

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

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 EMR, 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 EMR;
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 EMR (e.g. MPA planning and management);
3. As a biologically informed data input to models of the marine environment in the EMR, 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 EMR.

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 EMR. The predicted patterns are represented as point data on a 0.01 degree grid (~1.2 km²) covering the continental shelf & upper slope of the EMR (approximately 87,000 km²). Four separate meso-scale (10's-100's km) predictions have been provided that subdivide the EMR into 10, 15, 20 and 40 sub-units (i.e. the 20 prediction divides the region into 20 sub-units called clusters, collectively they form a cluster set). The predictions were limited to the mainland shelf & upper slope due to the lack of suitable data for the remainder of the EMR, and restricted to south of 24.5°S because the GBR is managed by the GBRMPA.

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 EMR. 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, there is some geographical overlap between clusters 1 and 3. 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, 20 and 40) 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 EMR were collated from four different sources: the Great Barrier Reef seabed biodiversity survey, the Queensland East Coast Trawl Fishery scallop and prawn surveys, the South East Fishery fish trawl and benthic sled surveys, and various surveys from the vessel Kapala off the NSW coast.
2. All suitable available physical data, comprising 29 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 presence/absence data were conducted on over 700 seabed fish and invertebrate species to identify thresholds along each of the 29 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 29 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 29 biologically informed variables were then used to populate each $0.01^\circ \times 0.01^\circ$ grid cell in the EMR. 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 is being 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 EMR. 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 EMR. 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. Final product is due around May 2010. 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 CERF Hub.

Contact for further information

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Roland Pitcher 07 3826 7250 roland.pitcher@csiro.au

Attachments

1. Four maps for a quick view of the each of the cluster sets (i.e. 10, 15, 20 and 40 clusters) predicting seabed assemblage patterns of marine fauna in the East Marine Region.
2. A map of the 10-cluster set identifying the physical variables having most influence on the predicted seabed assemblages pattern of marine fauna in the EMR.
3. Maps identifying the spatial limits of each individual cluster in the 10 cluster set predicting seabed assemblage patterns of marine fauna in the East Marine Region.
4. Description of physical attributes for each individual cluster in the 10 cluster set predicting seabed assemblage patterns of marine fauna in the East Marine Region
5. Metadata record for database of seabed assemblage patterns of marine fauna in the East Marine Region.

Acknowledgement of datasets

Great Barrier Reef Seabed Biodiversity Project:

Pitcher, C.R., Doherty, P., Arnold, P., Hooper, J., Gribble, N., and 50 others (2007). Seabed Biodiversity on the Continental Shelf of the Great Barrier Reef World Heritage Area. AIMS/CSIRO/QM/QDPI Final Report to CRC Reef Research. 320 pp.

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.

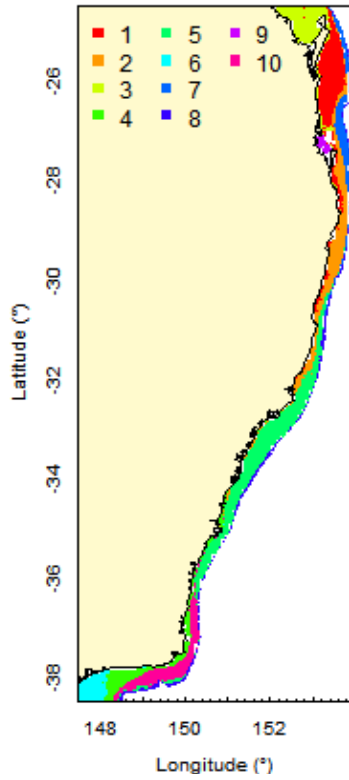
Queensland East Coast Trawl Fishery Bycatch Project: data provided by Dr. Tony Courtney QDPI&F

Courtney, A. J., Haddy, J. A., Campbell, M. J., Roy, D. P., Tonks, M. L., Gaddes, S. W., Chilcott, K. E., O'Neill, M. F., Brown, I. W., McLennan, M., Jebreen, E. J., van der Geest, C., Rose, C., Kistle, S., Turnbull, C. T., Kyne, P. M., Bennett, M. B. and Taylor, J. (2007). Bycatch weight, composition and preliminary estimates of the impact of bycatch reduction devices in Queensland's trawl fishery. Fisheries Research and Development Corporation (FRDC) Project #2000/170 Final Report 307p.

