PRODUCT DESCRIPTION FOR STAKEHOLDERS
CERF Marine Biodiversity Hub

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

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

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

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 NMR. The predicted patterns are represented as point data on a 0.01 degree grid (~1.2 km^2) covering most of the NMR (approximately 780,000 km^2). Four separate meso-scale (10's-100's km) predictions have been provided that subdivide the NMR into 20, 40, 60, 80 sub-units (i.e. the 20 prediction divides the region into 20 sub-units called clusters, collectively they 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 NMR. 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 — the accompanying continuous colour maps provide insight into this (this information to be provided soon).

The different scales of clusters (i.e. cluster sets of 20, 40, 60 and 80) 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 NMR were collated from three different sources: the Torres Strait seabed biodiversity survey, various surveys in the Gulf of Carpentaria by the Southern Surveyor and several other vessels, and the Data Trawler archive data set of older broad-scale voyages in the region.
2. All suitable available physical data, comprising 28 physical variables (e.g. bathymetry, mud content of sediment, dissolved oxygen, temperature, light availability, etc.) were collated to provide full coverages of the region.
3. Analyses were conducted on about 900 seabed fish and invertebrate species to identify thresholds along each of the 28 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 28 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 28 biologically informed variables were then used to populate each 0.01° × 0.01° grid cell in the NMR. The data were used to produce maps to display predicted spatial patterns in seabed assemblages (see attachments).

It should be note 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. 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 NMR. 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 NMR. 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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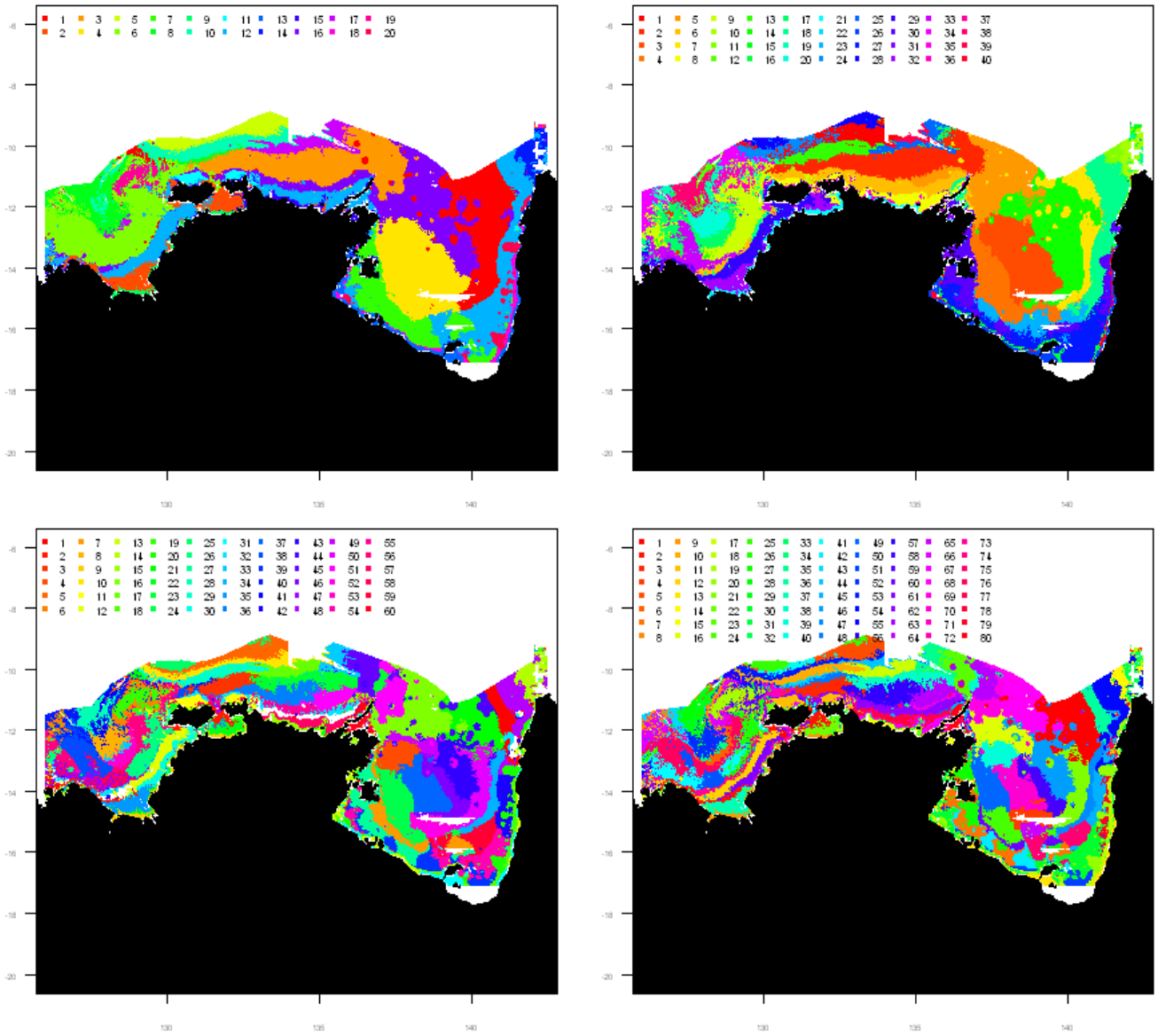
Attachments

