Estuarine, Coastal and Marine (ECM) National Habitat Mapping Project

ECM National Habitat Map Series
User Guide

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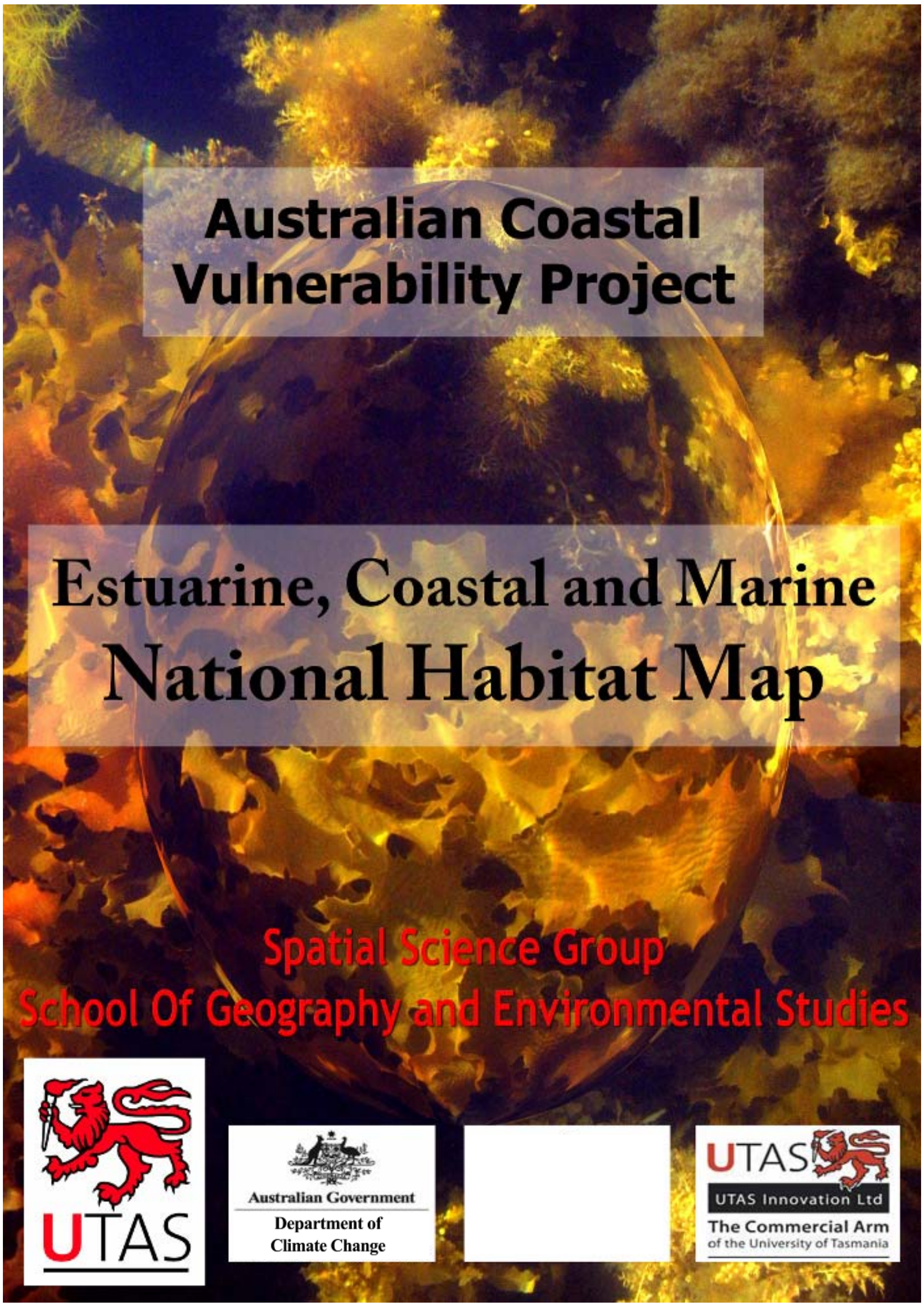
This project is a component of the
Australian “First Pass Coastal Vulnerability Assessment” Project
and is also supporting
NRM reporting on the ecological integrity of key ECM habitats

Agency Support
Department of Climate Change, Australian Government
National Land and Water Resources Audit
School of Geography and Environmental Studies, University of Tasmania



Australian Government
Department of Climate Change

National Land & Water Resources Audit
An Initiative of the Natural Heritage Trust

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ECM National Habitat Map Series User Guide overview

The User Guide includes the following:

- Map Series definition, background and objectives
- A brief description of each component and information product
- Data Characteristics and Data Dictionary
- Data quality information including data set and feature level metadata
- The NISB Habitat Classification Scheme (see Appendix 1)
- Acknowledgements of the Data Suppliers (see Appendix 2)
- Summary metadata of the input Data Sources (see Appendix 3)

Acronyms

AGO	Australian Greenhouse Office (now within the DCC)
ASDD	Australian Spatial Data Directory
ASRIS	Australian Soil Resource Information System
CMA	Catchment Management Authority
CS	Coordinate System
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVA	Coastal Vulnerability Assessment Project
DCC	Department of Climate Change, Australian Government
DEM	Digital Elevation Model
ECM	Estuarine, Coastal and Marine
ERIN	Environmental Resources Information Network
FMP	Feature level metadata pointer
GIS	Geographic Information System
GCS	Geographic Coordinate System
ICAG	Intergovernmental Coastal Advisory Group
ISB	Intertidal/Subtidal Benthic
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
MQ	Mixed Quality
NISB	National Intertidal/Subtidal Benthic
NLWRA	National Land and Water Resources Audit (Audit)
NOO	National Oceans Office
NRM	Natural Resource Management
NVIS	National Vegetation Information Systetm
OSDM	Office of Spatial Data Management
OSRA	Oil Spill Response Atlas
SMB	Structural Macrobiota
WMS	Web Mapping Services

Citation

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1. Agency partners and contributors

National: An adjective describing something that is produced or agreed by jurisdictions at all levels including the Australian Government, State/NT Governments, NRM Regions and Local Governments.

A very large number of agencies at the national and state level participated in this **national** project. In terms of the actual data sets, the project was dependent on the goodwill and cooperation of these partners and contributors. Acknowledgements of the individuals involved is covered elsewhere later in this report; however, we wish to start this report by acknowledging and appreciating the following Agencies:

Summary List of Data Custodians

For the whole *ECM National Habitat Map Series* all the following contributors must be acknowledged:

<u>Subset of contributors for the *National Intertidal/Subtidal (NISB) Habitat Map*:</u>

Department of Natural Resources, Environment and the Arts, Northern Territory Government of Australia
Queensland Department of Primary Industries and Fisheries
Queensland Parks and Wildlife Services Environmental Protection Agency
Great Barrier Reef Marine Park Authority
National Oceans Office
Western Australia Department of Environment and Conservation
South Australian Department of Environment and Heritage
New South Wales Department of Environment and Conservation
New South Wales Department of Primary Industries: Fisheries
Conservation Commission of the Northern Territory Land Conservation Unit
Victorian Department of Primary Industries
Parks Victoria
Tasmanian Aquaculture and Fisheries Institute

<u>Subset of contributors for the Coastal Wetlands Collection:</u>

Queensland Environmental Protection Agency
Australian Government Department of the Environment and Heritage
NSW Department of Planning

<u>Subset of contributors for the Estuaries Collection:</u>

Geoscience Australia

<u>Subset of contributors for the Dune and Dune Vegetation Collection:</u>

Australian Government Department of the Environment and Heritage
Department of Natural Resources, Environment and the Arts, Northern Territory Government of Australia
Queensland Department of Primary Industries and Fisheries
WA Department of Industry and Resources
WA Department of Minerals and Energy
WA Department of Mineral and Petroleum Resources
Victorian Department of Primary Industries
SA DEH - Natural and Cultural Heritage
Queensland Herbarium, Environmental Protection Agency
NSW Department of Primary Industries, Mineral Resources
NSW Department of Mineral Resources (DMR)

2. ECM National Habitat Map Series components

The following components together comprise the *Estuarine, Coastal and Marine National Habitat Map Series*:

- The *ECM National Habitat Mapping Project Final Report* (Mount and Bricher, 2008a)

- The derived information products (data sets):
  1. The *National Intertidal/Subtidal benthic (NISB) Habitat Map* (and associated NISB Habitat MQ (NISB_plus) data set)
  2. The *National ECM Key Habitat Distribution Map Series* (10 km and 50 km grid cell maps)
  3. A National Coastal Wetlands Map Collection
  4. A National Estuaries Map Collection
  5. A National Dune and Dune Vegetation Map Collection, and
  6. A National Shoreline Map (derived from the *National Geomorphic Shoreline Map* or “Smartline” (Sharples and Mount, 2008, in prep.)

