is predominantly flat and at the limited resolution of the data available (50 m) showed no pronounced topography.

Benthic habitats of the Huon Marine Park can be inferred from the seafloor geomorphology, although there is little available habitat validation data available for true benthic habitat characterisation (Figure 7). When mapped using the nationally adopted Seamap Australia benthic classification only the first tier of the seafloor classification hierarchy can be mapped (see https://seamapaustralia.org/wpcontent/uploads/2017/11/Classification_Hierarchy_20170907.pdf for further information) identifying the seamounts morphologies as hard substrata and the surrounding depressions as soft substrate. The resolution of the remaining data was too coarse to infer benthic habitat type.

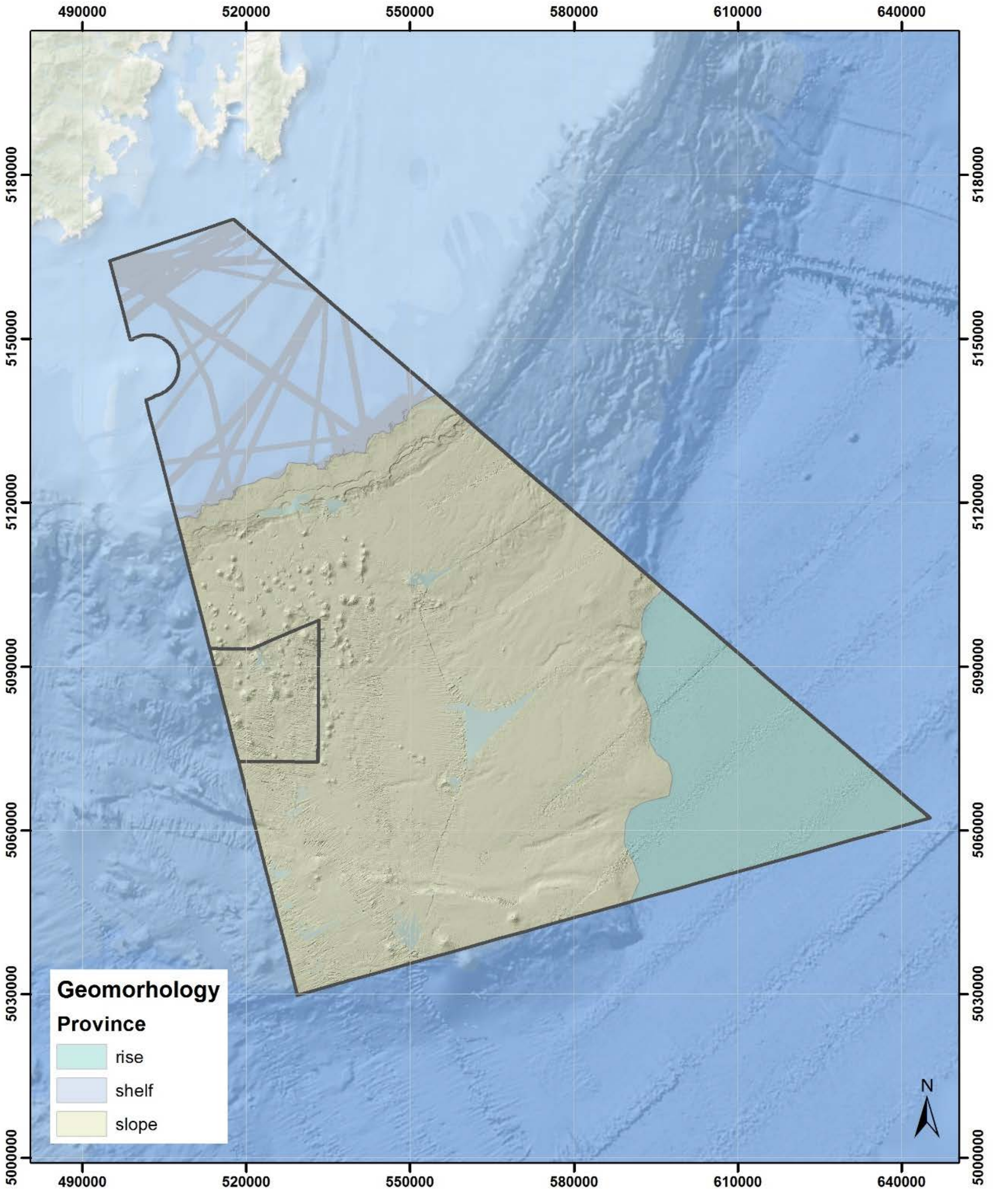

Figure 4: Geomorphic features (Level 1- Province) of Huon Marine Park.