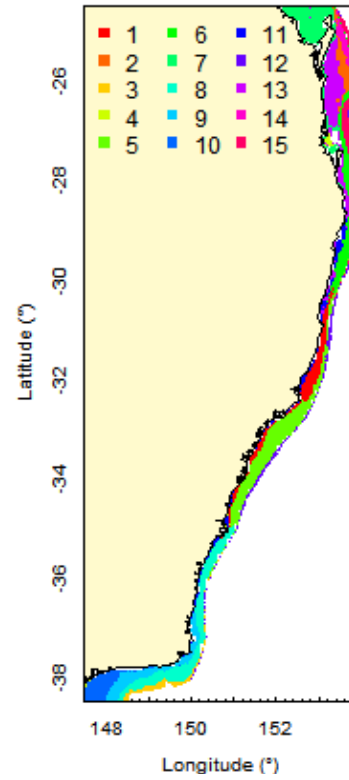
NSW Fisheries Research Institute *FRV Kapala* surveys: data provided by Ken Graham NSW FRI.

Attachment 1: Four maps for a quick view of the each of the cluster sets (i.e. 10, 15, 20 and 40 clusters) predicting seabed assemblage patterns of marine fauna in the East Marine Region.

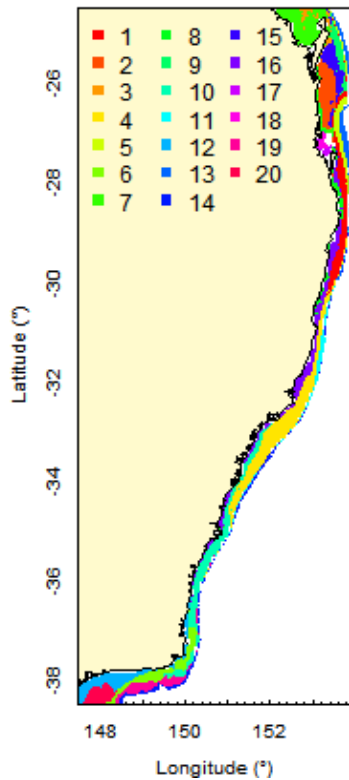
10 clusters



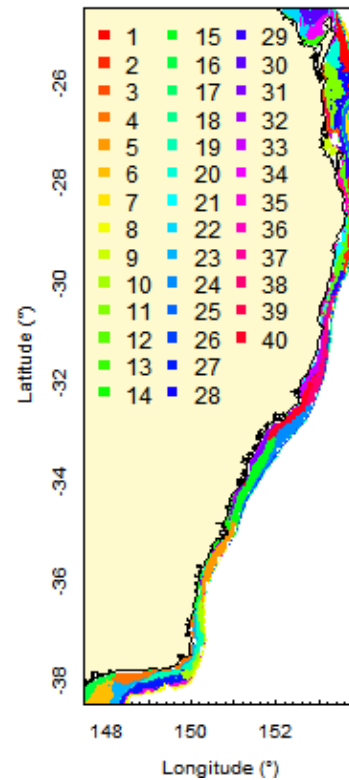
15 clusters



20 clusters



40 clusters



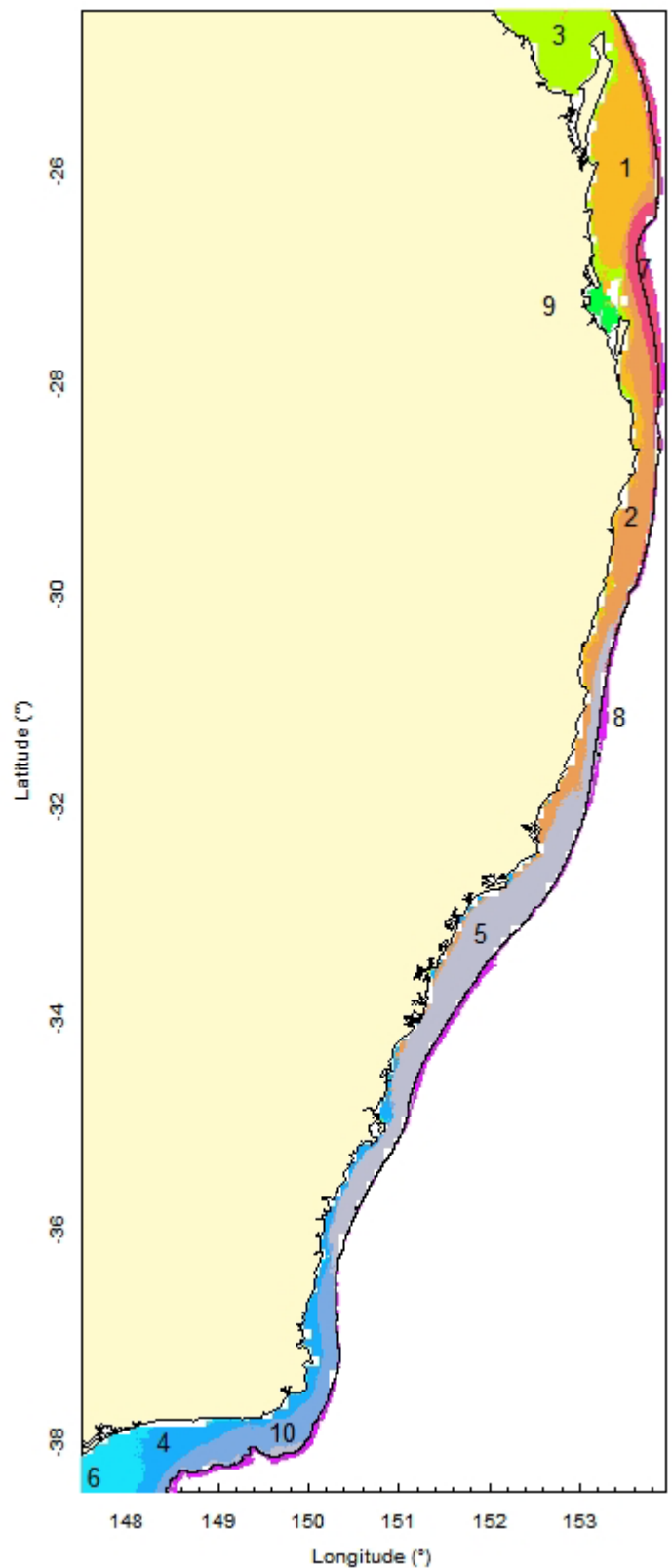
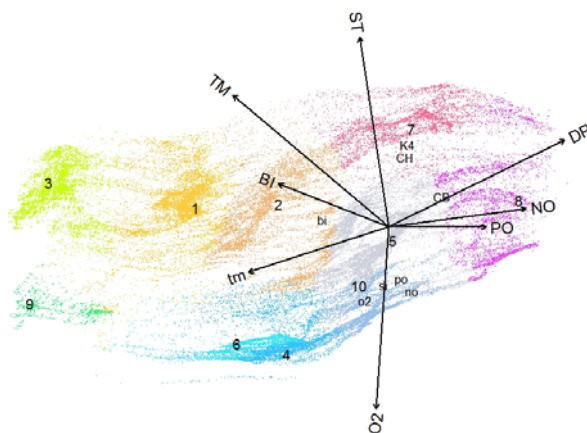
PRODUCT DESCRIPTION FOR STAKEHOLDERS