- *User Guide* and metadata for each product (i.e. this document)

- The *NISB Habitat Classification Scheme Version 1* (Mount et al, 2007) (Appendix 1 of this document)

- Data sources acknowledgement list (Appendix 2 of this document)

- Inventory of habitat mapping data sets (Appendix 3 of this document)

3. Introduction and Map Series Objectives

The production of the *ECM National Habitat Map Series* was driven by a number of immediate policy needs including supporting an assessment of the vulnerability of Australia's coastal ecosystems to the effects of climate change. It is also clear that there are a large number of other purposes for which the maps can be used including the following:

- Support for the development of national key habitat extent and distribution indicators by the National Land and Water Resources Audit (Audit) for reporting on coastal habitats.
- A consistent national input to future marine bioregionalisation processes, particularly supporting the development of IMCRA Bioregion sub-regions (or "ecoregions")
- Upgraded, nationally consistent Oil Spill Response Atlas (OSRA) habitat mapping for all states
- Enhanced information inputs to coastal planning including the flagging of the location of key coastal habitats at potentially higher risk of impact from development pressures
- An inventory of key habitat natural assets to assist NRM projects and activities
- Underpinning of improved wildlife management requiring detailed habitat type mapping

In more detail, the Department of Climate Change (DCC; formerly the Australian Greenhouse Office) is working with the States and Territories through the Intergovernmental Coastal Advisory Group (ICAG) to assess Australia's coastal vulnerability to climate change. An early objective of the Department is to deliver a "First Pass" Coastal Vulnerability Assessment (CVA) of the Australian coast and priority coastal systems (natural and artificial) by June 2008. This will identify risks and priorities and build foundational capacity towards future, more detailed assessments.

A key part of the CVA is the identification and mapping of coastal ecosystems and habitat types that have greater or lesser susceptibility to potential coastal impacts of climate change and sea level rise, such as accelerated erosion and increased marine inundation. These hazards may contribute to impacts including the direct loss of habitats (e.g. seagrass and mangroves), interruptions to biotic and chemical processes (e.g. coral bleaching) and progressive inland migration of ecosystems (e.g. mangrove and saltmarsh). These ecosystems and habitat types have undergone a detailed gap analysis of data and methods via an Australian Greenhouse Office consultancy (Voice et al., 2006).

Assessment of the potential rates and magnitudes with which these hazards may affect particular coastal ecosystems requires detailed measurement and modelling of a range of locally-variable factors (e.g., wave climate & energy, exposure, local bathymetry, littoral drift & sediment budget, and biotic responses). An important initial step is to be able to identify the location of those ecosystems which may be susceptible in some significant degree to such hazards. This, in turn, requires the availability of coastal habitat maps. The maps need to be in a format that enables the rapid and flexible extraction of the required information, such as a well designed GIS spatial database.

At the time this project was initiated, a significant number of coastal habitat maps existed for various discrete sections of the Australian coast. These were prepared for a wide range of purposes, by numerous researchers and agencies, and they existed in a variety of formats, at differing scales and resolutions. Moreover, these maps thematically classified and mapped coastal habitats using a variety of different classification schemes that included a mix of biotic, geomorphic and environmental factors. There was no consistently-classified coastal habitat mapping of the entire Australian coastline, except at scales too coarse to be of practical use in a vulnerability assessment.

In order to provide the basis for a First Pass vulnerability assessment of the whole Australian coastline, the DCC has contracted the National Land and Water Resources Audit (Audit) to prepare a national map of the Australian intertidal/subtidal benthic habitats using a nationally-consistent habitat classification that is capable of being readily interrogated to identify habitats that are potentially sensitive to a range of physical hazards related to climate change and sea-level rise. The Audit is involved as it has an interest in compiling national extent and distribution mapping of key estuarine, coastal and marine habitats to support one of the nationally agreed NRM indicators. The seaward boundary of the NRM estuarine, coastal and marine areas is the outer edge of the State Coastal Waters (i.e. 3 nm limits). The indicator will be delivered via the OzCoasts web site managed by Geoscience Australia.

The Audit coordinated a team of coastal habitat mapping specialists in the Spatial Science Group, School of Geography and Environmental Studies, University of Tasmania to undertake the bulk of the practical work involved in creating the nationally-consistent coastal classification system and map. The team works through UTAS Innovation Ltd., and is led by Dr Richard Mount (GIS, Remote Sensing and coastal monitoring and mapping specialist and the Audit's National Estuarine, Coastal and Marine (ECM) Information Coordinator). Via the services of the team, the Audit will produce the following coastal ecosystem and habitat data layers:

beaches (shorelines)	mangroves
estuaries	seagrasses
coastal wetlands	macroalgae
dune vegetation	coral reefs
saltmarsh	rocky reefs

The broad class of "sediment" (i.e. unconsolidated substrates such as sand, silt etc) has been added to the project's list of classes as it is regularly mapped and is an important habitat type, particularly for the project's primary objectives.

In practice, a series of information products have been developed to meet the project requirements (see Section 4).

3.1. Map Series scope

By necessity the project began by defining more closely the scope of the map series. Many of the tasks for producing the national maps were open ended and given the imperative for a rapid "first pass" assessment, limitations were placed on the project to enable delivery of the products within the required time frame. These constraints are as follows:

- The project was designed to collate existing habitat data sets only

- Existing classification schemes should be used when available and, ideally, collected data needs to be translated into nationally consistent schemes. However, where a national scheme is not in place or cannot be produced in the time available, we will need to accept the source data's classification scheme i.e. create a compilation or collection of data sets consisting of data coded with various schemes rather than translating the data into a single national scheme. Coastal wetlands and dune vegetation are good cases in point. The same applies where significant information will be lost through the translation process. Estuaries are a good case in point here.

- The map series' definition of the "coastal zone" includes:

    - The marine influenced waters within the *State Coastal Waters* (i.e. 3 nm limit, which constitutes the seaward boundary for NRM), and

    - The land that is either below 10 m elevation (i.e. 10 m above AHD) or within 500 m of the coastline as defined by the mean high water mark. In the low lying areas, this area broadly equates to the distribution of coastal vegetation such as mangroves and, in the environments with more relief than 10 m, this area broadly equates to the extent of habitats subject to a marine influence, for example coastal dunes or coastal cliff habitats. The *Shuttle Radar Topography Mission (SRTM) Version 2* digital elevation model (DEM) was used to generate the elevation portion of the coastal zone area.

- Given that many issues that arise when comparing mapped data sets of multiple scales, two derived information products were generated to provide a simplified spatial representation of the **distribution** of each of the key habitats. These derived products enable the visualisation of the habitat distributions at the regional and national extents. **It is extremely important to note that they are definitely NOT able to be used to calculate areas of habitat types.** The map format selected for distribution maps was the grid cell format and the two grid cell sizes are 10 km (state and regional) and 50 km (national), respectively.

4. Information Product Descriptions

4.1. Map Series Information Products overview

The *ECM National Habitat Map Series* consists of 2 main groups of **information products**. Firstly, a series of national habitat distribution maps were produced for the habitat types of saltmarsh, mangrove, seagrass, macroalgae, sediment, coral reef and rock substrate including the three following information products:

1. A thematically simplified, high spatial resolution **National Intertidal/Subtidal Benthic (NISB) Habitat Map**
2. A set of 10 km grid cell **ECM Key Habitat Distribution Maps** depicting the regional and statewide distribution of each key habitat type
3. A set of 50 km grid cell **ECM Key Habitat Distribution Maps** depicting the national distribution of each key habitat type

Four additional information products covering the remaining habitat types of dune vegetation, estuaries, coastal wetlands and shorelines (beaches) are identified as follows:

4. A **Dune and Dune Vegetation Map collection**
5. A **National Estuaries Map collection**
6. A **National Coastal Wetlands Map collection**, and
7. A **National Shoreline Map**

Together, the information products form the *ECM National Habitat Map Series*. The coastal ecosystem and habitat layers are as nationally comprehensive and consistent as is practical with current data, that is, legacy data from all States and the Northern Territory. Where appropriately licensed by the data suppliers, these layers are intended to form part of a coastal vulnerability spatial information system that will underpin the national coastal vulnerability assessment process. Where appropriately licensed or permitted by the data suppliers, the derived information products are intended to be made available through the proposed OzCoast portal housed at Geoscience Australia. The final nationally-consistent coastal habitat map series is intended to be a public domain data set managed by the Australian Government with full attribution of the various original mapping sources used to build the final map.

4.2. Defining the Map Series coastal zone

The map series' definition of the "coastal zone" includes:

- The marine influenced waters within the *State Coastal Waters* (i.e. 3 nm limit, which constitutes the seaward boundary for NRM), **and**

- The land that is either below 10 m elevation (i.e. 10 m above AHD) or within 500 m of the coastline as defined by the mean high water mark. In the low lying areas, this area broadly equates to the distribution of coastal vegetation such as mangroves and, in the environments with more relief than 10 m, this area broadly equates to the extent of habitats subject to a marine influence, for example coastal dunes or coastal cliff habitats. The *Shuttle Radar Topography Mission (SRTM) Version 2* digital elevation model (DEM) was used to generate the elevation portion of the coastal zone area.

The zone is important to define for geoprocessing purposes as many of the spatial data sets classes are not defined with reference to the coastal zone. For example, the NVIS saltmarsh classes extend inland across the continent, well beyond the coastal influence. It was therefore necessary to clip the NVIS saltmarsh layers with the coastal zone polygon defined for this project. On the other hand, the mangrove data sets almost completely fell within the coastal zone polygon. The coastal zone layer is called *coastal_buffers_04.shp* and is found in the *Data_Delivery\Reference_Layers* directory.

4.3. Map Series classification schemes

Any method of reporting and assessment that seeks to compare ecological units of interest must address the issue of classification. Classification schemes ideally organise and group information about distinguishable components of ecological systems so that comparisons can be made between the extent and distribution of the components across space and time.