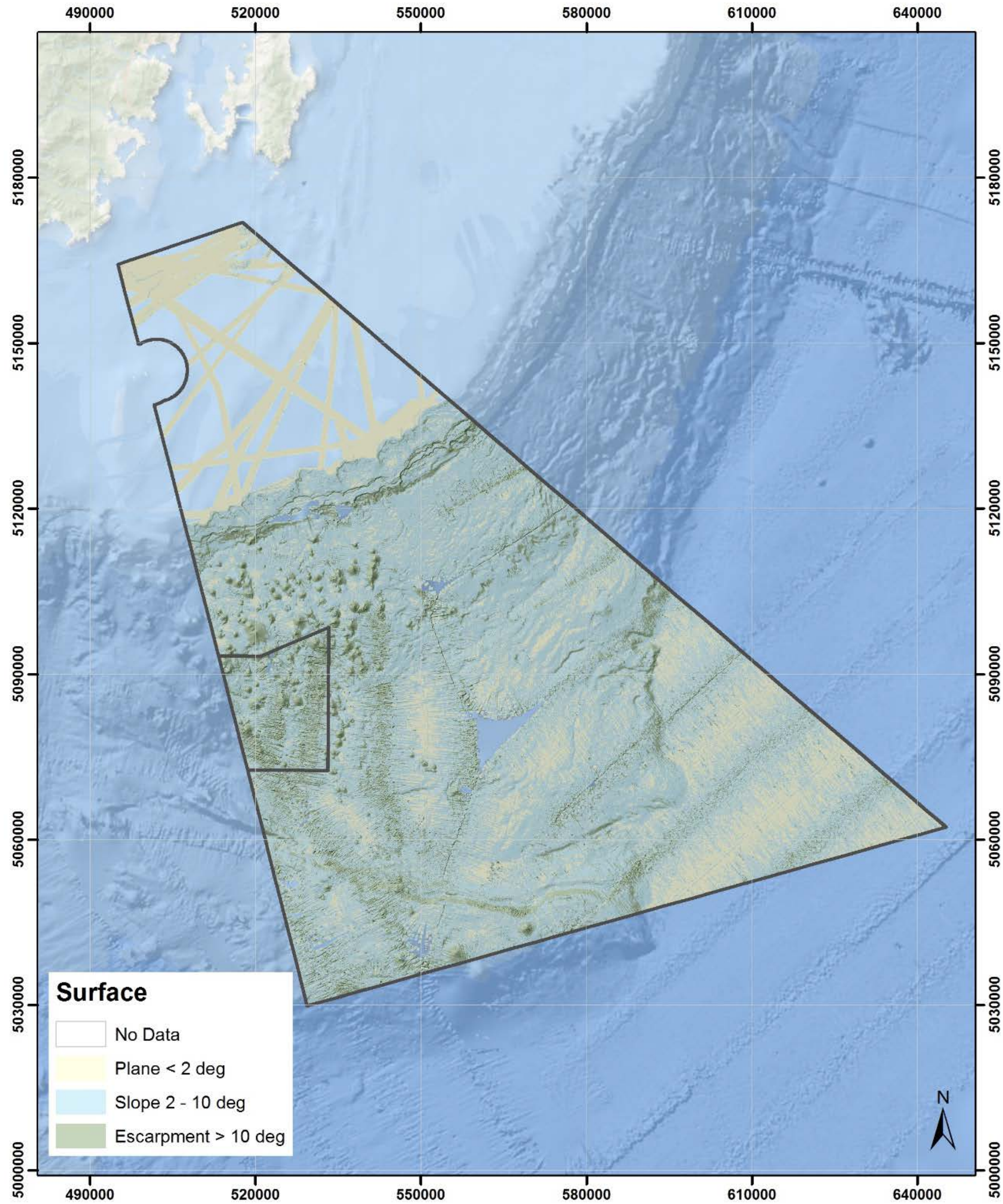

Figure 5: Geomorphic features (Level 2- Surface) of Huon Marine Park.

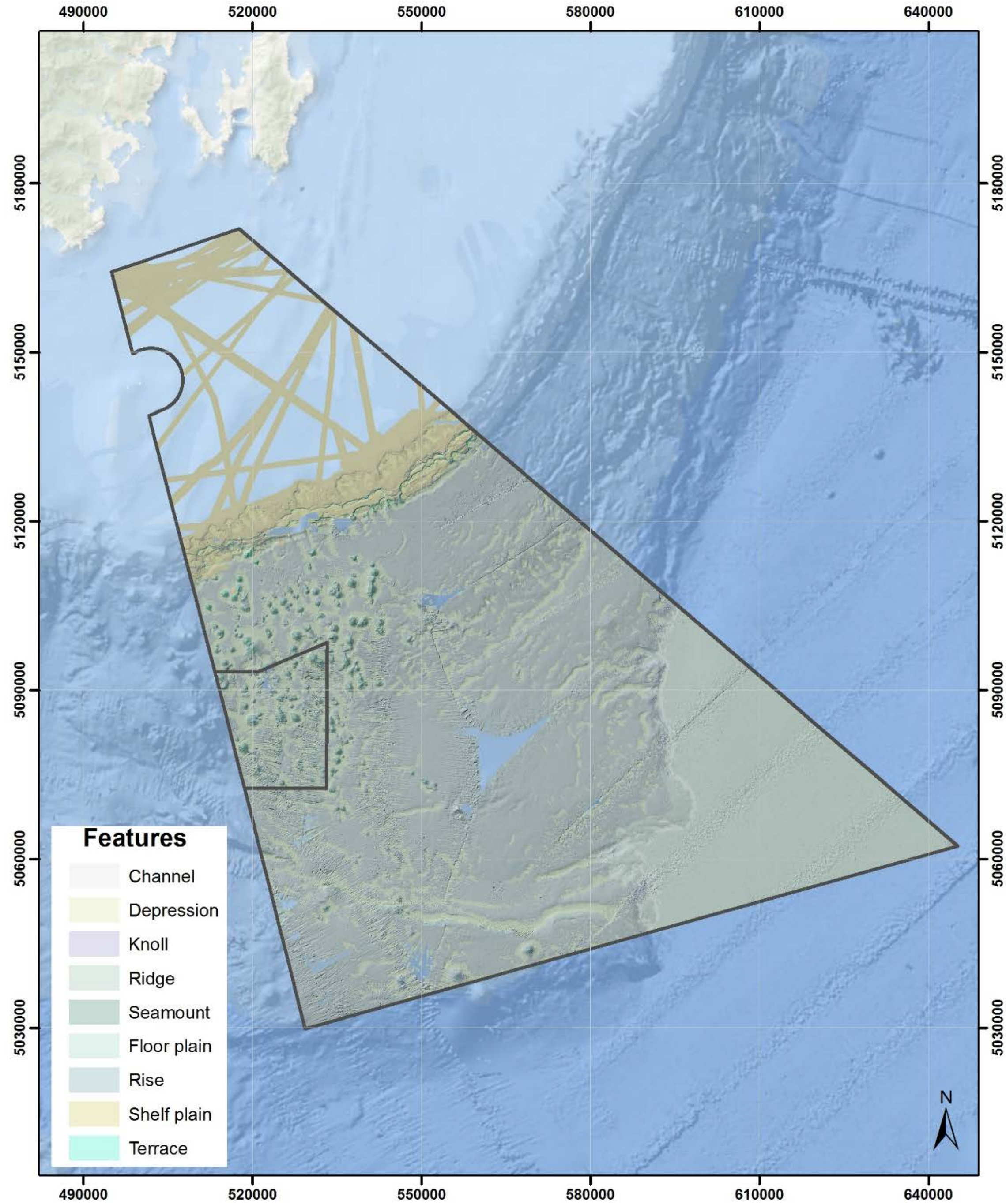

Figure 6: Geomorphic features (Level 3- Features) of Huon Marine Park.