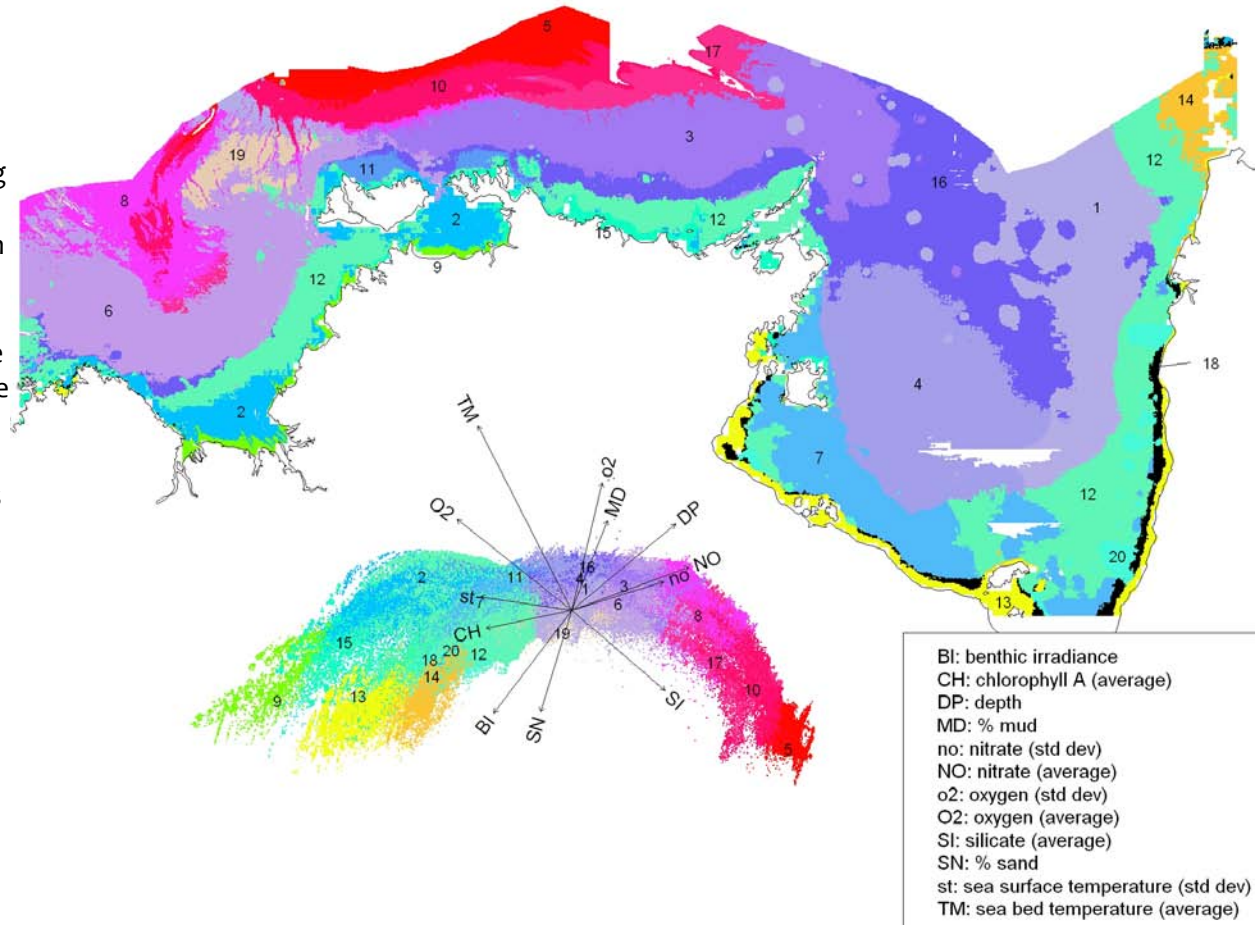
1. Four maps for a quick view of the each of the cluster sets (i.e. 20, 40, 60 and 80 clusters) predicting seabed assemblage patterns of marine fauna in the North Marine Region.
2. A map of the 20-cluster set identifying the physical variables having most influence on the predicted seabed assemblages pattern of marine fauna in the NMR.
3. Maps identifying the spatial limits of each individual cluster in the 20 cluster set predicting seabed assemblage patterns of marine fauna in the North Marine Region.
4. Description of physical attributes for each individual cluster in the 20 cluster set predicting seabed assemblage patterns of marine fauna in the North Marine Region
5. Metadata record for database of seabed assemblage patterns of marine fauna in the North Marine Region.