CERF Marine Biodiversity Hub

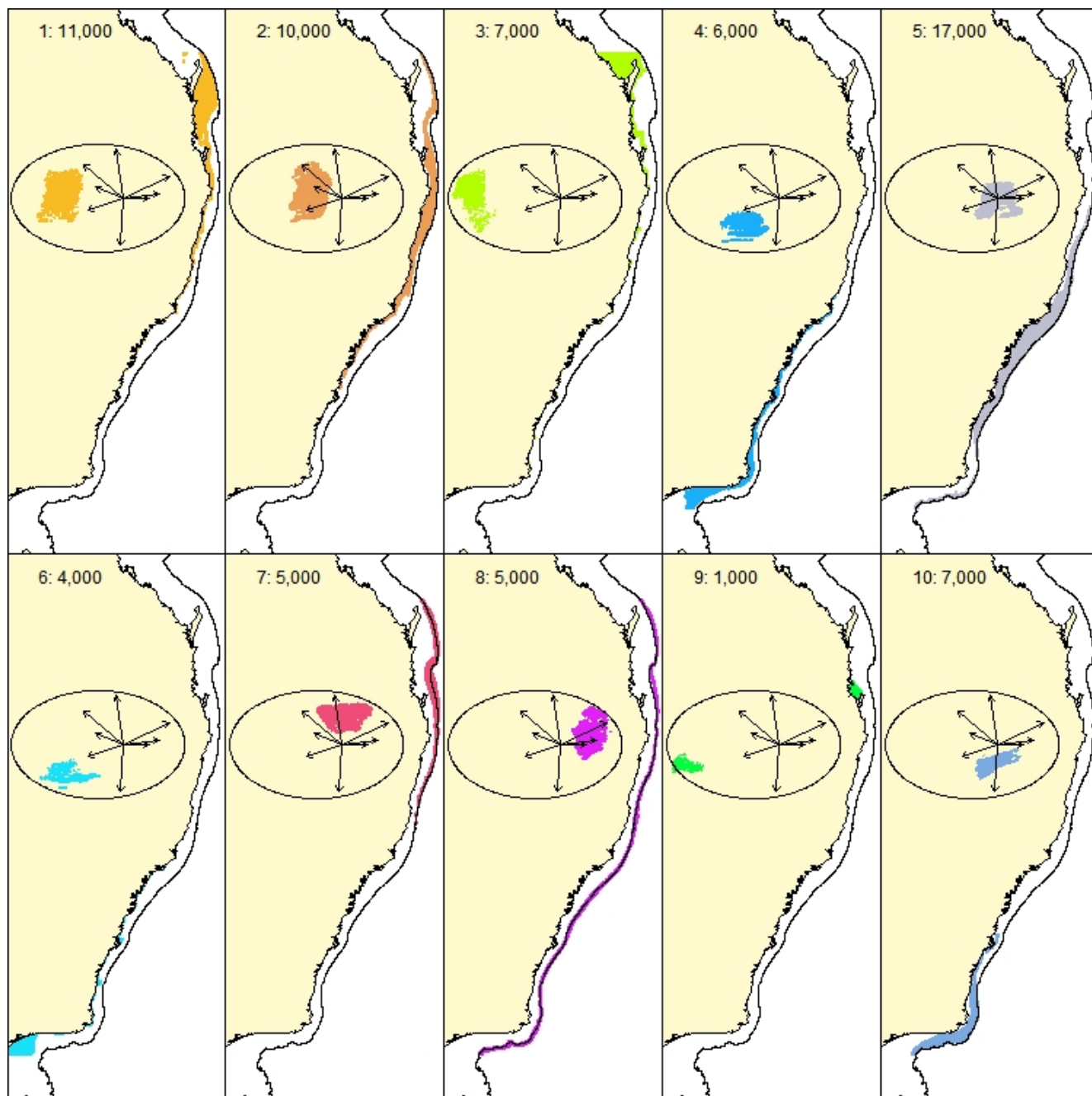
Attachment 2: A map of the 10-cluster set identifying the physical variables having most influence on the predicted seabed assemblages pattern of marine fauna in the EMR. The interpretive colour key can be used to identify the physical variables having most influence on predicted patterns. For example, the colour purple is associated with deeper areas, red with higher sea surface temperature, green with shallow areas with high benthic irradiance, blue with high oxygen. 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 10-cluster set. Some clusters (e.g. 1, 3, 6) are disjointed (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 75% of the total variation; the remaining 25% is not shown as it cannot be displayed in 2 dimensions (if more information is required please phone the provided contact person)

bi: benthic irradiance (range)	no: nitrate (range)
si: silicate (range)	O2: oxygen (average)
CB: % carbonate	o2: oxygen (range)
BI: benthic irradiance (average)	PO: phosphate (average)
CH: chlorophyll A (average)	po: phosphate (range)
DP: depth	ST: sea surface temperature (average)
K4: K 490 (average)	TM: temperature (average)
NO: nitrate (average)	tm: temperature (range)



Attachment 3: Maps identifying the spatial limits of each individual cluster in the 10 cluster set predicting seabed assemblage patterns of marine fauna in the East Marine Region. The number of $0.01^\circ \times 0.01^\circ$ grids in the cluster is shown to the nearest thousand. The 200m depth contour is also shown. The location of the grids in the colour key is also shown inside the ellipse (see Attachment 2).