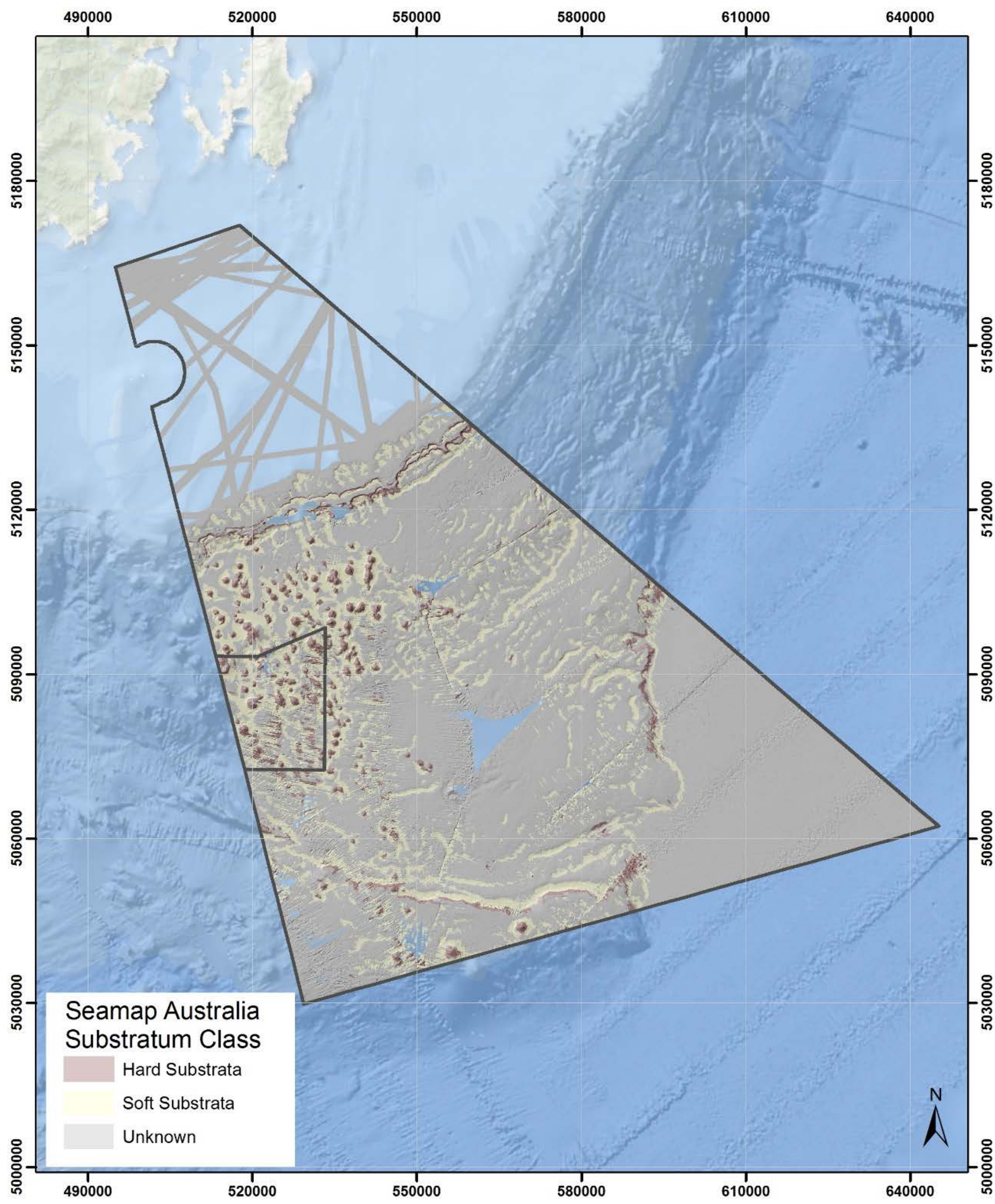

Figure 7: Seafloor habitats within Huon Marine Park mapped from a 50 m bathymetry grid (Figure. 1), using a 50m hillshade as the background. Much of the mapped region lacks validation data required to further differentiate soft sediment and hard substrate classes (www.seamapaustralia.com).

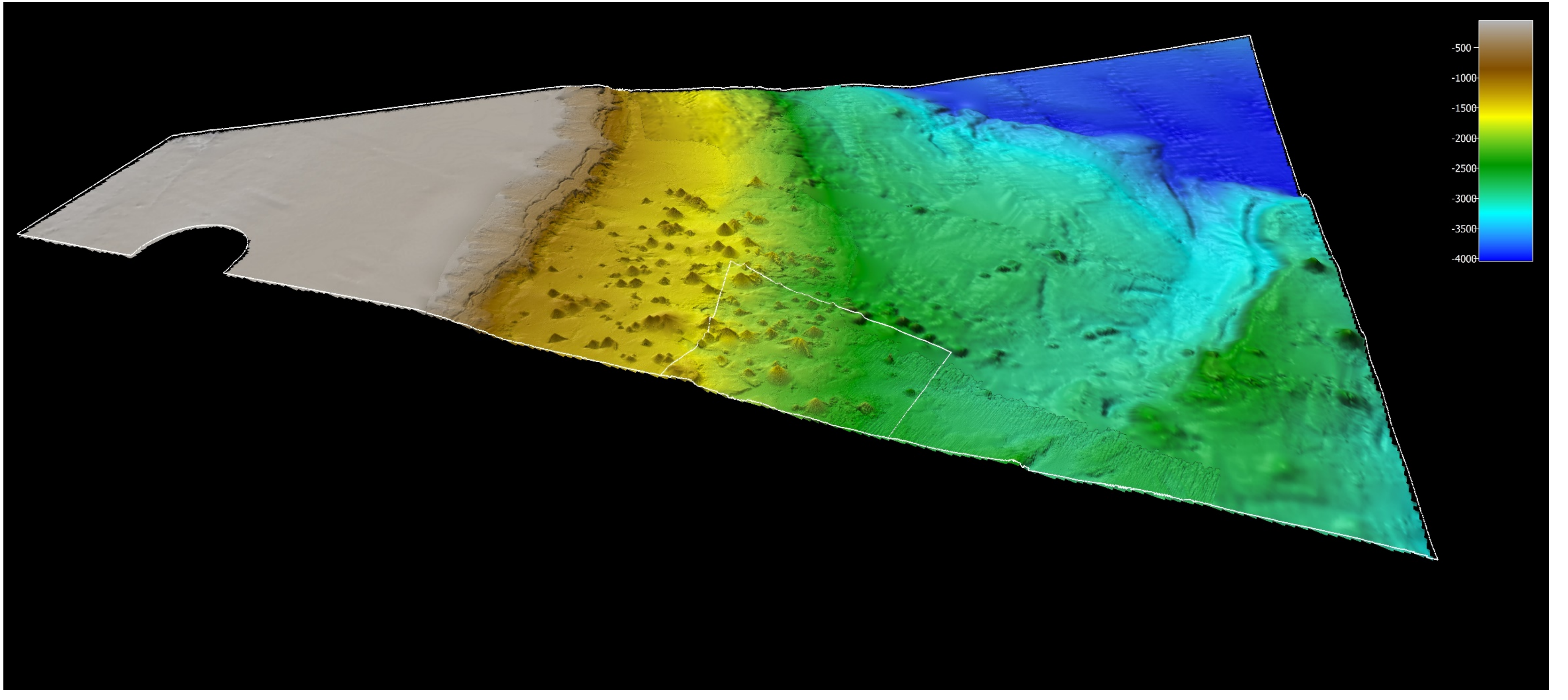

Figure 8: Updated bathymetry map of the Huon Marine Park mapped from a variety of data at different grid resolutions and showing an oblique perspective. The map shows the changing slope of the seafloor: flat on the continental shelf, and relatively steep at the shelf edge (shelf break), with relatively high relief on the seamounts. (Vertical exaggeration x 2.)

