Product title: Predicted seabed assemblage patterns of marine fauna in the Southeast Marine Region (SEMR).

Relevance of product to marine planning and management

This product provides planners and managers with the most recent and complete information about the predicted seabed assemblage patterns of marine fauna, at a range of scales, in the SEMR, based on extensive analyses of species responses to the physical environment. It can be used as follows:

1. To produce maps of predicted patterns of seabed assemblage of marine fauna (i.e. benthic invertebrates and demersal fish combined) in the SEMR;
2. To provide the results of scientific analysis of extensive biological data to planners and managers with the responsibility to conserve and manage seabed biodiversity in the SEMR (e.g. MPA planning and management);
3. As a biologically informed data input to models of the marine environment in the SEMR, where appropriate (e.g. Marxan); and
4. To identify areas of highest priority for future seabed biodiversity surveys, the findings of which can be compared with these predictions of seabed assemblage patterns of marine fauna in the SEMR.

Product description

This product (i.e. an Access database and csv files) contains data (longitude, latitude and attribute variables) that describe the predicted spatial patterns of the seabed assemblages of demersal fish and benthic invertebrates in the SEMR. The predicted patterns are represented as point data on a 0.01 degree grid (~0.9 km^2) covering the continental shelf & upper slope of the SEMR (approximately 240,000 km^2). Four separate meso-scale (10's-100's km) predictions have been provided that subdivide the SEMR into 10, 15, 23 and 35 sub-units (i.e. the 15 prediction divides the region into 15 sub-units called clusters, which collectively form a cluster set).

Interpretation of product

The product represents the predicted spatial patterns of seabed assemblages of marine fauna (i.e. demersal fish and benthic invertebrates) in the SEMR. Each predicted assemblage is represented as a cluster in the data-product that should be interpreted as areas of seabed where the mixture of demersal fish and benthic invertebrate species and their abundances are characteristic of a particular physical environment, reasonably homogeneous and, to varying extents, distinct from other assemblages in the cluster set. Some clusters will be more distinct compared to others, and the boundaries between them will have varying levels of fuzziness; some are gradual, some are steep. For example, for the 15 cluster set, there is some geographical overlap between clusters 6 and 9 and between 5 and 7. The accompanying colour maps, and in particular the colour key (Attachment 2) provide insight into this.

The different scales of clusters (i.e. cluster sets of 10, 15, 23 and 35) provide progressively finer scale information. The individual clusters of finer-scale cluster sets are expected to represent more homogeneous assemblages, compared to those in coarser scale cluster sets, but at finer scales the differences between individual clusters are smaller and less certain. In coarser scale cluster sets, individual clusters may not be as homogenous, but are expected to have greater and more certain differences compared to their neighbouring clusters. For more information on certainty please phone or email the contact.

Brief description of methods/data used develop output

The following provides a basic description of methods/data used to develop this product:

1. All suitable available biological data (i.e. demersal fish and benthic invertebrate species) for the SEMR were collated from the following sources: Orange Roughy cruises, the Soviet fishing fleet in the 1960s and 1970s, Southeast Fishery trawl and benthic sled surveys, cruises from the Soela research vessel, trawl surveys using 3 different kinds of gear (Engel Balloon 45, Engel Balloon 90 and Boris Box 90).
2. All suitable available physical data, comprising 27 physical variables (e.g. bathymetry, mud content of sediment, dissolved oxygen, temperature, light availability, etc.) were collated by the CERF Marine Biodiversity Hub, to provide full coverages of the region.
3. Analyses of abundance data were conducted on over 550 seabed fish and invertebrate species to identify thresholds along each of the 27 physical gradients (e.g. percentage of mud content in sediment) that correspond to observed changes in the spatial patterns of benthic species;
4. Thresholds of each of physical gradient (i.e. within a single physical variable such as percentage of mud content in sediment) were then used to transform that physical variable to a biologically-informed variable. Thresholds that corresponded to relatively large changes in benthic assemblages were more influential in transforming the variable than those corresponding to small changes;
5. Each of the 27 biologically informed variables was weighted based on the importance of that variable in determining seabed assemblages. Physical variables that corresponded to relatively large changes in benthic assemblages were considered more important than those corresponding to small changes; and
6. The 27 biologically informed variables were then used to populate each 0.01° × 0.01° grid cell in the SEMR. The data were used to produce maps to display predicted spatial patterns in seabed assemblages (see attachments).