Attachment 1: Four maps for a quick view of the each of the cluster sets (i.e. 20, 40, 60 and 80 clusters) predicting seabed assemblage patterns of marine fauna in the North Marine Region.

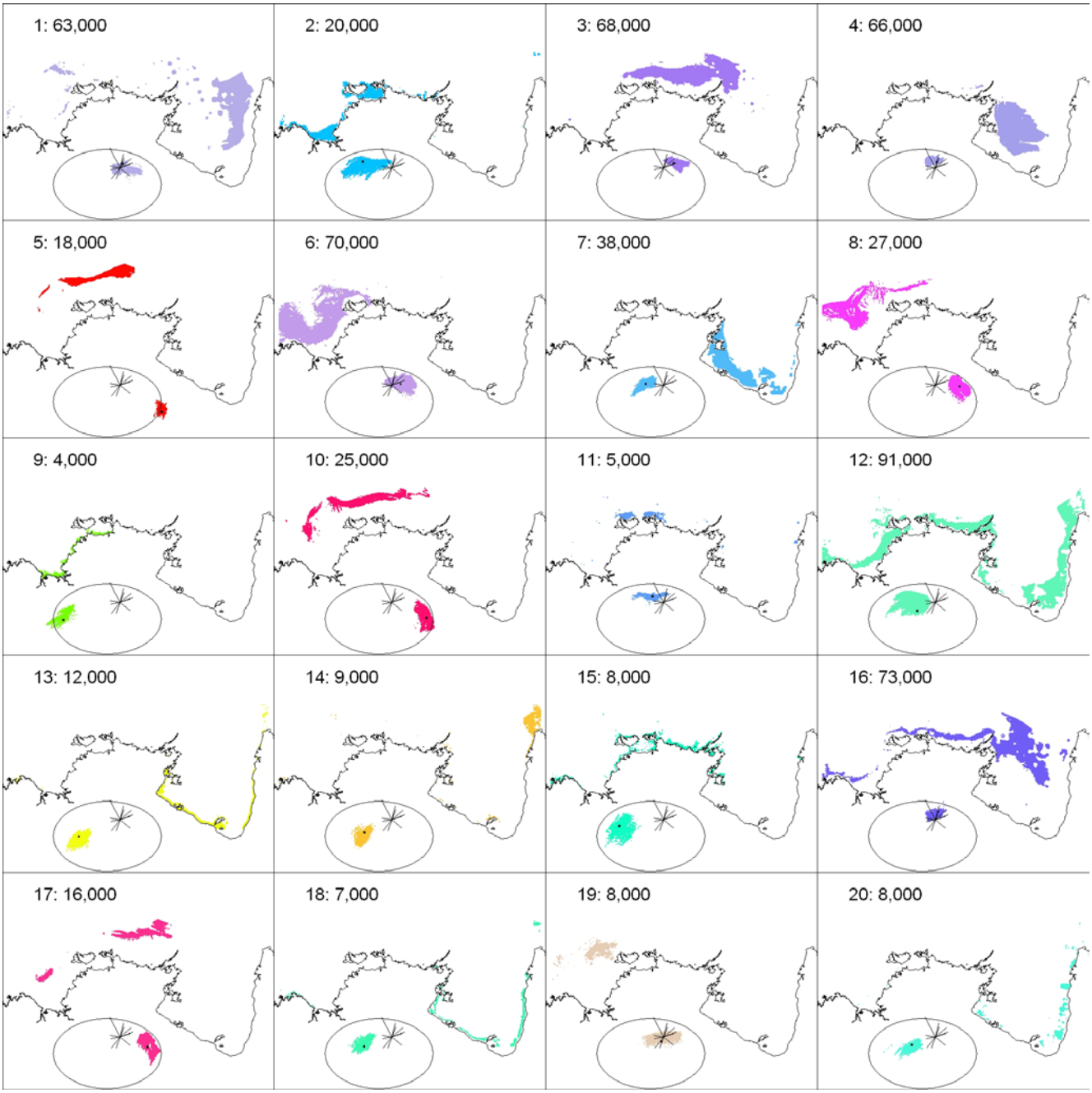


Attachment 2: A map of the 20-cluster set identifying the physical variables having most influence on the predicted seabed assemblages pattern of marine fauna in the NMR. The interpretive colour key can be used to identify the physical variables having most influence on predicted patterns. For example, the colour green is associated with high chlorophyll A average, red with high silicate average, purple with high nitrate average. The gray area near the origin of the arrows corresponds to medium values of the physical variables. Cluster 18 has been rendered in black to make it easier to see. Also shown in the colour key are the centres (medoids) of each cluster in the 20-cluster set. Many clusters 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 58% of the total variation; the remaining 42% 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 20 cluster set predicting seabed assemblage patterns of marine fauna in the North Marine Region. The number of 0.01° × 0.01° grids in the cluster is shown to the nearest thousand.



Attachment 4: Description of physical attributes for each individual cluster in the 20 cluster set prediction for seabed assemblage patterns of marine fauna in the North Marine Region