4.2 Continental shelf

There has been relatively little mapping on the continental shelf in Huon Marine Park. However, incremental mapping by the CERF and NESP Marine Biodiversity Hubs, coupled with Marine National Facility (MNF) transits throughout this region over the period 2007-2019[2] (Figure 9 top) has allowed improved understanding of shelf-based features, particularly on the nature and extent of mid-shelf reef and soft-sediment systems (Figure 9). As much of this mapping has been targeted on describing the extent of particular features (e.g. shelf reef) it is not suitable for use in producing inferential statistics on overall habitat cover or type. The current information suggests that the NE quadrant of the shelf area of the park contains extensive areas of reef that extend from the northern boundary in around 40 m depth to a reef margin at around 100 m depth lying 10 km to the SE (Figure 9). Ground-truthing of this reef by Autonomous Underwater Vehicle (AUV) surveys and towed-video (e.g. Figs 11 and 12), suggests it is of moderate to high structural complexity, and likely to be of dolerite origin, similar to the adjacent Tasmanian coastline (Nichol et al. 2009). Recent unpublished mapping in southern Tasmania (Figure 9b), in addition to mapping in the adjacent Tasman Fracture Marine Park (Monk et al. 2016), suggests that this lower depth margin of cross shelf reef outcropping (100 m) is typical of the region, and may reflect erosion margins associated with past ice-age sea-level stands. Close examination of vessel-transit mapping in the remainder of the Huon AMP suggests that it is unlikely significant additional reef outcrops will be found further offshore than the currently mapped extent and that soft-sediment habitats predominate from there to the shelf-break. Currently, there is insufficient mapping of the shelf-break in this area to determine whether further reefs are present in shelf-incised canyon heads and similar features as has been found in other SE marine parks (e.g. Flinders MP) (Monk et al. 2017) where upwelling and/or enhanced currents maintain exposure of bedrock.

[2] At the time of writing, data collected by the MNF in March 2019 had not been fully processed

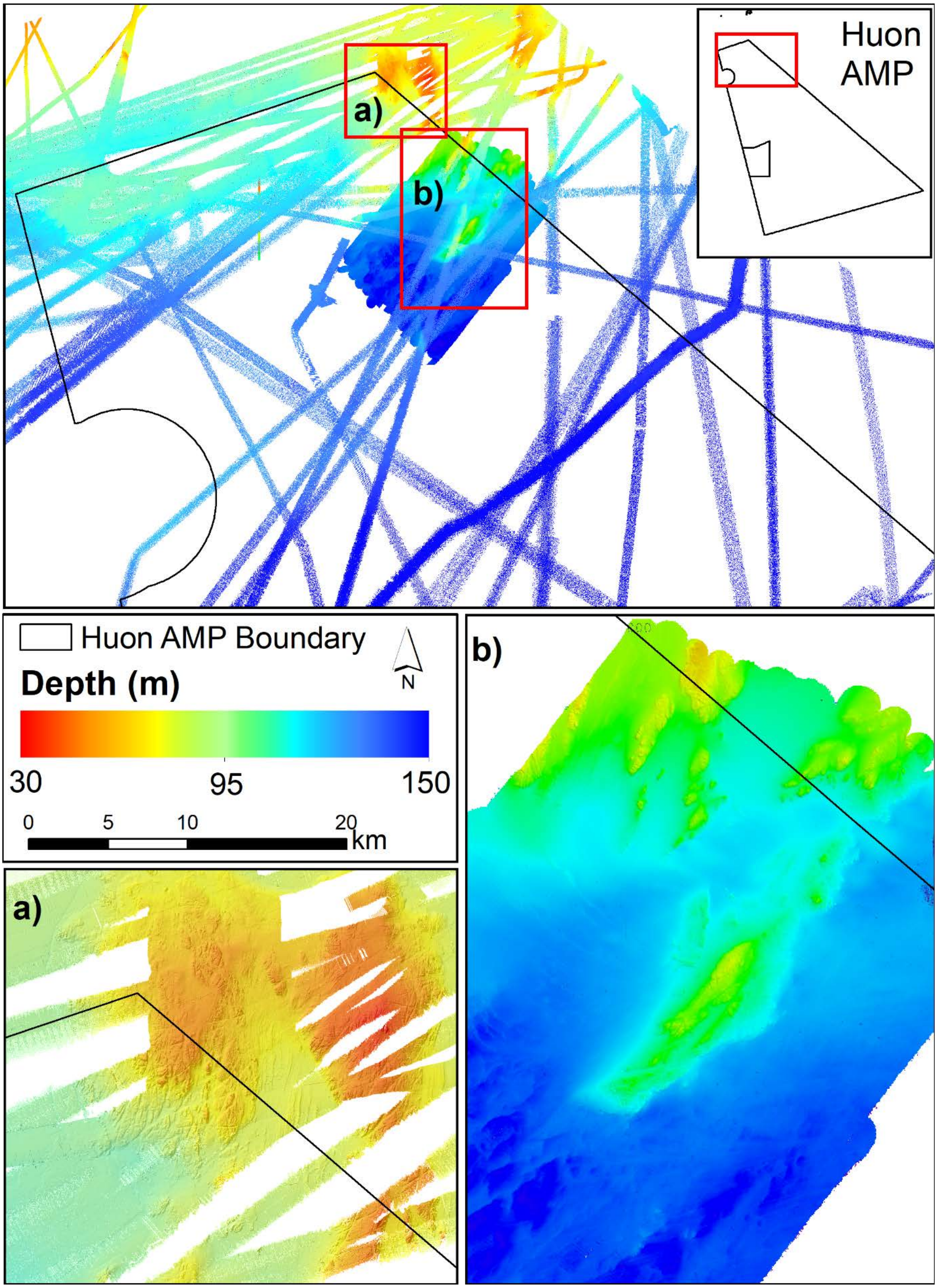

Figure 9. New multibeam data collected in the northern section of the Huon Marine Park in April 2019.