It should be noted that this method identifies the physical attributes that are associated with the predicted seabed assemblages of marine fauna; it does not identify the suite of species that typify the assemblages due to gaps in the available biological data. The method has been developed in collaboration with and reviewed by an international team of 10 scientists from Australia, Canada, USA (Maine and Texas) and has been applied in these regions also.

Advantages/improvements over existing products

The product is based on a novel technique that uses biological information to transform physical data and predict spatial patterns of seabed assemblages of marine fauna at a range of scales in the SEMR. This product uses the most recently available and broadest collation of data on the physical environment and of biology (surveys of demersal fish and benthic invertebrates) in the SEMR. The data sources have been newly collated to provide input to this product, and include additional data for some variables (e.g. bathymetry and sediments), as well as many new variables (eg. bottom water attributes) and new biological surveys that have not been used previously for this purpose.

Conditions of use

This product does not contain any confidential information. It is a preliminary product subject to further development by the CERF Marine Biodiversity Hub. The data may be copied for distribution within DEWHA for their internal business operations, but may not be provided to third parties. Enquiries from third parties should be directed to the Marine BiodiversityHub.

Contact for further information

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Attachments

1. Four maps for a quick view of the each of the cluster sets (i.e 10, 15, 23 and 35 clusters) predicting seabed assemblage patterns of marine fauna in the Southeast Marine Region.
2. A map of the 15-cluster set identifying the physical variables having most influence on the predicted seabed assemblages pattern of marine fauna in the SEMR.
3. Maps identifying the spatial limits of each individual cluster in the 15 cluster set predicting seabed assemblage patterns of marine fauna in the Southeast Marine Region.
4. Description of physical attributes for each individual cluster in the 15 cluster set predicting seabed assemblage patterns of marine fauna in the Southeast Marine Region
5. Metadata record for database of seabed assemblage patterns of marine fauna in the Southeast Marine Region.

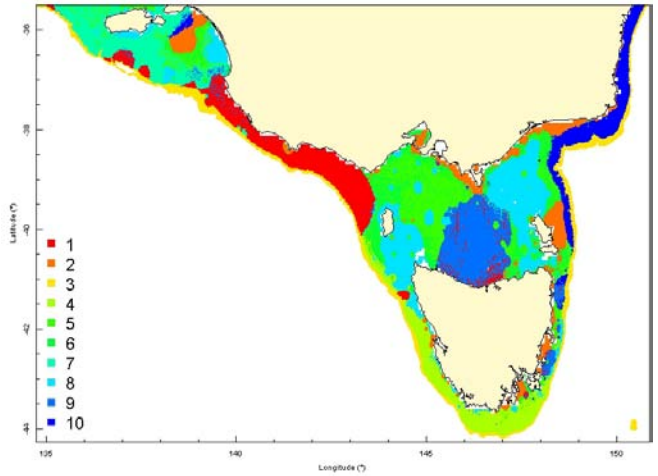
Acknowledgement of datasets

South East Fishery Ecosystem Project:

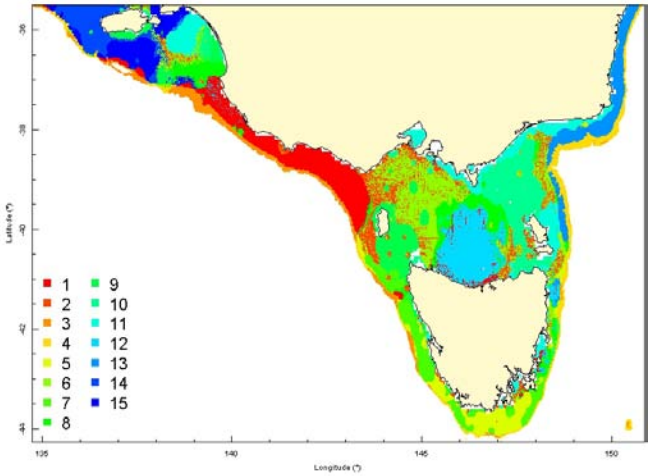
Bax, N and Williams, A. (2000). Habitat and fisheries production in the South East Fishery ecosystem - Final report to the Fisheries Research and Development Corporation. CSIRO Marine Research, Hobart.

Attachment 1: Four maps for a quick view of the each of the cluster sets (i.e. 10, 15, 23 and 35 clusters) predicting seabed assemblage patterns of marine fauna in the Southeast Marine Region.