In Australia, there are a large number of habitat classification schemes; for example, there are more than 15 schemes for wetland classification systems (including marine and estuarine wetlands). The estuarine, coastal and marine environments are extremely diverse and there is currently no classification scheme that covers all three environments. They must, therefore, be split into areas that have sufficient features in common to enable the application of classification schemes.

For the purposes of this map series, the habitats are split into onshore environments (i.e. dunes and dune vegetation) and the subtidal and intertidal environments (i.e. whether estuarine, nearshore or marine) including saltmarsh, mangroves, seagrasses, macroalgae, sediment, rock and coral reef. These classes of habitat types broadly equate to land cover mapping in the terrestrial environment. The **intertidal and subtidal habitats** did not have a single national classification scheme and it was necessary to produce one during the project. Details of the process for developing the scheme and the resulting scheme are available in *National Intertidal/Subtidal Benthic (NISB) Habitat Classification Scheme Version 1* (Mount, Bricher and Newton, 2007) (see Figure 1 below and Appendix 1).

Estuaries are treated separately as a higher order habitat as they include elements of the other habitat classes and are considered a useful organising entity and have their own classification schemes. Similarly, **coastal wetlands** are treated separately as they overlap with other categories, such as mangroves, saltmarshes and estuaries. Both estuaries and coastal wetlands are, therefore, dealt with as separate data sets with their own classifications. Where there are additional data sets with conflicting classification schemes, they are simply treated by including them on a stand alone basis within a "collection". This also applies to the **dune vegetation** data set.

The **shoreline (beaches)** category will also be treated separately because a complementary concurrent project (the *National Geomorphic and Shoreline Stability Mapping Project* (Sharples and Mount, 2008)) is producing a comprehensive shoreline classification scheme and mapping and will effectively deliver the "Beach" habitat data sets to the CVA project.

4.4. The NISB Habitat Map

The *NISB Habitat Map* layers form the primary data sets of the *ECM National Habitat Map Series*. They conform to the definitions, classes and standards defined in the *National Intertidal/Subtidal Benthic (NISB) Habitat Classification Scheme Version 1* (Mount, Bricher and Newton, 2007) (see Figure 1 below and Appendix 1). The data were processed on a state-by-state basis as many characteristics were similar within states but not among states. In addition, the production of the 10 km grid cell distribution maps was implemented on a state-by-state basis as they are designed to assist with the extent of a whole state or larger NRM Region. While this approach may bring some minor problems at state boundaries, the advantages were considered to outweigh these.

One of the main tasks of the project was to derive the maps based on the *NISB Habitat Classification Scheme* (Scheme) from the various intertidal/subtidal benthic habitat data sets supplied by the contributing state and research agencies. This required a comprehensive and thorough matching of the source data set attributes with the classes defined by the Scheme. The decision rules defined in the Scheme were also used to establish the destination class to which the source class belonged. Usually there was a considerable simplification of the source data’s classes into the nationally consistent classes. For example, some Victorian data sets had over 90 classes for mapping seagrass. This reduced thematic resolution is necessary as it enables a map to be derived that is comparable across the entire continent.

Further NISB Habitat information products, the 10 km and 50 km grid cell *ECM Key Habitat Distribution Map Series* (see the next section for details) and the *NISB Habitat MQ data set*, was developed as it became clear there were considerable differences in the quality and resolution of the candidate data sets. In response to this issue, criteria were set for deciding whether a data set “qualified” for inclusion in the *NISB Habitat Map.* Drawing on the *NISB Habitat Classification Scheme*, the data needed to fall within the accuracy range typically achieved by the leading state mapping agencies. This broadly equates to a resolution that is at least 1:50,000 scale or, preferably, more detailed. Other criteria included an assessment of the data collection methods and coverage. Some data were highly detailed at the quadrat and transect extent, but had very limited coverage. Other data consisted of single samples spaced more than 10 km apart. Some data had little or no field assessment (“ground truthing”) and these were regarded as consisting of lower quality for the purposes of the project.

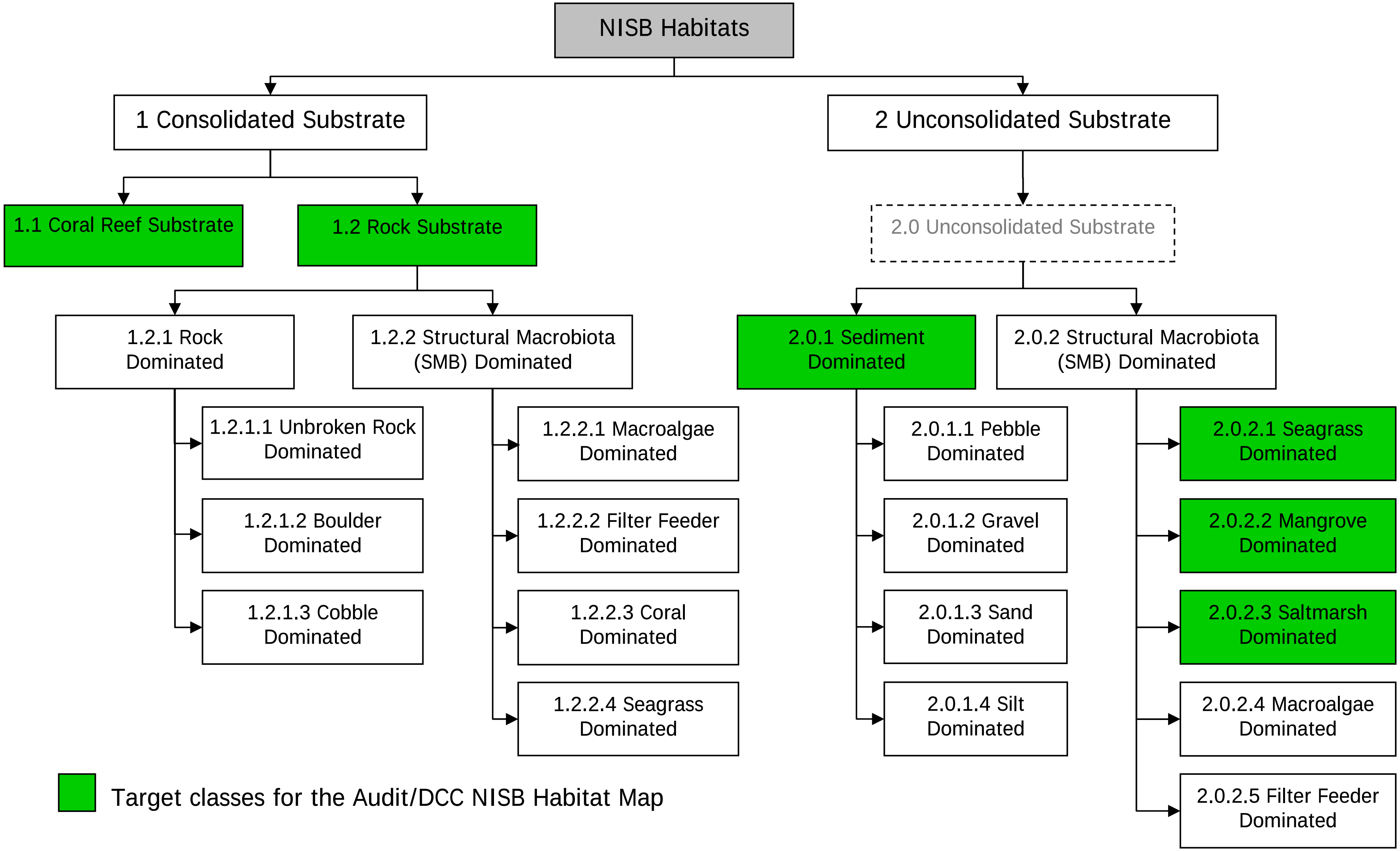

Figure 1. National Intertidal/Subtidal Benthic (NISB) Habitat Classification Scheme Version 1 (Mount et al, 2007)

While the standard *NISB Habitat Map* consists of the higher quality data, there were significant amounts of information that would be lost, especially for the habitat distribution maps, if the coarser and lower quality data sets were not included in some way. The approach taken was to add the coarser data to the standard *NISB Habitat Map* data set and use it for the production of the 10 km and 50 km grid cell *ECM Key Habitat Distribution Maps*. The data are often labelled as "*NISB_plus*", indicating that it is the NISB Habitat layer plus other lower quality layers. It is referred to as the *NISB Habitat MQ data set*, where the "MQ" refers to "Mixed Quality".

Data set name	**Purpose**	**Quality comment**
NISB Habitat Map	Supporting detailed **extent and distribution** mapping at the local, state and regional scale	Scale generally better than 1:50,000 and usually with substantial ground truthing
NISB Habitat MQ data set ("NISB_plus")	Supporting **distribution** mapping at the regional and national scale through the production of **grid cell distribution maps**	Mixed scales including broad coarse scales, sometimes with limited ground truthing

4.5. The ECM Key Habitat Distribution Map Series

The grid cell maps were produced specifically to assist with visualisation of the data at the regional, state and national scales. The fine, resolution NISB Habitat data is not easily visible when creating maps at these broader coverages. Careful logic was applied to the process as there were concerns that there should neither be an overstatement of the distribution of ECM key habitats and misconceptions arise that the mapping of the continent's key habitats was competed, nor that the distributions be understated.