5. THE ECOLOGICAL SIGNIFICANCE OF THE HUON MARINE PARK

5.1 Seabirds

While there has been limited research on the pelagic seabirds that are likely to use the Huon Marine Park, the Atlas of Living Australia suggest that the region supports more than 40 bird species. This was confirmed during a systematic program of observing during a 3-week survey in 2018 that made over 61,000 sightings that included 43 seabird species (plus one terrestrial species) (Table 1). Species include several rare and threatened species such as the Wandering Albatross (*Diomedea exulans exulans*). Short-tailed shearwaters (*Ardenna tenuirostris*), Fairy Prion (*Pachyptila turtur*), Northern Giant Petrels (*Macronectes halli*), and Shy Albatross (*Thalassarche cauta cauta*) are the numerically dominant species encountered during scientific research in the region.

Table 1. Birds observed during a 3-week survey in 2019 (data from Eric Woehler, Zara King and Alice Forrest, Birdlife Australia). Note, the shelduck (#37) is not a seabird.

1. Silver gull	23. Salvin's albatross
2. Australasian gannet	24. Campbell's albatross
3. Kelp gull	25. Snares cape petrel
4. Crested tern	26. Chatham albatross
5. Black-faced cormorant	27. Common diving petrel
6. Short-tailed shearwater	28. Gibson’s albatross
7. Shy albatross	29. Grey petrel
8. Fairy prion	30. Mottled petrel
9. White-chinned petrel	31. Subantarctic skua
10. Southern royal albatross	32. Little penguin
11. Grey-headed albatross	33. White-faced storm petrel
12. Westland petrel	34. Grey-backed storm petrel
13. Northern giant petrel	35. Gould’s petrel
14. Northern royal albatross	36. Arctic jaeger
15. Cape petrel	37. Australian shelduck
16. White headed petrel	38. Soft-plumaged petrel
17. Southern giant petrel	39. Pacific gull
18. Wandering albatross	40. Fiordland crested penguin
19. Black-bellied storm petrel	41. Cook's petrel
20. Black-browed albatross	42. Great winged petrel
21. White-fronted tern	43. Little shearwater
22. Antarctic prion	44. Hutton’s shearwater

5.2 Benthic fauna

The complex bottom topography and range of substrate types occurring in the Huon Marine Park provide habitats for a diverse range of benthic species both on the continental shelf and the deep sea areas.

5.2.1 Continental shelf assemblages

Benthic invertebrates:

The reefs on the continental shelf region of the Huon Marine Park support a rich array of sessile organisms with AUV surveys identifying 122 morphospecies during a preliminary assessment of this imagery to describe the typical flora/fauna of this region (Monk et al. 2017); see the AUV image viewer for further information (https://auv.aodn.org.au/auv/). Morphospecies are distinct biological entities that can be separated from each other on the basis of distinguishing features (such as shape and colour) but cannot be confidently identified to species level. From the AUV imagery examined, the shelf reefs in Huon Marine Park were characterised by a short matrix of many entwined groups (Bryozoa/Cnidaria/Hydroid/Sponge) forming a dense carpet of fine species that cannot be distinguished at the resolution of the imagery and cover 85% of the reef surface (Figure 10). Sponges were the most abundant group that could be distinguished from the imagery, contributing 9.1% to total cover. The remaining important groups were encrusting algae (4.9 %), corals (2.55 %), bryozoans (1.6%), ascidians (0.6 %) and hydroids ((0.1 %). The presence of encrusting algae was a notable feature, indicating some of these reefs were in photic depths. However, as the shallowest mapped reef peaked at 53 m below the surface, it appears these are too deep to support canopy-forming algae. Despite this, a small proportion of foliose red algae was noted (0.05%). Of the individual morphospecies identified, sponges dominated (with 102 morphospecies), followed by corals (7), bryozoans (4), ascideans (3), algae (3), worms (2) and hydroids (1). As per similar deep-water surveys in the SE region (Monk et al. 2016), no single morphospecies was dominant. While encrusting coralline algae was notable at 3.3% cover, reflecting the position of some of this reef system in the lower photic zone, the next most common morphospecies was a gorgonian with 2.1 % cover, then a sponge with 0.62% cover. The majority of remaining morphospecies had individual covers of less than 0.1%. A set of typical images of this benthic cover are shown in Figure 10.

Notably nearly 10 % of the morphospecies identified were singletons (i.e. only seen once) and were mostly sponges. Interestingly, the number of singletons observed within the Huon Marine Park in analysis undertaken so far, is considerably lower when compared to similar shelf habitats in other Australian Marine Parks in SE Australia where AUV surveys have been conducted (e.g. Tasman Fracture Monk et al. (2016)). This suggests that the benthic assemblage in the Huon Marine Park consists of morphospecies that are diverse yet spatially common.