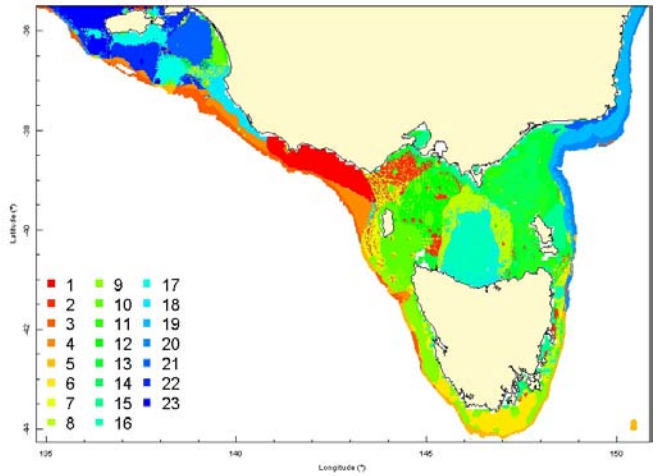
10 clusters



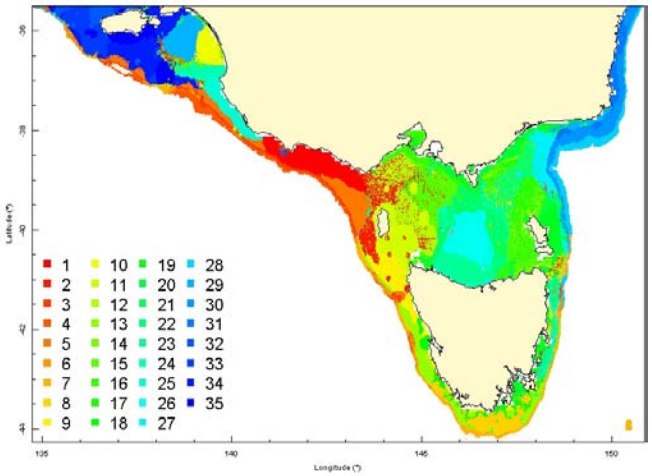
15 clusters



23 clusters

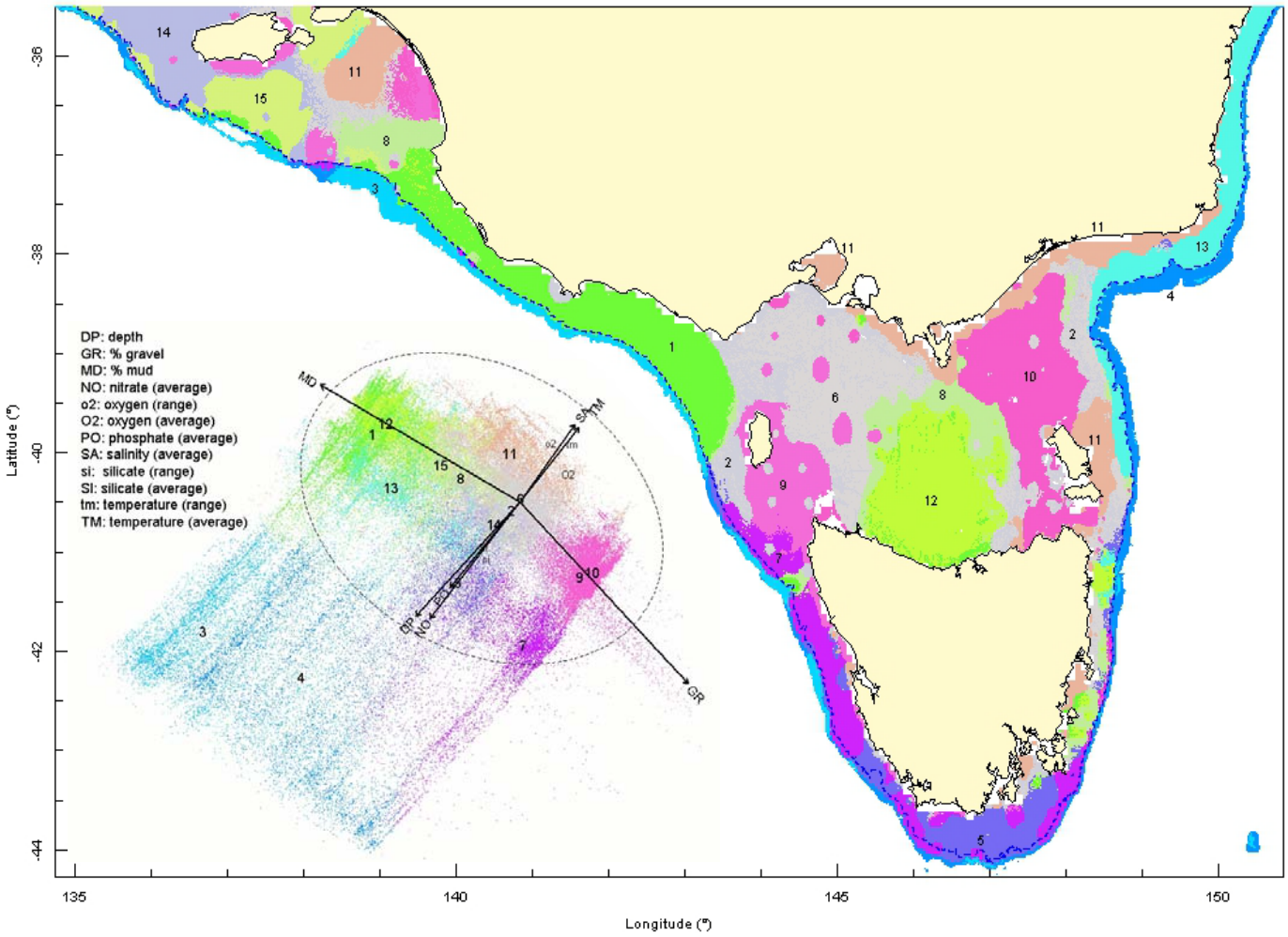


35 clusters

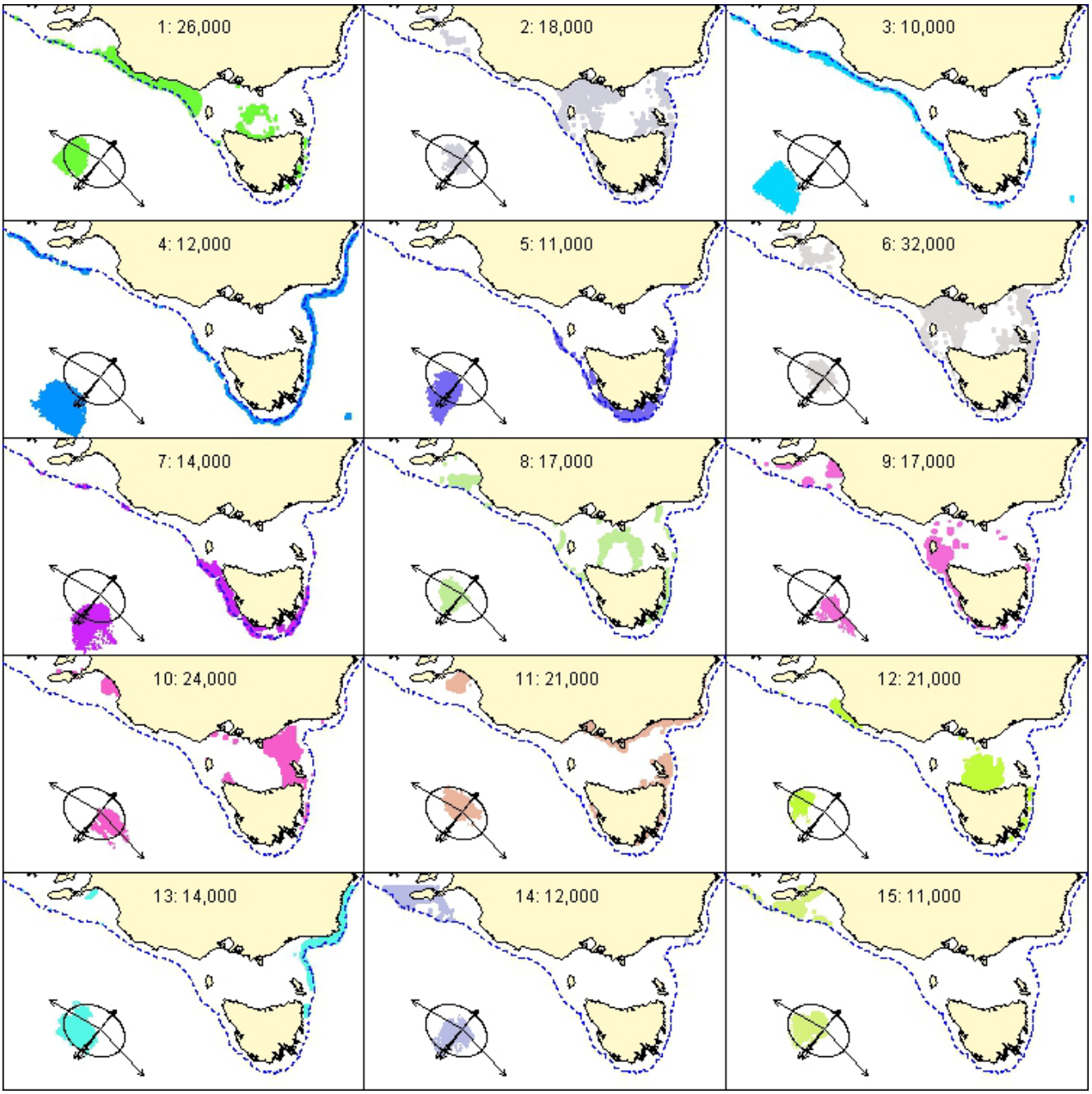


Attachment 2: A map of the 15-cluster set identifying the physical variables having most influence on the predicted seabed assemblages pattern of marine fauna in the SEMR. The interpretive colour key can be used to identify the physical variables having most influence on predicted patterns. For example, the colour blue is associated with deeper areas, brown with higher average temperature and salinity, green with muddier areas, purple with more gravelly. The gray area near the origin of the arrows corresponds to medium values of the physical variables. Also shown in the colour key are the centres (medoids) of each cluster in the 15-cluster set. Most clusters (especially 9) are disjointed to some extent (see Attachment 3 to identify their spatial limits). A brief description of the physical variables having most influence on predicted seabed assemblage patterns is provided in Attachment 4.

Note - The map and interpretive colour key account for 51% of the total variation; the remaining 49% is not shown as it cannot be displayed in 2 dimensions (if more information is required please phone the provided contact person)



Attachment 3: Maps identifying the spatial limits of each individual cluster in the 15 cluster set predicting seabed assemblage patterns of marine fauna in the Southeast Marine Region. The number of 0.01° × 0.01° grids in the cluster is shown to the nearest thousand. The 200m depth contour is also shown as a dashed line. The location of the grids in the colour key is also shown relative to the ellipse (see Attachment 2).