The physical attributes of each predicted assemblage of the 20 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. Eastern Carpentaria basin [~76K km^2]: moderately high variation in seabed oxygen (O2 SD: 0.58--0.65 mg l^{-1}), moderately low chlorophyll A (Chl A: 0.37--0.44 mg m^{-3}), moderately low turbidity (K490: 0.060--0.066 m^{-1}), primarily sandy (61--73%), deep mid-shelf (54–65 m)
2. Joseph Bonaparte Gulf / Beagle Gulf [~24K km^2]: high average water temperature at the seabed (CRS T: 28.1–28.3°C), low silicate average (Si: 3.22–4.38 µM), high turbidity (K490: 0.19–0.25 m^{-1}), high chlorophyll A (Chl A: 2.85–4.50 mg m^{-3}), sandy-muddy sediments with high gravel (16--36 %), high variation in bottom stress (BS IQR: 0--1 Nm^{-2}), inshore depth range (13–28 m),
3. Arafura mid-shelf [~82K km^2]: moderately high sediment mud content (49–70 %), low sediment sand content (26–45 %), high variation in seabed oxygen (O2 SD: 0.59--0.71 mg l^{-1}), low salinity average (S: 34.3--34.4 ‰), mid-shelf depth range (54–64 m),
4. Central Gulf of Carpentaria [~79K km^2]: high sediment mud content (49–72 %), low sediment sand content (25–45 %), low chlorophyll A (Chl A: 0.35–0.375 mg m^{-3}), low turbidity (K490: 0.058–0.06 m^{-1}), high salinity average (S: 34.9--35.1 ‰), high variation in seabed oxygen (O2 SD: 0.65--0.67 mg l^{-1}), mid-shelf depth (53–59 m),
5. Timor—Arafura slope [~22K km^2]: very low average water temperature at the seabed (CRS T: 16.3–20.4°C)*, low variation in sea surface temperature (SST SD: 1.2–1.2°C), very low benthic irradiance (BI: 0.000–0.001), upper slope depth range (129–185 m)*, very high silicate average (Si: 21.38–27.66 µM)*, very low chlorophyll A (Chl A: 0.240–0.272 mg m^{-3}), very low average seabed oxygen (O2: 2.45–2.58 mg/l)*, very low turbidity (K490: 0.048–0.052 m^{-1}), very high nutrients (NO3: 14.0--19.3 µM)*,
6. Timor mid-shelf [~84K km^2]: high sediment carbonate (48–75 %), high average sea surface temperature (SST: 28.6–28.8°C), low variation in water temperature at the seabed (CRS T SD: 1.0--1.3 °C), moderately high variation in bottom stress (BS IQR: 0.1--0.3 Nm^{-2}), mid-shelf depth range (65–84 m),
7. SW Carpentaria inner shelf [~46K km^2]: high variation in sea surface temperature (SST SD: 2.5–3.0°C), very high salinity average (S: 34.9--35.2 ‰), high variation in water temperature at the seabed (CRS T SD: 2.2--2.7 °C), inner-shelf depth range (21–35 m),
8. Timor outer-shelf [~32K km^2]: very high average sea surface temperature (SST: 28.8–28.9°C), low variation in sea surface temperature (SST SD: 1.1–1.2°C), low benthic irradiance (BI: 0.001–0.003), outer-shelf depth range (94–117 m), moderately low average seabed oxygen (O2: 3.01--3.45 mg l^{-1}), moderately high silicate average (Si: 10.9--13.9 µM), moderately high sediment mud content (42–70 %),
9. Bonaparte–Anson–Beagle coastal [~5K km^2]: very high average water temperature at the seabed (CRS T: 28.3–28.5°C), high benthic irradiance (BI: 0.271–0.728), very shallow depth (1–4 m), very low silicate average (Si: 2.85–3.18 µM), very high chlorophyll A (Chl A: 4.34–7.17 mg m^{-3}), very high turbidity (K490: 0.256–0.321 m^{-1})*, very high sediment gravel content (20--43 %), moderately high salinity average (S: 34.5--34.8 ‰),
10. Timor — Arafura shelf-break [~30K km^2]: low average water temperature at the seabed (CRS T: 22.6–24.3 °C), low benthic irradiance (BI: 0.002–0.008), shelf-break depth range (89–116 m), high silicate average (Si: 15.13–19.10 µM)*, low chlorophyll A (Chl A: 0.272–0.333 mg m^{-3}), low average seabed oxygen (O2: 2.71–3.06 mg/l), low turbidity (K490: 0.051–0.058 m^{-1}), high sediment mud (36--81 %),