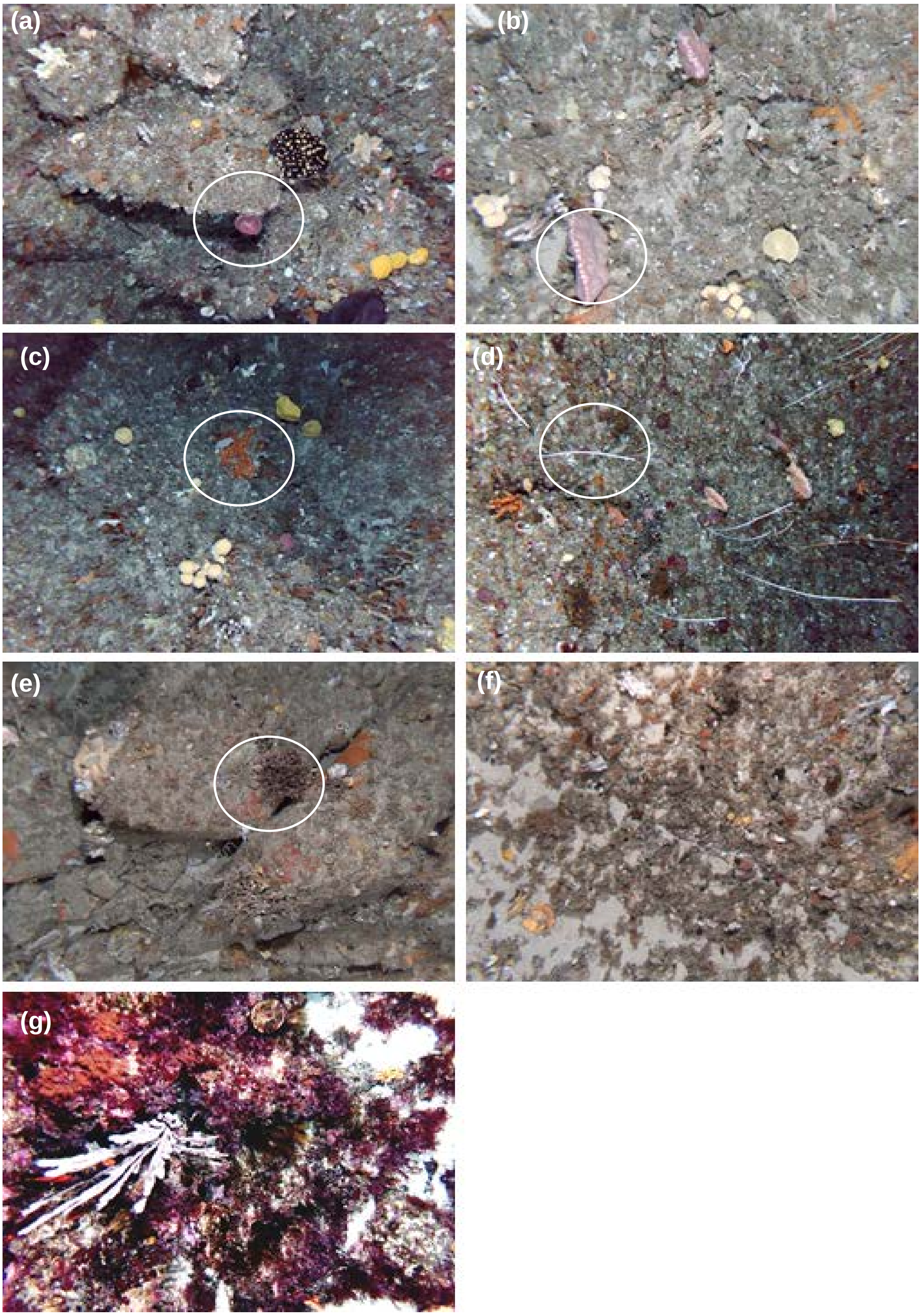

Figure 10: Typical images from the 2009 AUV sampling of reef habitat on the continental shelf of Huon Marine Park showing a variety of morphospecies of sessile invertebrates. These include (a) cup sponge, (b) plate sponges, (c) encrusting sponge, (d) seawhips, (e) massive sponges, (f) bryozoan/hydroid turf mix and (g) red algae.

Another notable feature of the invertebrate assemblage on the continental shelf of the Huon Marine Park is the heavily cropped nature of its physical structure relative to areas surveyed in similar depths around the Tasmanian coastline. It appears that this may be due to the very high energy wave environment (more than 10 m during large storms). Presumably this limits maximum size of many sessile invertebrates such as sponges and corals due to drag, as well as damage via abrasion against the substrate or via “sand-blasting” as adjacent sediments are entrained with the high-energy water movement.

While mobile invertebrates are not normally surveyed by the AUV imagery, the prevalence of Southern rock lobster (*Jasus edwardsii*) in the Huon Marine Park surveys was evident from examination of imagery (Figure 11), and this formed the basis of a study examining the abundance, distribution and size structure of lobsters in the park (Bessell et al. Unpublished data). Abundances in Huon Marine Park were notably greater than seen in other shelf regions around southern to north-eastern Tasmania (see https://auv.aodn.org.au/auv/) with lobsters widely distributed across the reef systems, reflecting the broad suitability and widespread nature of the moderate-complexity reef system found in the Huon Marine Park. This is also reflected in the regular observation of commercial lobster-fishing vessels and deployed gear during all surveys of the park.

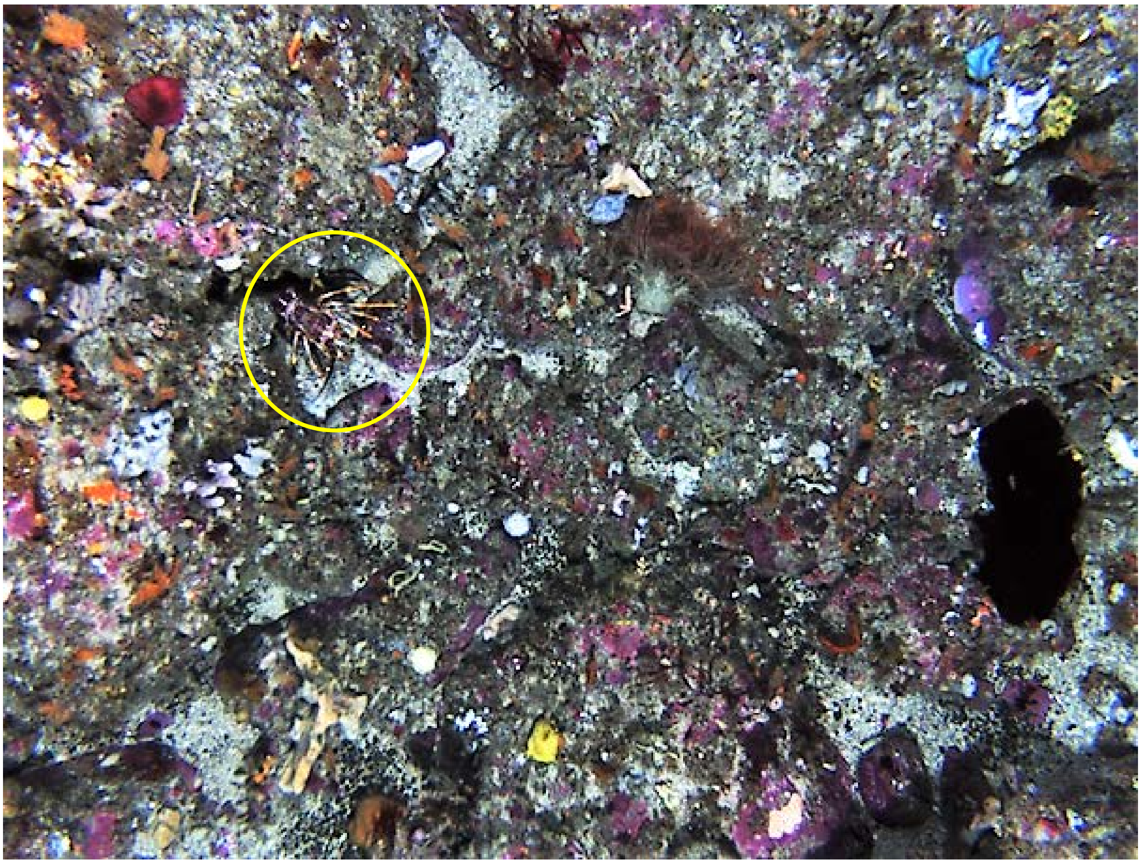

Figure 11: Example of lobster in AUV imagery from the Huon Marine Park.