Firstly, a standard set of grid cells were developed based on the successful use of the 1:100,000 map sheets for a sister weed mapping project within the Audit. Standard 50 km and 10 km cells were produced for the whole of Australia and then subset with the project's coastal zone polygon. This created the ECM set of grid cells depicted in Figure 2 and Figure 3. The 10 km and 50 km grid cells are precisely nested and have the characteristic of being evenly sized the across the whole continent, both east-west and north-south (See Figure 2 and Figure 3 for an example).

For each key habitat distribution map, each grid cell depicts where the following occurs in the *NISB Habitat MQ data set*:

- Firstly, if any of the specified key habitat type occurs, then attribute the cell with "present"
- Secondly, if there is none of the habitat mapped yet the whole area is mapped, mark the cell with "absent"
- Thirdly, if there is none of the habitat mapped and the whole cell is not mapped, then mark the cell as "unknown".
- Finally, if the entire cell is located in an environment where the habitat could not occur, such as saltmarsh below the high water mark, then mark the cell as "not applicable".

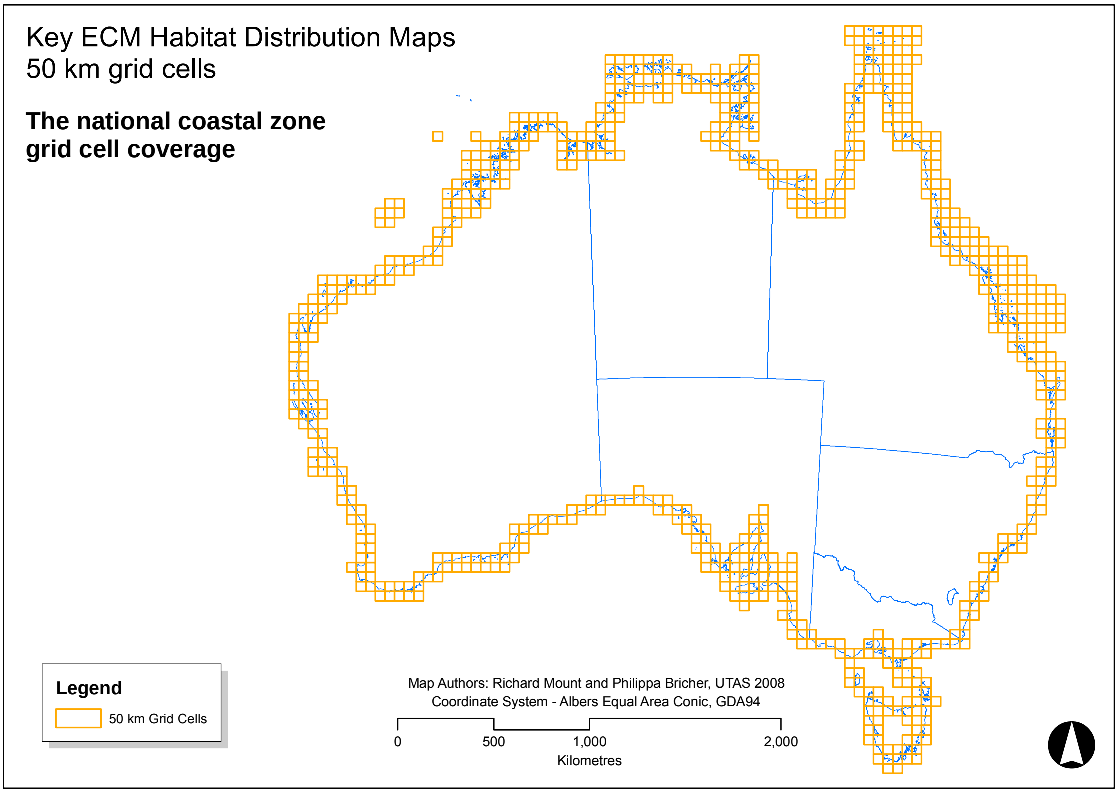

Figure 2. The 50 km grid cells (here blank) used for displaying the distribution key ECM habitats

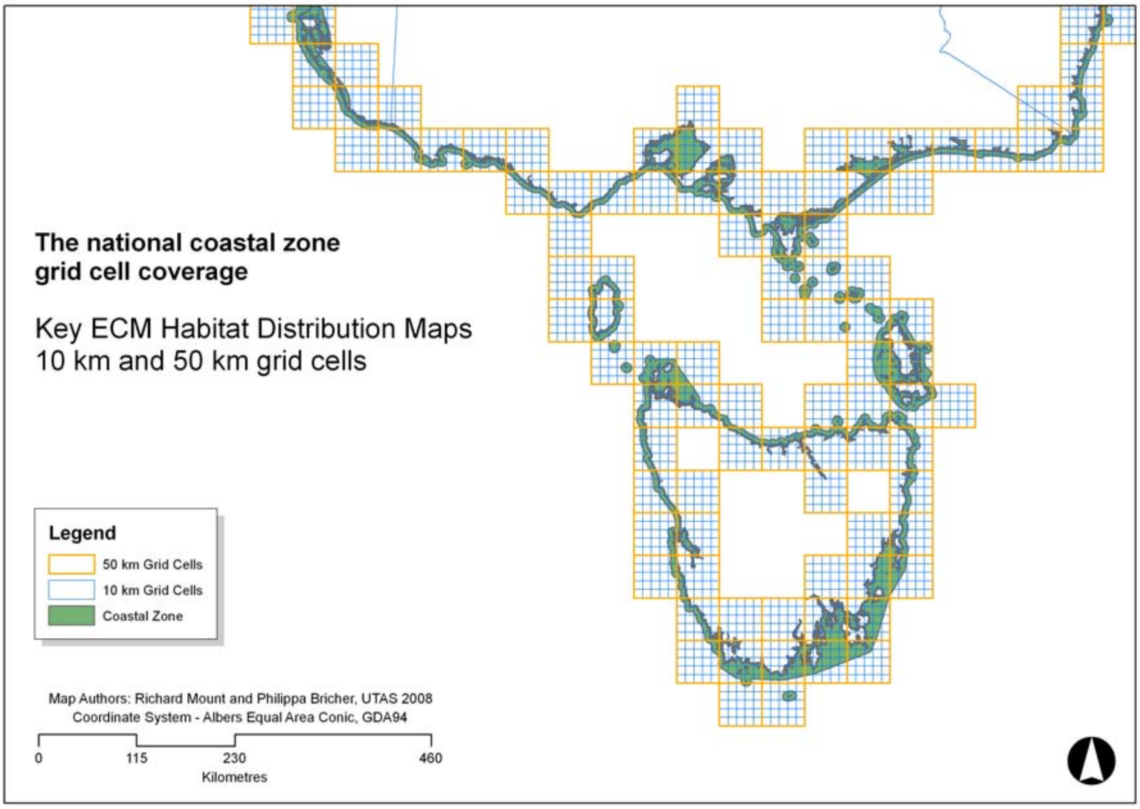

Figure 3. An example of the 10 km habitat distribution grid cells nested within the 50 km grid cells.

Clearly, there will be exceptions to these rules and they are completely dependent on the quality of the spatial data, however, they are considered to be robust in a number of ways. Firstly, they are built for the purpose of showing where a habitat has been mapped, no matter how small the patch or the mapping effort. This means the approach will honour the mapper's observations. Secondly, the method also indicates where further mapping work could be required (i.e. the "unknown" class), thus helping to indicate where significant work remains to be done.

It is notable that the classes included in the *NISB Habitat Map* are drawn from a number of levels within the hierarchy. This is quite acceptable and is regarded as a useful feature of the Classification Scheme, however, when applying the logic described above to a series of nested classes a complex series of logic tests need to be applied. For the purposes of the distribution maps, all coral was lumped together (i.e. both "coral reef substrate" and "coral dominated habitat on a rock substrate" as was all seagrass (i.e. a few seagrasses occur on a rock substrate).

It should also be noted that mapping macroalgae via acoustics (i.e. single beam and multi-beam sonar systems) is usually not achievable for technical reasons. This means that, while much of the mapped rock substrate is highly likely to be covered in macroalgae and/or filter feeders, and while it may be reasonable to assume that that is the case, without adequate ground truthing via, for example, a video camera or diver observations, it must be recorded as rock, not macroalgae. This means that the macroalgae mapping is not comprehensive enough to be included in the habitat distribution maps, though with the application of careful assumptions, a reasonable map could be made for particular purposes.

4.6. The National Habitat Map Series Collections

A series of map compilations, or collections, were developed for both the higher level organising entities, such as estuaries and coastal wetlands, and for the less well defined data sets, such as dune vegetation. It is important to note that a different approach was taken to creating each collection.

Coastal wetlands

Firstly, there are a very large number of **wetlands** spatial databases in Australia. Another Audit project is currently compiling a list of the databases and assessing them for their quality with regard to showing the extent, or area, of Australia's wetlands. The project is finding that the standards and methodologies for mapping wetlands are very variable. There is also a Wetlands Classification Scheme being developed, again with the assistance of the Audit. As such, it was considered prudent to simply compile the data sets that were available within the project's time frame and document the remaining data sets. See Appendix 4 for a list of potential wetlands data sets.

Given the range of approaches to wetland mapping it was considered reasonable to intersect the available data with this project's coastal zone polygon. This means that if a small part of the wetland falls within the coastal zone the entire wetland is included in the final mapped layer. This approach is based on the assumption that a wetland is usually level and that if any part of the wetland is subject to, for example, inundation or erosion, the whole wetland is potentially affected.