11. Melville/Coburg nearshore [~6K km^2]: low sediment carbonate (30–34 %), very high sediment mud content (72–90 %), very low sediment sand content (12–27 %), very low sediment gravel content (0--1 %), low sediment carbonate (: 30--35 %), low salinity average (S: 34.3--34.3 ‰), moderately high average water temperature at the seabed (CRS T: 27.9--28.2 °C), depth (25–39 m),
12. north region inner-shelf [~110K km^2]: low sediment mud content (10–27 %), moderately high sediment sand content (59--78 %), inner-shelf depth range (20–36 m),
13. SW & East Carpentaria coast [~14K km^2]: very high variation in sea surface temperature (SST SD: 2.9–3.5°C), very high benthic irradiance (BI: 0.521–0.772), very shallow (1–3 m), high sediment sand content (63–82 %), very high average seabed oxygen (O2: 4.60–4.73 mg/l), high chlorophyll A (Chl A: 2.746–4.198 mg m^{-3}), low sediment carbonate (29–46 %), relatively low average sea surface temperature (SST: 27.2–27.9°C), high turbidity (K490: 0.192–0.254 m^{-1}),
14. Western Torres Strait [~10K km^2]: very low sediment mud content (4–9 %), high sediment sand content (72–83 %), high sediment gravel content (11--20 %), high sediment carbonate (66–86 %), relatively low average sea surface temperature (SST: 27.5–27.7°C), very high variation in salinity (S SD: 1.4--1.6 ‰)*, very high variation in bottom stress (BS IQR: 0.2--2.3 Nm^{-2}), very high bottom stress (BS: 0.1--0.6 Nm^{-2}), moderately shallow (Depth: 6–12 m),
15. Arnhem land / Kimberley coast [~10K km^2]: high average water temperature at the seabed (CRS T: 28.1–28.5°C), high benthic irradiance (BI: 0.362–0.793), low silicate average (Si: 2.87–3.28 µM), very low salinity average (S: 34.2--34.3 ‰), shallow depth (1–6 m),
16. Northern Carpentaria—Arnhem inner-shelf [~89K km^2]: moderately high salinity average (S: 34.6--34.9 ‰), moderately high variation in seabed oxygen (O2 SD: 0.63--0.68 mg l^{-1}), depth range (52–61 m),
17. Arnhem / Bonaparte outer-shelf [~19K km^2]: low average water temperature at the seabed (CRS T: 23.8–24.8°C), high silicate average (Si: 12.42–13.92 µM), low average seabed oxygen (O2: 2.79–3.04 mg/l) and very high variation in seabed oxygen (O2 SD: 0.66--0.75 mg l^{-1}), high nutrients (NO3: 6.8--8.4 µM) and very high variation in nitrate (NO3 SD: 4.6--4.8 µM), outer-shelf depth range (69–79 m),
18. SW & East Carpentaria nearshore [~8K km^2]: very low average sea surface temperature relatively (SST: 27.2–27.7°C) and high variation in sea surface temperature (SST SD: 2.4–3.4°C), high average seabed oxygen (O2: 4.52–4.65 mg/l), moderately high chlorophyll A (Chl A: 2.093--3.548 mg m^{-3}) with very high variation (Chl A SD: 0.630--1.205 mg m^{-3}), moderately high turbidity (K490: 0.161--0.226 m^{-1}) with very high variation in turbidity (K490 SD: 0.024--0.043 m^{-1}), nearshore depth range (7–12 m),