Demersal fishes

There has not been any documented targeted sampling of reef-affiliated fishes within the shelf region of the Huon Marine Park. However, limited imagery available from three towed-video transects, coupled with two opportunistic BRUV deployments in this area, give a limited insight into the more common species present (Figure 12). The towed-video transects encountered extensive schools of butterfly perch, but no other species were sighted. The BRUV deployments also encountered large numbers of butterfly perch, but also included significant numbers of rosy wrasse (*Pseudolabrus rubicundus*), Degan's leatherjackets (*Thamnaconus degeni*) and cosmopolitan leatherjackets (Monacanthidae). For an indication of likely additional fish assemblages that may be encountered, recent sampling on reefs at similar depth and wave exposure in the Tasman Fracture Marine Park and associated external reference sites (Monk et al. 2016), suggest the shelf reefs of the Huon Marine Park are likely to harbour populations of commercial and recreationally important fishes such as Tasmanian trumpeter (*Latris lineata*), gummy shark (*Mustelus antarcticus*) and jackass morwong (*Nemadactylus macropterus*).

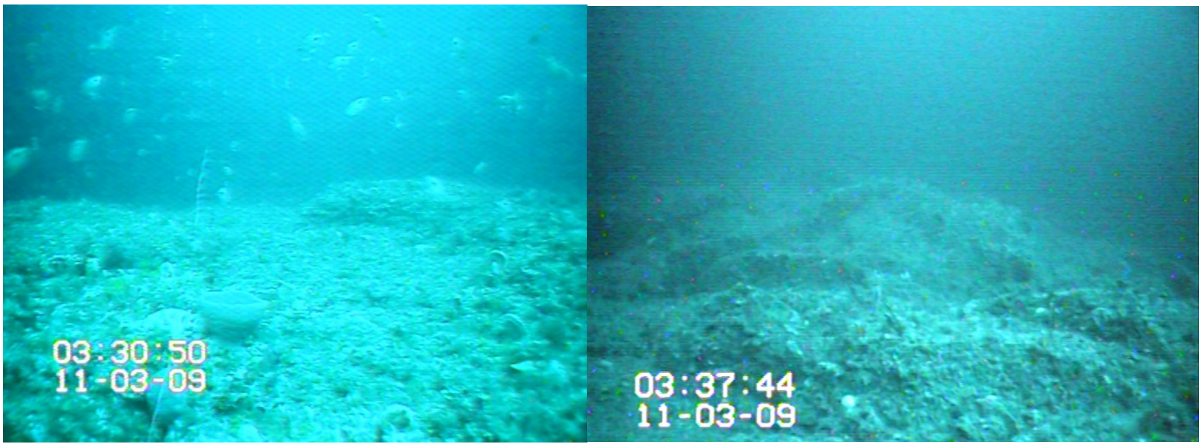

Figure 12. Towed video on shelf reef in the Huon Marine Park in approximately 60 m depth, showing schools of butterfly perch (left) and moderate complexity reef structure (right).

5.5.2 Deep-sea assemblages

There is relatively good knowledge of deep-sea benthic assemblages in the Huon Marine Park compared to the deep-sea areas of other parks, and relative to Australia's deep sea more generally. The impetus for research off southern Tasmania can be linked to commercial fishing activities in the 1980's. Research initially focussed on the bottom trawl fishery because it was 'new' in terms of the depths being targeted (~700-1500 m) and the target species, orange roughy. Very little was known about the stock size, productivity or ecology of orange roughy, or about the habitats being fished. Early work revealed that most fishing occurred on the seamounts and that there was a substantial bycatch of stony coral and other deep-sea benthos.

After it was realised, in the mid-1990's, that bottom fishing was having a substantial impact on seamount benthic communities, there have been four scientific surveys to document the make-up and structure of the coral-associated communities, the impacts of fishing, and the changes that are occurring (potential recovery) in areas where fishing has ceased; survey details can be found in Koslow and Gowlett-Holmes (1999), Thresher et al. (2009), and Williams et al. (2007) and Williams (2018). The implementation of the marine parks has enabled a comparison of seamounts that are now protected with those that are still fished and others that were never fished.

Whilst seamounts have been the primary focus for surveys, other sampling has taken place on the adjacent continental slope and in deeper areas (>1500 m). The deepest samples were taken at depths around 4000 m using a remote operated vehicle (ROV) – an underwater robot equipped to film and collect biodiversity (Thresher et al. 2009). Collectively, these surveys enabled comparison of the seamount biodiversity across a broad deep-sea area of the Huon Marine Park.

Seamount communities are highly diverse. Based on faunal collections from the early surveys (1997-2008), museum experts tentatively tallied over 970 species from 16 Phyla. Eight higher level taxonomic groups (sponges, octocorals, molluscs, echinoderms, decapods, ascidians, seaspiders and black corals) represented 73% of the total number of catch records and yielded 703 species. Collectively, there were 338 (47%) new species to science, 86 new records for Australia and 242 described species. Sponges were most poorly known (86% new species), but even well-studied groups such as molluscs, decapods and ophiuroids had > 53%, 40% and 27% new species, respectively (Williams et al. 2008). The richness of molluscan fauna in this area was described as ‘astounding’ and requiring a complete rewrite of textbooks for the fauna in this area (Williams et al. 2008).

These surveys found that the seamount biota and seabed types in the Huon Marine Park and adjacent waters were highly structured by depth. The shallowest zones (<1000 m and 1000-1500 m) were dominated by reefs of stony coral, with diverse and abundant associated faunas. Dead reef, rubble and rock seabed dominated the deeper zones, and biomass decreased dramatically with increasing depths. However, an extraordinarily high biomass of large barnacles (*Tetrachaelasma tasmanicum*), an undescribed hormathiid anemone and large bamboo corals (i.e. gorgonians) in the isidid genera *Keratoisis* and *Isidella* were discovered in 2000-2500 m depths just to the west of the Huon Marine Park. This community has by far the highest peak biomass reported in the deep-sea outside of vent communities (Thresher et al. 2011). A conceptual diagram generated by Thresher et al. (2009) describes the six key biotic zones associated with the flanks of the seamounts (Figure 13).

Seamounts have been described as rocky oases on the massive and predominantly muddy floor of the deep sea because they provide hard, elevated and current-swept attachment sites for rich communities of ‘emergent’ filter-feeding animals such as corals, sponges, seastars and anemones. Analysis of sea-floor images from a total of 20 seamounts from the Huon Marine Park and the Chatham Rise off New Zealand (Rowden et al. 2010) revealed that the mean biomass of epibenthic megafauna on seamounts was nearly four times greater than on the adjacent continental slope at comparable depths. This difference is largely attributable to the stony coral *Solenosmilia variabilis*, whose mean biomass was 29 times higher on seamounts. In terms of trophic guilds, filter-feeders and filter-feeders ⁄ predators made up a significantly greater proportion of biomass on seamounts, whereas deposit feeders and those with mixed feeding modes dominated at slope habitats.