Dune vegetation

The dune vegetation data sets were in many ways the least developed of all the target data sets. There is little actual mapping of dune vegetation per se, rather the collection has proceeded by firstly compiling the available mapping of dunes from sources such as geomorphological and geological maps and then intersecting those with vegetation maps, such as the *National Vegetation Information Systems* (NVIS). While the approach is practical given the timeframe of this project, it does not guarantee capture dune vegetation as there may be differences in the mapping methods and classification schemes of the source data sets. This means that caution should be exercised in the interpretation of this collection.

Unlike the coastal wetlands, the **dune and dune vegetation** data sets were clipped, or limited, to the extent of the coastal zone buffer polygon. This decision was based on the assumption that this habitat type is found in non-coastal areas as well as the coastal zone and that, while there is unlikely to be a crisp dividing boundary between coastal and non-coastal areas, it was not possible to accurately delineated this boundary with the evidence to hand. In the absence of higher level evidence, the coastal zone polygon boundary was used.

Estuaries

For **estuaries**, there is well founded national classification scheme based on geomorphic principles (Ryan et al, 2003). This scheme has considerable relevance to the assessment of coastal vulnerability as it capture information about the energy regimes operating within each estuary and the national data set using the scheme (OzEstuaries) has been included here. The data set's classes were also easily mapped across to the *NISB Habitat Classification Scheme* classes. This was done and the resulting polygons added to the *NISB Habitat Mixed Quality (MQ) data set* (or AKA *NISB_plus*).

Other estuary data sets largely depict the topographic boundaries of the estuaries; however, they do so without reference to a consistent classification scheme. For this reason they are not included in this collection.

Shoreline (Beaches)

For the shoreline itself, the *National Shoreline Geomorphic and Stability Mapping Project* (Sharples and Mount, 2008, in prep) is running in parallel to this project and is producing a nationally consistent "smartline" map for all shoreline types that comprehensively maps a large number of shoreline attributes including information about the intertidal zone and the immediate backshore and foreshore. These are considered suitable for defining shoreline habitat types including for example, the location of the sandy beaches suitable for shorebird habitat. Details are provided in the *National Shoreline Geomorphic and Stability Map User Guide* (Sharples, 2008, in prep) that accompanies that data set.

A key component of that project is the linking (joining) of the "Smartline" to Andy Short's Australian Beach Safety and Management Program (ABSAMP) database of 12,000 sandy beaches. This linkage will provide easy access to the large store of ecological and geophysical information contained in that database.

The *Shoreline Habitat Map Collection* will be available as soon as that project delivers its data sets in March 2008.

5. Data characteristics

5.1. Coordinate System (CS)

Two standard coordinate systems were selected based on the Australian Government agencies, especially including Geoscience Australia. The geographic coordinate system (GCS) based on the GDA94 datum is preferred for most purposes. Where area needs to be calculated, the Albers Equal Area Conic Projection based on the GDA94 datum is used with the standard meridians and parallels as specified in the standards used by Geoscience Australia (GA, 200?).

The standard **geographical** CS (GCS) (i.e. latitude and longitude) is based on the Geocentric Datum of Australia 1994 (GDA94). In ArcGIS it is called **GCS_GDA_1994**.

Angular Unit	Degree (0.017453292519943299)
Prime Meridian	Greenwich (0.000000000000000000)
Datum	D_GDA_1994
Spheroid	GRS_1980
Semimajor Axis	6378137.000000000000000000
Semiminor Axis	6356752.314140356100000000
Inverse Flattening	298.257222101000020000

The standard **projected** CS (PCS) is based on the GDA94 datum as well and is an **Albers equal area conic projection**. It was chosen to enable Australia-wide representations of the geographic data that conform closely to the true shape of the continent and to enable delivery of spatial data in measurement units of metres. The projected CS has input values as detailed below.

Projection	**Albers**
Datum	GCS_GDA_1994
Spheroid	GRS80
Unit of measurement	Meter, 1.0
False_Easting	0.0
False_Northing	0.0
Central_Meridian	134°
Standard_Parallel_1	-36°
Standard_Parallel_2	-18°
Latitude_Of_Origin	0°

5.2. Data Dictionary for the National Intertidal/Subtidal Benthic (NISB) Habitat Map Series Fields

Field Name	Type	Width	Attribute Description	Range	Definition
NISB_sub01	Text	30	Classification under the first tier (substrate) of the NISB Habitat Classification Scheme	1 Consolidated	Any habitat in which the substrate is predominantly made up of particles of cobble size (>64 mm diameter) or larger. This includes coral reefs, solid rock and boulders
				2 Unconsolidated	A substrate that is predominantly made up of particles of pebble size (<64 mm diameter) or smaller. This includes gravels, sands and silts
				3 Unknown	Could not be mapped across to the NISB Habitat Classification Scheme (usually, either because it was unidentified or because it's a mixed rock/sediment site)
NISB_sub02	Text	26	Classification under the 2nd tier (substrate) of the NISB Habitat Classification Scheme	1.0 Consolidated	Could not be classified any further than 1 Consolidated
				1.1 Coral Reef	Any habitat in which the structure is predominantly formed by a coral framework. As all coral reef has some kind of rock substrate, coral reef is here defined as an object that has more than 50% coral cover.
				1.2 Rock Substrate	A structure that is predominantly formed by a rock framework. Here it is defined as a consolidated substrate that has 50% or less coral cover
				2.0 Unconsolidated	A dummy class “holder” at the second level of the hierarchy to enable consistency in the numbering throughout the class hierarchy
				3.0 Unknown	Could not be mapped across to the NISB Habitat Classification Scheme (usually, either because it was unidentified or because it's a mixed rock/sediment site)
NISB_dom01	Text	40	Classification under the 3rd tier (dominant habitat) of the NISB Habitat Classification Scheme	1.0.0 Consolidated	Could not be classified any further than 1 Consolidated
				1.1.0 Coral Reef	This scheme does not classify beyond 1.1 Coral Reef
				1.2.0 Rock Substrate	Could not be classified any further than 1.2 Rock Substrate

				1.2.1 Rock Dominated	A rocky substrate on which there is less than 5% seagrass or 10% other SMB cover
				1.2.2 Structural Macrobiota Dominated	A habitat in which seagrass covers more than 5% of the substrate or one or more groups of other SMB cover more than 10% of the substrate
				2.0.0 Unconsolidated	Could not be classified any further than 2 Unconsolidated
				2.0.1 Sediment Dominated	An unconsolidated habitat with either <5% seagrass cover or <10% other SMB cover
				2.0.2 Structural Macrobiota Dominated	A habitat in which >= 5% the substrate is covered by seagrass or >=10% by any other SMB (Seagrass has a lower threshold than other SMB because a significant amount of the biomass occurs below the surface (Duarte and Chiscano, 1999).
				3.0.0 Unknown	Could not be mapped across to the NISB Habitat Classification Scheme (usually, either because it was unidentified or because it's a mixed rock/sediment site)
NISB_dom02	Text	33	Classification under the 4th tier of the NISB Habitat Classification Scheme	1.0.0.0 Consolidated	Could not be classified any further than 1 Consolidated
				1.1.0.0 Coral Reef	This scheme does not classify beyond 1.1 Coral Reef
				1.2.0.0 Rock Substrate	Could not be classified any further than 1.2 Rock Substrate
				1.2.1.0 Rock Dominated	Could not be classified any further than 1.2.1 Rock Dominated
				1.2.1.1 Unbroken Rock Dominated	A rock dominated substrate where the cover is dominated by continuous outcropping rock.
				1.2.1.2 Boulder Dominated	A rock dominated substrate where the cover is dominated by rocks larger than 256 mm diameter.
				1.2.1.3 Cobble Dominated	A rock dominated substrate where the cover is dominated by rocks between 64 mm and 256 mm diameter.
				1.2.2.0 Structural Macrobiota Dominated	Could not be classified any further than 1.2.2 Structural Macrobiota Dominated
				1.2.2.1 Macroalgae Dominated	SMB dominated habitat in which macroalgae has greater substrate cover than other SMB
				1.2.2.2 Filter Feeder Dominated	SMB dominated habitat in which sessile filter feeders (e.g. sponges, ascidians and tunicates) have greater substrate cover than other SMB
				1.2.2.3 Coral Dominated	SMB dominated habitat in which coral has greater