Attachment 4: Description of physical attributes for each individual cluster in the 10 cluster set prediction for seabed assemblage patterns of marine fauna in the East 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. Sunshine Coast inner shelf [$\sim 13\text{K km}^2$]: moderately low depth (Depth: 44–59 m), low sediment carbonate (CRBNT: 22–52 %), low nitrate (NO_3 : 1.6–3.0 μM), low phosphate average (PO_4 : 0.24–0.34 μM), range of water temperature at the seabed (CRS T SD: 4.2–5.0 $^\circ\text{C}$)*
2. East coast mid shelf [$\sim 12\text{K km}^2$]: depth (Depth: 57–86 m), low average seabed oxygen (O_2 : 4.19–4.36 mg l^{-1}), low range of seabed oxygen (O_2 SD: 0.37–0.45 mg l^{-1}), average water temperature at the seabed (CRS T: 18.5–19.8 $^\circ\text{C}$)*, low silicate average (Si: 1.76–2.91 μM)
3. Hervey Bay/ Sunshine Coast nearshore [$\sim 9\text{K km}^2$]: low depth (Depth: 12–25 m)*, very low sediment carbonate (CRBNT: 10–18 %), very low nitrate (NO_3 : 0.2–0.3 μM)*, very low phosphate average (PO_4 : 0.11–0.13 μM)*, average water temperature at the seabed (CRS T: 24.2–24.4 $^\circ\text{C}$)*, range of water temperature at the seabed (CRS T SD: 5.1–5.7 $^\circ\text{C}$)*, low silicate average (Si: 1.39–2.65 μM)
4. SE Victoria inner shelf [$\sim 7\text{K km}^2$]: moderately low depth (Depth: 51–77 m), low sediment carbonate (CRBNT: 17–44 %), low average water temperature at the seabed (CRS T: 14.1–14.8 $^\circ\text{C}$), low average sea surface temperature (SST: 16.0–18.3 $^\circ\text{C}$)
5. Central Coast shelf [$\sim 20\text{K km}^2$]: depth (Depth: 111–145 m), low average seabed oxygen (O_2 : 4.26–4.58 mg l^{-1}), low benthic irradiance (BI: 0.000–0.001)
6. North Bass Strait [$\sim 5\text{K km}^2$]: low depth (Depth: 41–55 m), low phosphate average (PO_4 : 0.31–0.37 μM), average seabed oxygen (O_2 : 5.40–5.51 mg l^{-1})*, very low silicate average (Si: 1.32–1.80 μM), very low average sea surface temperature (SST: 15.6–15.7 $^\circ\text{C}$)*
7. East Coast outer shelf [$\sim 7\text{K km}^2$]: depth (Depth: 137–235 m), very low average seabed oxygen (O_2 : 4.04–4.11 mg l^{-1})*, low range of seabed oxygen (O_2 SD: 0.14–0.34 mg l^{-1}), very low range of water temperature at the seabed (CRS T SD: 0.9–1.3 $^\circ\text{C}$), low range of benthic irradiance (bi: 0.000–0.004)
8. East Coast slope [$\sim 5\text{K km}^2$]: depth (Depth: 275–357 m)*, nitrate (NO_3 : 11.6–14.5 μM)*, phosphate average (PO_4 : 0.90–1.12 μM)*, very low range of seabed oxygen (O_2 SD: 0.10–0.31 mg l^{-1}), very low average water temperature at the seabed (CRS T: 11.0–12.3 $^\circ\text{C}$)*, low range of water temperature at the seabed (CRS T SD: 0.9–1.5 $^\circ\text{C}$), very low benthic irradiance (BI: 0–0)*, very low range of benthic irradiance (bi: 0–0)*
9. Moreton Bay [$\sim 1\text{K km}^2$]: very low depth (Depth: 2–11 m)*, low nitrate (NO_3 : 0.3–0.6 μM)*, range of water temperature at the seabed (CRS T SD: 8.8–9.4 $^\circ\text{C}$)*, silicate average (Si: 7.79–12.15 μM)*
10. SE coast outer shelf [$\sim 8\text{K km}^2$]: depth (Depth: 115–139 m), low average water temperature at the seabed (CRS T: 13.7–14.1 $^\circ\text{C}$), low range of water temperature at the seabed (CRS T SD: 1.6–2.5 $^\circ\text{C}$), low average sea surface temperature (SST: 16.9–18.5 $^\circ\text{C}$), low benthic irradiance (BI: 0–0), low range of benthic irradiance (bi: 0.000–0.001)

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

Database for benthic habitat prediction in the East Marine Region (EMR). Version 1.0

Short title : MarLIN **record number :** 8631 **Anzlic Identifier :** ANZCW0306008631 **ISO Topic Category/s**

Oceans

Data Type

Aggregated/Derived Data

Custodian Organisation :

CSIRO Division of Marine and Atmospheric Research - Cleveland

PO Box 120

Cleveland

QLD Australia 4163

<http://www.cmar.csiro.au/>

Jurisdiction : Australia

Contributors : Nick Ellis

Acknowledgements : Geoscience Australia for sediment, bathymetry and benthic stress
CSIRO Marine and Atmospheric Research for CARS data

SeaWifs for turbidity data

Queensland Primary Industries and Fisheries for bycatch composition data

NSW Fisheries Research Institute for catch composition data gathered on FRV Kapala

Funding: CERF Marine Biodiversity Hub

References :

Great Barrier Reef Seabed Biodiversity Project:

Pitcher, C.R., Doherty, P., Arnold, P., Hooper, J., Gribble, N., and 50 others (2007). Seabed Biodiversity on the Continental Shelf of the Great Barrier Reef World Heritage Area.