Population genetic studies of deep sea corals from the Huon Marine Park have provided insights to ecological processes within the park, as well as links with other marine parks. For some species, such as the cosmopolitan coral *Desmophyllum dianthus*, the Huon Marine Park provides an important stepping stone for long distance dispersal across the SE marine park network, but for *Solenosmilia variabilis*, populations within the Huon Marine Park may appear to be highly structured, reliant on local recruitment, and are likely isolated from other areas (Miller et al. 2010, Miller et al. 2011, Miller and Gunasekera 2017).

Three surveys in 1997, 2006/7, and 2018 (Koslow et al. 1999; Williams et al. 2007; Williams 2018, respectively), aimed to provide information on fishing impacts on seabed communities and community changes through time after fishing ceased. This time-series comparison is achieved by surveying seamounts where fishing still occurs (the Pedra seamount adjacent to the Huon Marine Park, and St. Helens Seamount off eastern Tasmania); seamounts that were fished but are now protected (The Sisters Seamount in the Huon Marine Park, and Main Matt Seamount in the adjacent Tasman Fracture Marine Park), and several seamounts in the Huon Marine Park that were never fished (Williams 2018).

The first survey confirmed that complex biogenic habitats (reefs) formed by corals are important components of the benthic fauna of seamounts, and their fragility makes them susceptible to damage by bottom trawling. These findings were quantified in the second survey using more sophisticated photographic methods. The second survey (Althaus et al. 2009) found that trawling reduced the bottom cover of the matrix-forming stony coral *Solenosmilia variabilis* by two orders of magnitude and that loss of coral habitat translated into three-fold declines in richness, diversity and density of other megabenthos. The community structures diverged widely between trawled and untrawled seamounts. This survey also found no change in the megafaunal assemblage consistent with recovery over a 5–10 year timeframe on seamounts where trawling had ceased (Williams et al. 2010). A few individual taxa were found at significantly higher abundance where trawling had occurred – either because fauna were resistant to the direct impacts of trawling (two chrysogorgid corals and solitary scleractinians), or from protection in natural refuges inaccessible to trawls (unstalked crinoids, two chrysogorgid corals, gorgonians, and urchins). The most recent survey in December 2018 (Williams 2018) observed some apparent signs of change including higher abundances of both mobile fauna (e.g. urchins and feather-stars) and non-mobiles (anemones and small corals) in areas that were previously impacted by bottom trawling but then protected. These patterns were highly variable between seamounts, and interpretations will need to be confirmed by analysis of the data during 2019/ 2020.

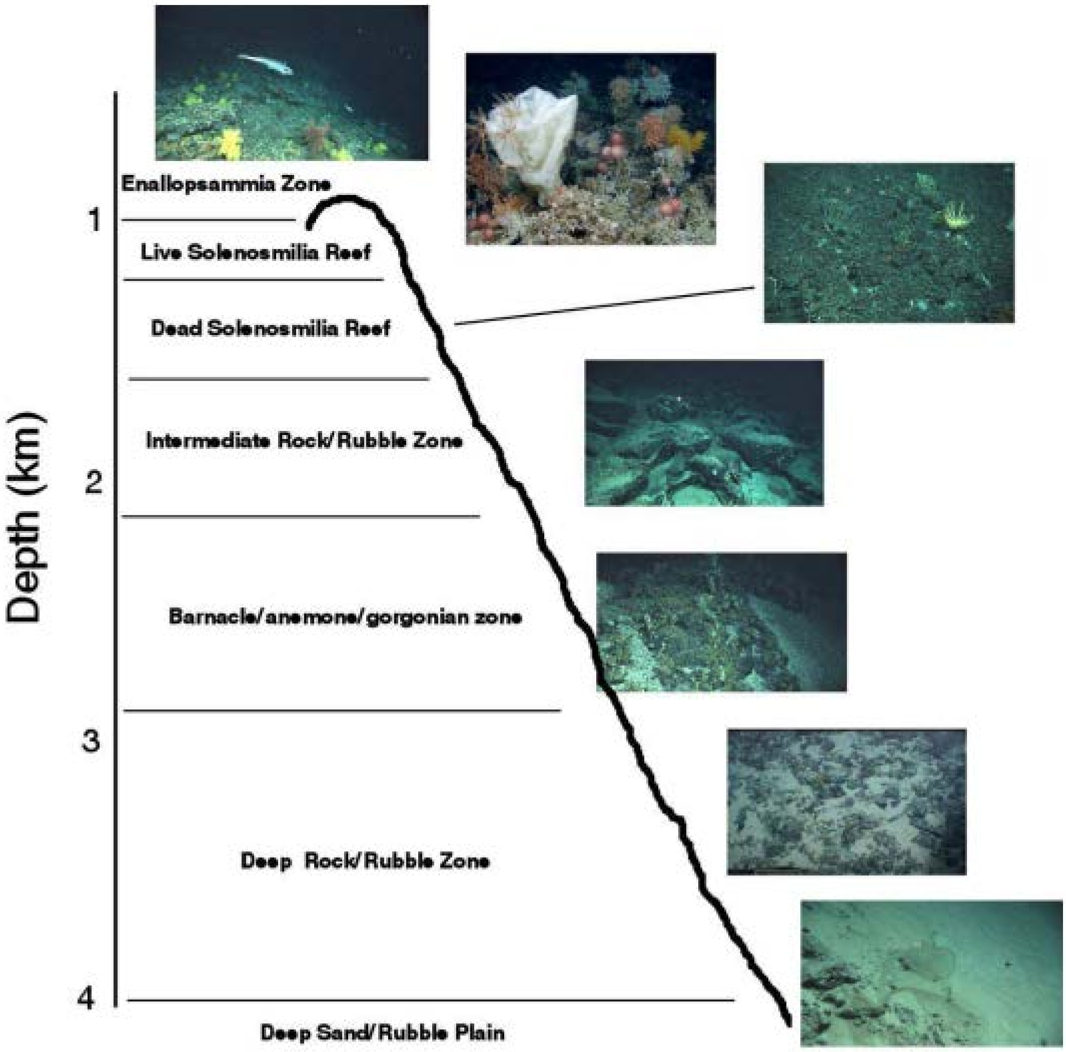

Figure 13: Conceptual diagram of the six main biotic zones in the Huon AMP to a depth of 4 km (Source: Thresher et al. 2009).

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www.nespmarine.edu.au

Contact:

Karen Miller
Australian Institute of Marine Science
Indian Ocean Marine Research Centre
Crawley WA 6009
k.miller@aims.gov.au

Scott Nichol
Geoscience Australia
PO Box 378
Symonston, ACT, 2601
scott.nichol@ga.gov.au