					substrate cover than other SMB
				1.2.2.4 Seagrass Dominated	SMB dominated habitat in which seagrass has greater substrate cover than other SMB
				2.0.0.0 Unconsolidated	Could not be classified any further than 2 Unconsolidated
				2.0.1.0 Sediment Dominated	Could not be classified any further than 2.0.1 Sediment Dominated
				2.0.1.1 Pebble Dominated	A sediment dominated habitat which predominantly consists of particles 4 to 64 mm diameter
				2.0.1.2 Gravel Dominated	A sediment dominated habitat which predominantly consists of particles 2 to 4 mm diameter
				2.0.1.3 Sand Dominated	A sediment dominated habitat which predominantly consists of particles 63 µm to 2 mm diameter
				2.01.4 Silt Dominated	A sediment dominated habitat which predominantly consists of particles <63 µm diameter
				2.0.2.0 Structural Macrobiota Dominated	Could not be classified any further than 2.0.2 Structural Macrobiota Dominated
				2.0.2.1 Seagrass Dominated	An SMB dominated habitat in which seagrasses have greater substrate cover than other SMB. For seagrass, dominance is defined at 5%, compared with 10% for other SMB.
				2.0.2.2 Mangrove Dominated	Intertidal tall forests to shrublands, in areas with low wave energy. This habitat comprises more than 30 species, with most concentrated in Australia's north (DEWR, 2007). NB: Even though mangroves can occur on rocky shores, the substrate under mangroves is rarely mapped. Therefore, an arbitrary decision has been made here to class all mangroves as occurring on unconsolidated substrates.
				2.0.2.3 Saltmarsh Dominated	Extensive damp and water-logged flats, mostly in near-estuarine areas. The vegetation is dominated by hardy low shrubs, especially samphire communities (DEWR, 2007).
				2.0.2.4 Macroalgae Dominated	An SMB dominated habitat in which macroalgae have greater substrate cover than other SMB.
				2.0.2.5 Filter Feeder Dominated	An SMB dominated habitat in which filter feeders have greater substrate cover than other SMB.
				3.0.0.0 Unknown	Could not be mapped across to the NISB Habitat Classification Scheme (usually, either because it was

					unidentified or because it's a mixed rock/sediment site)
ANZLIC_ID	Text	20	ANZLIC Metadata unique identifying number (if applicable)		
DSource	Text	100	The custodians of the original file from which the features presented here were derived		
DOrig_File	Text	100	The original shapefile, geodatabase or raster from which the features presented here were derived		
DMeta_File	Text	100	The name under which the metadata for the DOrig_File was saved		
Area	Double	20	Area in m²	0-1000	
HOI_1	String	20	Habitat of Interest (a relabelling of NISB classifications for the purpose of generating 10km and 50km tile maps)	Rock, Unconsolidated	Any polygon containing rock/unconsolidated substrates
HOI_2	String	20	Habitat of Interest (a relabelling of NISB classifications for the purpose of generating 10km and 50km tile maps)	Seagrass, Sediment, Coral, Saltmarsh, Mangrove	Any polygon containing seagrass/sediment/coral/saltmarsh/mangrove dominated habitats
S_Roc	String	254	Distribution status of rock substrates (NISB class 1.2)	Presence, Absence, Unknown, N/A	• Presence = the HOI is found within that tile. • Absence = the entire area covered by the tile has been mapped and the HOI is not found within it. • N/A = The area covered by the tile has not been completely mapped, but the area is unlikely to contain the HOI, because it is terrestrial (in the case of rock, sediment, coral, seagrass) or below the tide line (in the case of saltmarsh). • Unknown = The HOI is not found in the mapped portion of the tile, but the tile is not completely mapped. Therefore, its presence or absence cannot be ascertained.
S_Unc	String	254	Distribution status of unconsolidated substrates (NISB class 2.0)	Presence, Absence, Unknown, N/A	As above

S_Sea	String	254	Distribution status of seagrass dominated habitats (NISB class 1.2.2.4 or 2.0.2.1)	Presence, Absence, Unknown, N/A	As above
S_Sed	String	254	Distribution status of sediment dominated habitats (NISB class 2.0.1)	Presence, Absence, Unknown, N/A	As above
S_Cor	String	254	Distribution status of coral dominated habitats (NISB class 1.1 or 1.2.2.3)	Presence, Absence, Unknown, N/A	As above
S_Sal	String	254	Distribution status of saltmarsh dominated habitats (NISB class 2.0.2.3)	Presence, Absence, Unknown, N/A	As above
S_Man	String	254	Distribution status of mangrove dominated habitats (NISB class 2.0.2.2)	Presence, Absence, Unknown, N/A	As above

5.3. *Data Dictionary for the National Dune Vegetation Collection*

Field Name	Type	Width	Attribute Description	Range	Definition
ANZLIC_ID	Text	20	ANZLIC Metadata unique identifying number (if applicable) for original dune presence data		
DSource	Text	100	The custodians of the original file from which the dune features presented here were derived		
DOrig_File	Text	100	The original shapefile, geodatabase or raster from which the dune features presented here were derived		
DMeta_File	Text	100	The name under which the metadata for the DOrig_File was saved		
Dune_Dsc1	Text	150	The primary descriptive information used to determine dune presence		
Dune_Dsc2	Text	150	Secondary descriptive information used to determine dune presence, where applicable		
State	Text	3	The State (or Territory) in which the dune polygon falls		
Dune	Text	3	A classification of the reliability of dune presence	y	Yes: Dunes, beach ridges or dune fields specified in original data source
				m	Maybe: Dunes potentially present but not specified in original data source; this classification was used only when no other data was available for a location
DOrig_Scal	Text	30	The spatial scale of the original dune presence data file		

NVIS_mvs	Text	150	Descriptions of major vegetation subgroups derived from the National Vegetation Information System		
V_ANZLICID	Text	20	ANZLIC Metadata unique identifying number (if applicable) for original vegetation data		
V_DSource	Text	100	The custodians of the original data file from which the vegetation features presented here were derived		
V_DOrigFil	Text	100	The original shapefile, geodatabase or raster from which the vegetation features presented here were derived		
V_DMetaFil	Text	100	The name under which the metadata for the V_DOrigFil was saved		
V_DOrigScl	Text	30	The spatial scale of the original vegetation data file		

6. Data Quality Information

The concept of "quality" is a relative one as the quality of an individual data set will change depending on the purpose for which it is used. In the spatial sciences, assessing the quality of a data set is usually done in the context of the specified purpose and is referred to as assessing the data set's "fitness-for-purpose". This is a challenging concept when all the exact purposes are not able to be specified, as is the case here. While a number of purposes are specified (e.g. for the *First Pass Coastal Vulnerability Assessment* and the *NRM Key Habitat Distribution Indicator*), there are likely to be many other uses for this data set. The approach taken in this situation is to ensure that the data is labelled according to its known characteristics. This is referred to as a "truth-in-labelling" approach and provides information to those who intend to use the data in the future for currently non-specified purposes.

The data quality information for the Map Series works differently for each component of the data. The *NISB Habitat Map* and the *ECM Key Habitat Distribution Map Series* qualify as data sets in their own right and have a full metadata record and data dictionary. The source data for these data sets are comprehensively listed and the data suppliers and any metadata associated with the original data sets are acknowledged at every level – that is in this report, in the metadata and, for the *NISB Habitat Map,* in the data itself as Feature level Metadata Pointer (FMP). For the *Map Collections*, each collected data set has its own metadata record (where available) and FMP was added.

6.1. Metadata

Metadata statements are presented here for the following National ECM Map Series components:

- The *NISB Habitat Map*
- The 10 km and 50 km *NISB Habitat Distribution Grid Cell Maps*

All other metadata is documented within the body of this User Guide.

DATASET CITATION

Title: National Intertidal/Subtidal Benthic (NISB) Habitat Map

Custodian: ERIN for Department of Climate Change (TBA)

Creator: Dr Richard Mount and Phillippa Bricher, Spatial Science Group, School of Geography, University of Tasmania

Jurisdiction: Australia

DESCRIPTION

Abstract:

The *NISB Habitat Map* was created by the University of Tasmania for a partnership between the Department of Climate Change and the National Land and Water Resources Audit. It supports the DCC/Audit partnership by providing a nationally consistent set of the available mapping data for those habitats that occur between the approximate position of the highest astronomical tide mark (HAT) and the location of the outer limit of the photic benthic zone (approximately at the 50-70 m depth contour). This area is broadly equivalent to the “inner” and “mid-shelf” regions identified by Geoscience Australia. The resulting map data set forms a core component of the *ECM National Habitat Map Series*.

The habitat classes include: coral reef, rock dominated habitat, sediment dominated habitat, mangroves, saltmarsh, seagrass, macroalgae and filter feeders (e.g. sponges), as defined in the *NISB Habitat Classification Scheme*. The scheme is designed to support the development of marine ‘ecoregions’ or bioregional subregions. Details of the scheme and the process of its development are available in *National Intertidal/Subtidal Benthic (NISB) Habitat Classification Scheme Version 1* (Mount, Bricher and Newton, 2007).

The *NISB Habitat Map* consists of two layers for each state. <STATENAME>_NISB.shp consists of the entire available habitat mapping at a resolution finer than 1:50 000 (with a few exceptions, outlined in the data quality section below). <STATENAME>_NISB_PLUS.shp consists of all the data in <STATENAME>_NISB.shp along with coarser resolution data, including NVIS and OzEstuaries data. These layers were used to produce the *National ECM Key Habitat Distribution Map Series* 10 km and 50 km tile maps.

Datum: Geodetic Datum of Australia 1994

Projection: Geographic coordinates

GEOGRAPHIC EXTENT NAME

Australia excluding external territories – AUS - Australia – Australia

GEOGRAPHIC BOUNDING BOX

North bounding latitude: 8.912920° S
South bounding latitude: 55.326655° S
East bounding latitude: 112.609896° E
West bounding latitude: 159.810665° E

DATA CURRENCY

Start date: 1984

End date: 2007

DATA STATUS

Progress: Complete

Maintenance and update frequency: Not scheduled.