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Fisheries Research and Development Corporation (FRDC) Project #2000/170 Final Report 307p.

NSW Fisheries Research Institute FRV Kapala surveys: data provided by Ken Graham NSW FRI.

Abstract : This product (i.e. an Access database and csv files) contains data (longitude, latitude and physical data) that explains the predicted spatial patterns of benthic habitats for demersal fish and benthic invertebrates in the EMR. Predicted patterns for habitats represent point data on a 0.01 decimal degree grid covering most of the EMR (approximately 78,000 square km).

Attributes Overview :

CERF_ID: a primary key

LON: longitude

LAT: latitude

component01-09: the 9-dimensional principal component data that was clustered

probweight: cell weighting used in two-stage CLARA/PAM clustering

cluster10: the 10-cluster clustering

cluster15: the 15-cluster clustering

cluster20: the 20-cluster clustering

cluster40: the 40-cluster clustering

r: red value for rendering on a map (scale 0-1)

g: green value for rendering on a map (scale 0-1)

b: blue value for rendering on a map (scale 0-1)

Location Keywords

Australia > New South Wales Coast

Australia > Queensland Coast Southern

Australia > Victoria Coast

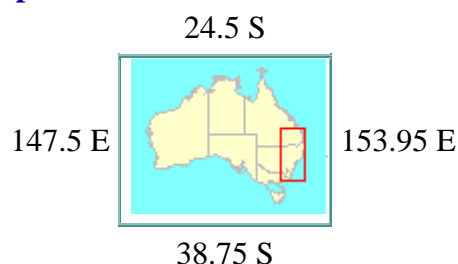
ANZLIC Geographic Extent Names (Category, [Jurisdiction], Name)

Ocean and Sea Regions, [Australia], New South Wales Coast

Ocean and Sea Regions, [Australia], Queensland Sub Tropical Coast

Ocean and Sea Regions, [Australia], Victoria Coast

Geographic Extent



Dataset contains GIS spatial data in format Geocentric Australia (New Standard GDA).

Maximum Depth

400

Subject Categories and Search Word(s)

MarLIN Subject Categories

1383. Biogeography and biogeographic regions

Habitat Keywords

PRODUCT DESCRIPTION FOR STAKEHOLDERS

CERF Marine Biodiversity Hub



**MARINE
BIODIVERSITY
RESEARCH**
Prediction and Management of
Australia's Marine Biodiversity

EARTH SCIENCE > Biosphere > Aquatic Habitat > Benthic Habitat

GCMD Keywords

EARTH SCIENCE > Land Surface > Landscape > Landscape Ecology

EARTH SCIENCE > Oceans > Marine Biology > Marine Habitat

ANZLIC Search Words

ECOLOGY

ECOLOGY Habitat

ECOLOGY Landscape

MARINE Biology

Oceans

Originating Research Project

Not Entered

Beginning date : Not Known

Ending date : Not Known

Progress : Complete

Maintenance and Update Frequency : As required

Stored Data Format(s)

DIGITAL - Database Files - MS Access

Stored Data Volume

12 MB of digital data

Specific Software Requirements

Requires Microsoft Access

Stored Data Documentation

Stored Data Location

Available Format Type(s)

Same As Stored

Access constraint

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 CERF Hub.

Lineage

This is an original derivation.

Positional accuracy

Data are based on interpolated values from a variety of sources. E.g. see CARS (Anzlic

Identifier : ANZCW0306005960)

Parameter accuracy

Logical consistency report

Completeness

PRODUCT DESCRIPTION FOR STAKEHOLDERS

CERF Marine Biodiversity Hub



**MARINE
BIODIVERSITY
RESEARCH**
Prediction and Management of
Australia's Marine Biodiversity

Refer to the published literature.

Contact

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Metadata Access

Public

Metadata Entry Created

09-Mar-2010 by Nick Ellis

Metadata Export

Show ANZLIC core metadata in [ANZLIC XML format](#)

Show full metadata in [MarLIN \(extended ANZLIC\) XML format](#)

Metadata Updateable By

Nick Ellis

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