Attachment 4: Description of physical attributes for each individual cluster in the 15 cluster set prediction for seabed assemblage patterns of marine fauna in the Southeast Marine Region

The physical attributes of each predicted assemblage of the 10 cluster output are distinguished by multiple variables used to characterise the region. Many clusters are distinguished on multi-variable combinations rather than individual variables. The following descriptions identify the most influential physical variables for each of the predicted seabed assemblages of marine fauna in the cluster set, clusters particularly distinctive on one variable are indicated by * (typical range shown in parentheses).

1. Victorian Shelf [~32K km^2]: depth (119–60 m), low sediment gravel content (Gravel: 2–5 %)
2. Bass Strait Fringes [~22K km^2]: moderately shallow (79–54 m), low sediment carbonate (CRBNT: 62–84 %), low sediment mud content (Mud: 1–5 %)
3. Great Australian Bight Slope [~12K km^2]: moderately deep (835–502 m), very low sediment gravel content (Gravel: 2–7 %), low sediment sand content (Sand: 45–67 %), low average water temperature at the seabed (CRS T: 6.4–9.3 °C), low range of water temperature at the seabed (CRS T SD: 0.6–1.0 °C), low benthic irradiance (BI: 0–0), low range of benthic irradiance (bi: 0–0)
4. Southeast Slope [~15K km^2]: moderately deep (828–420 m), very low average water temperature at the seabed (CRS T: 6.1–9.9 °C), very low range of water temperature at the seabed (CRS T SD: 0.6–0.9 °C), very low benthic irradiance (BI: 0–0), very low range of benthic irradiance (bi: 0–0)
5. Southern Tasmanian Shelf [~13K km^2]: moderately deep (170–122 m), low average water temperature at the seabed (CRS T: 11.7–12.6 °C), low range of water temperature at the seabed (CRS T SD: 1.6–2.2 °C), very low average sea surface temperature (SST: 13.8–14.2 °C), low range of sea surface temperature (SST SD: 3.7–4.4 °C), low benthic irradiance (BI: 0–0), low range of benthic irradiance (bi: 0–0)
6. Northwest Bass Strait [~38K km^2]: moderately shallow (76–55 m), very low nitrate (NO3: 1–2 µM)
7. Western Tasmanian Shelf [~16K km^2]: moderately deep (171–103 m), low average sea surface temperature (SST: 14.1–14.7 °C), low range of sea surface temperature (SST SD: 4.0–4.3 °C)
8. Central Bass Strait [~20K km^2]: moderately deep (78–58 m)
9. Western Bass Strait [~20K km^2]: shallow (68–46 m), very low sediment mud content (Mud: 1–3 %), low nitrate (NO3: 1.0–2.1 µM), low average sea surface temperature (SST: 14.8–15.5 °C)
10. Northeast Bass Strait [~29K km^2]: shallow (60–44 m), low sediment mud content (Mud: 1–3 %)
11. Inshore and Eastern Bass Strait [~25K km^2]: very shallow (55–30 m), very low sediment carbonate (CRBNT: 23–41 %)*
12. Southern Bass Strait [~26K km^2]: moderately deep (80–69 m), low sediment gravel content (Gravel: 3–5 %), very low sediment sand content (Sand: 36–64 %)
13. Eastern Shelf [~17K km^2]: moderately deep (139–102 m), low sediment carbonate (CRBNT: 48–72 %)
14. West of Kangaroo Island [~14K km^2]: moderately deep (133–82 m), very low range of sea surface temperature (SST SD: 3.7–4.2 °C)
15. South of Kangaroo Island [~14K km^2]: moderately deep (94–52 m), low sediment sand content (Sand: 68–75 %), low nitrate (NO3: 1.2–1.7 µM)

Attachment 5: Metadata record for benthic habitat database for SEMR.