ACCESS:

Format: ArcGIS shapefile (.shp)

Access constraints:
XXXX (TBA by Custodian)

DATA QUALITY

Lineage:

The NISB Habitat Map is a composite data set of the best available habitat mapping data for Australia's intertidal and subtidal benthos. Using ArcGIS 9.2, all the input layers were imported into geodatabases for processing. Fields were added to each layer's attribute table, listing the data source (DSource), original file name (DOrig_File), metadata file name (DMeta_File) and ANZLIC ID number (ANZLIC_ID).

Each layer then had NISB fields added, which correspond to the four tiers in the *NISB Habitat Classification Scheme* (2007). NISB_Sub01 and NISB_Sub02 refer to the first two tiers of the classification, which are based on the substrate. NISB_Dom01 and NISB_Dom02 refer to the dominant land cover, as described in the third and fourth tiers. The scheme is hierarchical, so where insufficient information was available to fully classify a polygon, it was classified to the finest tier possible.
The NISB Habitat Classification Scheme includes decision rules that describe the limits of each habitat class. For example, for a polygon to be described as class 1.2.2 Structural Macrobiota Dominated, SMBs (Structural Macrobiota such as seagrass or mangrove) must cover more than 10% of the substrate. However, many of the source data sets do not include information on percent cover, and so the original classifications were accepted on face value. That is, if the data provider identified a polygon as seagrass dominated sediment, we classified it as 2.0.2.1 Seagrass Dominated, without information about how precisely the original category fit the NISB classes. Microsoft Access was used to reclassify the layers.

Where habitat types extended inland (e.g. saltmarsh or mangrove), a buffer was used to select those that are "coastal". The coastal zone is defined here as being within 500 m of the coast or less than 10 m above sea level. A 500 m buffer was created around the coastline as defined by the Geodata Coast 100k (Geoscience Australia 2004). The Shuttle Radar Topography Mission (SRTM) v2 Digital Elevation Model was used to determine all areas below 10 m ASL. These two areas were merged to create the coastal zone buffer.

Once all the layers for a state had been converted to the NISB Habitat Classification scheme, they were merged into a single layer. Where layers overlapped, a decision was made as to which was considered to be more reliable. This decision was based on a combination of the metadata records and a visual inspection of the data sets. Then, the erase and merge functions were used to combine the layers.

The layers were then tested to ensure that the classifications were translated correctly from the source data and that there were no overlapping polygons. Overlaps were discovered in some of the source data for Victoria and were left as they were. The layers were not tested topologically. The maps were not independently ground-truthed.

All areas were calculated in m^2, using Albers equal area projection.

The contributing agencies must be acknowledged with each use of this derived data set are:

Contributors to the *National Intertidal/Subtidal (NISB) Habitat Map*:
Department of Natural Resources, Environment and the Arts, Northern Territory Government of Australia
Queensland Department of Primary Industries and Fisheries
Queensland Parks and Wildlife Services Environmental Protection Agency
Great Barrier Reef Marine Park Authority
National Oceans Office
Western Australia Department of Environment and Conservation
South Australian Department of Environment and Heritage
New South Wales Department of Environment and Conservation
New South Wales Department of Primary Industries: Fisheries
Conservation Commission of the Northern Territory Land Conservation Unit
Victorian Department of Primary Industries
Parks Victoria
Tasmanian Aquaculture and fisheries Institute

Positional Accuracy:

As this is a multi-scale dataset, it is impossible to give a single value for positional accuracy. Most layers in the NISB dataset were mapped at scales finer than 1:50 000, which translates to a positional accuracy of approximately ±25 m. However, some seagrass mapping for Queensland and South Australia has errors up to ±100 m. It is recommended that the user reads the metadata for the source layers for more specific accuracy information.

Attribute Accuracy:

After the NISB habitat classification scheme was applied to the data, MS Access queries were used to confirm that all records had been reclassified correctly. However, it was not possible to test the accuracy of the source datasets, and the original classifications were taken on trust. A pragmatic approach was used in applying the scheme, as there was rarely sufficient information to test whether any given record met the criteria for classes (e.g. percent cover was often not listed). For this reason, if the source dataset stated that a polygon contained sparse seagrass, then it was classified as 2.0.2.1 Seagrass Dominated Habitat, even though it have had less than 5% seagrass cover. Conservative assumptions were made about the substrate, where this was not listed. For example, it was generally assumed that a seagrass site had a sediment substrate. The only state where it was believed that this assumption would not hold was Victoria and Tasmania, where *Amphibolis* occurs on both rock and sediment substrates in very limited locations. In those sites, substrate information was provided and no assumptions were made.

Logical consistency:

A single person conducted all classifications, using a consistent classification scheme. After merging, the datasets were visually inspected for overlaps, but were not tested for topological consistency.

Completeness:

Complete

CONTACT INFORMATION

Contact organisation:
Contact position:
Mail address:
Locality:
State:
Country:
Postcode:
Telephone:
Facsimile:
Email:

METADATA INFORMATION

Metadata date:

28/2/2008

Metadata author:

Phillippa Bricher
Spatial Information Science
School of Geography and Environmental Studies
University of Tasmania
Private Bag 76
Sandy Bay
TAS 7005

DATASET CITATION

Title: National ECM Key Habitat Distribution Map Series

Custodian: ERIN for Department of Climate Change (TBA)

Creator: Dr Richard Mount and Phillippa Bricher, Spatial Science Group, School of Geography, University of Tasmania

Jurisdiction: Australia

DESCRIPTION

Abstract:

The *National ECM Key Habitat Distribution Map Series* were derived from the *NISB Habitat Map* created by the University of Tasmania for a partnership between the Department of Climate Change and the National Land and Water Resources Audit. It supports the DCC/Audit partnership by providing a nationally consistent set of the available mapping data that show the distribution of habitats that occur between the approximate position of the highest astronomical tide mark (HAT) and the location of the outer limit of the photic benthic zone (approximately at the 50-70 m depth contour). This area is broadly equivalent to the “inner” and “mid-shelf” regions identified by Geoscience Australia. The resulting map data set forms a core component of the *ECM National Habitat Map Series*.

The habitat classes include: coral reef, rock dominated habitat, sediment dominated habitat, mangroves, saltmarsh, seagrass, macroalgae and filter feeders (e.g. sponges), as defined in the *NISB Habitat Classification Scheme*. The scheme is designed to support the development of marine ‘ecoregions’ or bioregional subregions. Details of the scheme and the process of its development are available in *National Intertidal/Subtidal Benthic (NISB) Habitat Classification Scheme Version 1* (Mount, Bricher and Newton, 2007).

The 10 km and 50 km tiles distribution maps that form the *National ECM Key Habitat Distribution Map Series* were derived from the *NISB Habitat Map* in order to produce maps at resolutions that are easy to interpret at state and national extents. For each state, two layers were produced, one with 10 km and one with 50 km tiles. In each layer, new fields were created listing the presence, absence, unknown distribution or non-applicability of the Habitats of Interest (HOI). The HOI are rock substrate (Class 1.2), unconsolidated substrates (Class 2.0), coral habitat (classes 1.1 and 1.2.2.3), sediment dominated habitats (Class 2.0.1), seagrass dominated habitats (Classes 1.2.2.4 and 2.0.2.1), mangrove dominated habitats (Class 2.0.2.2) and saltmarsh dominated habitats (Class 2.0.2.3).

There are technical geographic and cartographic issues that arise when comparing mapped data sets of multiple scales, as is the case for this compiled and derived data set. The two derived information products were generated to provide a simplified spatial representation of the broad **distribution** patterns of each of the key habitats

across large areas. These derived products are designed to enable the visualisation of the habitat distributions at the regional and national extents. **It is extremely important to note that they are definitely NOT able to be used to calculate areas of habitat types.**

Datum: Geodetic Datum of Australia 1994

Projection: Albers Equal Area Projection (Geoscience Australia Standard)
- **Spheroid:** GRS 80
- **Std parallel 1:** -18°N
- **Std parallel 2:** -36°N
- **Central Meridian:** 134°E
- **Latitude of origin:** 0°
- **Usage:** For calculating areas at national extents

GEOGRAPHIC EXTENT NAME

Australia excluding external territories – AUS - Australia – Australia

GEOGRAPHIC BOUNDING BOX

North bounding latitude: 8.912920°S
South bounding latitude: 55.326655°S
East bounding latitude: 112.609896°E
West bounding latitude: 159.810665°E

DATA CURRENCY

Start date: 1984

End date: 2007

DATA STATUS

Progress: Complete

Maintenance and update frequency: Not scheduled.

ACCESS:

Format: ArcGIS shapefile (.shp)

Access constraints:
XXXX (TBA by Custodian)

DATA QUALITY

Lineage:

The *National ECM Key Habitat Distribution Map Series* are derivatives from the *NISB Habitat Map*.

The *NISB Habitat Map* is a composite data set of the best available habitat mapping data for Australia's intertidal and subtidal benthos. Using ArcGIS 9.2, all the input layers were imported into geodatabases for processing. Fields were added to each layer's attribute table, listing the data source (DSource), original file name (DOrig_File), metadata file name (DMeta_File) and ANZLIC ID number (ANZLIC_ID).