19. Cootamundra Shoals area [~10K km^2]: high average sea surface temperature (SST: 28.5–28.6°C), very low variation in sea surface temperature (SST SD: 1.1–1.1°C), very high sediment carbonate (76–93 %), high bottom stress (BS: 0.1--0.1 Nm^{-2}) with high variation (BS IQR: 0.2--0.3 Nm^{-2}), typical depth range (36–56 m) with shoals to ~20 m,
20. Carpentaria sand patches [~9K km^2]: very high sediment sand content (88–93 %)*, low sediment mud content (5–11 %), low sediment gravel content (0--3 %), relatively low sediment carbonate (22–45 %), high average seabed oxygen (O2: 4.45–4.59 mg/l), depth range (12–23 m),

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

Database for benthic habitat prediction in the North Marine Region (NMR). Version 1.0

Short title : **MarLIN record number** : 8519 **Anzlic Identifier** : ANZCW0306008519 **ISO Topic**

Category/s Oceans

Data Type Aggregated/Derived Data

Area of Interest Northern Bioreg Data

Custodian Organisation : CSIRO Division of Marine and Atmospheric Research - Cleveland
PO Box 120
Cleveland
QLD Australia
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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. Funding: CERF Marine Biodiversity Hub

References :

Abstract : This product (i.e. an Access database and csv files) contains data (longitude, latitude and attribute variables) that describe the predicted spatial patterns of seabed biodiversity composition for demersal fish and benthic invertebrates in the NMR. The predicted patterns are represented as point data on a 0.01 degree grid (~1.2 km^2) covering most of the NMR (approximately 400,000 km^2). Four separate meso-scale (10's-100's km) predictions have been provided that subdivide the NMR into 20, 40, 60, 80 sub-units (i.e. cluster sets).

Attributes Overview : CERF_ID: a primary key
LON: longitude
LAT: latitude
component01-13: the 13-dimensional principal component data that was clustered
probweight: cell weighting used in two-stage CLARA/PAM clustering
cluster20: the 20-cluster clustering
cluster40: the 40-cluster clustering

cluster60: the 60-cluster clustering
cluster80: the 80-cluster clustering

Geographic Extent

8.89 S

126.06 E  142.5 E

17.12 S

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

Subject Categories and Search Word(s)

MarLIN Subject Categories

1383. Biogeography and biogeographic regions

Habitat Keywords

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

Northern Bioreg Data
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 113 MB of digital data
Specific Software Requirements Requires Msoft 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 There are some cells for which predictor data are missing in mid Gulf of Carpentaria
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Metadata Access Public
Metadata Entry Created 16-Jun-2009 by Nick Ellis
Metadata Last Updated 18-Jun-2009 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
Edit this MarLIN record (authorisation required)