Each layer then had NISB fields added, which correspond to the four tiers in the *NISB Habitat Classification Scheme* (2007). NISB_Sub01 and NISB_Sub02 refer to the first two tiers of the classification, which are based on the substrate. NISB_Dom01 and NISB_Dom02 refer to the dominant land cover, as described in the third and fourth tiers. The scheme is hierarchical, so where insufficient information was available to fully classify a polygon, it was classified to the finest tier possible.
The NISB Habitat Classification Scheme includes decision rules that describe the limits of each habitat class. For example, for a polygon to be described as class 1.2.2 Structural Macrobiota Dominated, SMBs (Structural Macrobiota such as seagrass or mangrove) must cover more than 10% of the substrate. However, many of the source data sets do not include information on percent cover, and so the original classifications were accepted on face value. That is, if the data provider identified a polygon as seagrass dominated sediment, we classified it as 2.0.2.1 Seagrass Dominated, without information about how precisely the original category fit the NISB classes. Microsoft Access was used to reclassify the layers.

Where habitat types extended inland (e.g. saltmarsh or mangrove), a buffer was used to select those that are "coastal". The coastal zone is defined here as being within 500 m of the coast or less than 10 m above sea level. A 500 m buffer was created around the coastline as defined by the Geodata Coast 100k (Geoscience Australia 2004). The Shuttle Radar Topography Mission (SRTM) v2 Digital Elevation Model was used to determine all areas below 10 m ASL. These two areas were merged to create the coastal zone buffer.

Once all the layers for a state had been converted to the NISB Habitat Classification scheme, they were merged into a single layer. Where layers overlapped, a decision was made as to which was considered to be more reliable. This decision was based on a combination of the metadata records and a visual inspection of the data sets. Then, the erase and merge functions were used to combine the layers.

The layers were then tested to ensure that the classifications were translated correctly from the source data and that there were no overlapping polygons. Overlaps were discovered in some of the source data for Victoria and were left as they were. The layers were not tested topologically. The maps were not independently ground-truthed.

To create the tile layers, tessellated grids with tiles of 10km and 50km that cover the extent of state coastal waters were created using Jenness Tools' Repeating Shapes tool (www.jennessent.com). Then, we used a script written by Dominik Jaskerniak and Luke Wallace, from the University of Tasmania, to classify these grids according to the habitat types found within them, as defined in the layer <STATENAME>_NISB_PLUS.shp.

The logic of the script was as follows: If a habitat of interest (HOI) occurs anywhere within a tile, that HOI is listed as *Present*. If the entire tile has been mapped and the HOI does not occur anywhere within that tile, it is labeled *Absent* (Note: due to the patchy nature of coastal habitat mapping, this is a very rare class). If the tile covers an area where it is extremely unlikely that the HOI exists (e.g. rock, sediment, coral, seagrass and macroalgae are only mapped below the high tide line, and are therefore unlikely to occur on land) then the tile is labeled *N/A*. If the tile is incompletely mapped, but the area that is mapped does not include any of the HOI, the tile is labeled *Unknown*.

The contributing agencies must be acknowledged with each use of this derived data set are:

Contributors to the *National Intertidal/Subtidal (NISB) Habitat Map*:
Department of Natural Resources, Environment and the Arts, Northern Territory Government of Australia
Queensland Department of Primary Industries and Fisheries
Queensland Parks and Wildlife Services Environmental Protection Agency
Great Barrier Reef Marine Park Authority
National Oceans Office
Western Australia Department of Environment and Conservation
South Australian Department of Environment and Heritage
New South Wales Department of Environment and Conservation
New South Wales Department of Primary Industries: Fisheries
Conservation Commission of the Northern Territory Land Conservation Unit
Victorian Department of Primary Industries
Parks Victoria
Tasmanian Aquaculture and fisheries Institute

Positional Accuracy:

As this is a multi-scale dataset, it is impossible to give a single value for positional accuracy. Most layers in the NISB dataset were mapped at scales finer than 1:50 000, which translates to a positional accuracy of approximately ±25 m. However, some seagrass mapping for Queensland and South Australia has errors up to ±100 m. It is recommended that the user reads the metadata for the source layers for more specific accuracy information.

Attribute Accuracy:

After the NISB habitat classification scheme was applied to the data, MS Access queries were used to confirm that all records had been reclassified correctly. However, it was not possible to test the accuracy of the source datasets, and the original classifications were taken on trust. A pragmatic approach was used in applying the scheme, as there was rarely sufficient information to test whether any given record met the criteria for classes (e.g. percent cover was often not listed). For this reason, if the source dataset stated that a polygon contained sparse seagrass, then it was classified as 2.0.2.1 Seagrass Dominated Habitat, even though it have had less than 5% seagrass cover. Conservative assumptions were made about the substrate, where this was not listed. For example, it was generally assumed that a seagrass site had a sediment substrate. The only state where it was believed that this assumption would not hold was Victoria and Tasmania, where *Amphibolis* occurs on both rock and sediment substrates in very limited locations. In those sites, substrate information was provided and no assumptions were made.

Visual inspections were used to confirm that the script had assigned the correct values to tiles, based on the values in the NISB_Plus layers.

Logical consistency:

A single person conducted all classifications, using a consistent classification scheme. After merging, the datasets were visually inspected for overlaps, but were not tested for topological consistency.

Completeness:

Complete

CONTACT INFORMATION

Contact organisation:
Contact position:
Mail address:
Locality:
State:
Country:
Postcode:
Telephone:
Facsimile:
Email:

METADATA INFORMATION

Metadata date:

28/2/2008

Metadata author:

Phillippa Bricher
Spatial Information Science
School of Geography and Environmental Studies
University of Tasmania
Private Bag 76
Sandy Bay
TAS 7005

6.2. *Feature level metadata pointer (FMP)*

One of the primary objectives of the FMPs is to ensure that the **data supplier is acknowledged** at the finest level of the data set. It also will enable a number of other functions:

- Discovery of the current version of the data set via the Australian Spatial Data Directory (ASDD)
- Updated data sets to be added more easily
- Support the ability of the user to “drill down” to the feature’s original data set metadata.
- Enable the data supplier to be contacted about the data set if needed.

Each feature in the *National ECM Habitat Map Series* has had 4 new attributes added. These are as follows:

ANZLIC_ID	Text	20	ANZLIC Metadata unique identifying number (if applicable)
DSource	Text	100	The custodians of the original file from which the features presented here were derived
DOrig_File	Text	100	The original shapefile, geodatabase or raster from which the features presented here were derived
DMeta_File	Text	100	The name under which the metadata for the DOrig_File was saved

An example entry is a follows:

ANZLIC_ID	DSource	DOrig_File	DMeta_File
unavailable	Tasmanian Aquaculture and Fisheries Institute University of Tasmania	SEAMAP_habitats_ mga.shp	Seamap_ACV_ Metadata.doc

See Section 5.2 Data Dictionary for the National Intertidal/Subtidal Benthic (NISB) Habitat Map Series Fields for the complete definition of all the added fields.

7. Data Licensing

Data licensing revolves around the **uses** to which the data will be put. The 2 primary uses are for the DCC's *First Pass Coastal Vulnerability Assessment* project and the production of the NRM Habitat Extent and Distribution Indicator by the Audit. While the vulnerability of the coast to climate change has provided the impetus for this work, the ECM Habitat Map will be useful for a very large range of other uses. Some of these are as follows:

- A consistent national input to future marine bioregionalisation processes, particularly supporting the development of IMCRA Bioregion sub-regions (or "ecoregions")
- Upgraded, nationally consistent Oil Spill Response Atlas (OSRA) habitat mapping for all states
- Enhanced information inputs to coastal planning including the flagging of the location of key coastal habitats at potentially higher risk of impact from development pressures
- An inventory of key habitat natural assets to assist NRM projects and activities
- Underpinning of improved wildlife management requiring detailed habitat type mapping

In the first instance, data licensing was completed that allowed the primary uses to proceed and, secondly, data licensing was facilitated that allowed further uses of the data by open viewing of the derived information products via web mapping services (e.g. OzCoasts) and open access via downloading of the data sets facilitated by, for example, an Office of Spatial Data Management's (OSDM) license. These uses were grouped into three tiers, summarised as follows:

1. That UTAS use the supplied data to produce the ECM Habitat Map and provide the derived information products to the DCC via the Audit including:
   a. The ECM Habitat map
   b. The national 10 km grid cell map
   c. The national 50 km grid cell map

2. That the DCC and the Audit (representing the Australian Government) publish the resulting information products via simple visual representations of the data, such as hard copy figures in reports and via Web Mapping Services (WMS) including OzCoasts, the web site managed by Geoscience Australia.

3. That the DCC and Audit (representing the Australian Government) distribute the resulting information products via standard Office of Spatial Data Management's (OSDM) data licenses as used by the AG for other nationally produced data sets, such as the National Vegetation Information System (NVIS), the Australian Soil Resource Information System (ASRIS) and award winning MapConnect.

This tiered approach to data licensing means that some of the data in the ECM National Habitat Map Series may be more accessible to a wider range of users than others. This is an almost inevitable outcome given the complex process of obtaining data licenses for multiple data sets from a wide range of government and research agencies, each operating with their own data licensing policies.

Data licenses are stored in the data license folder within each data set folder.

Acknowledgements

A large undertaking such as this requires goodwill and commitment from many people. We are very grateful for all the support provided to us by the many partners in this truly national (in the inclusive sense of the word!) project.

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Appendix 1:
National Intertidal/Subtidal Benthic (NISB)
Habitat Classification Scheme

Version 1

October 2007

Principal Authors

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(as part of the Australian Coastal Vulnerability Project)

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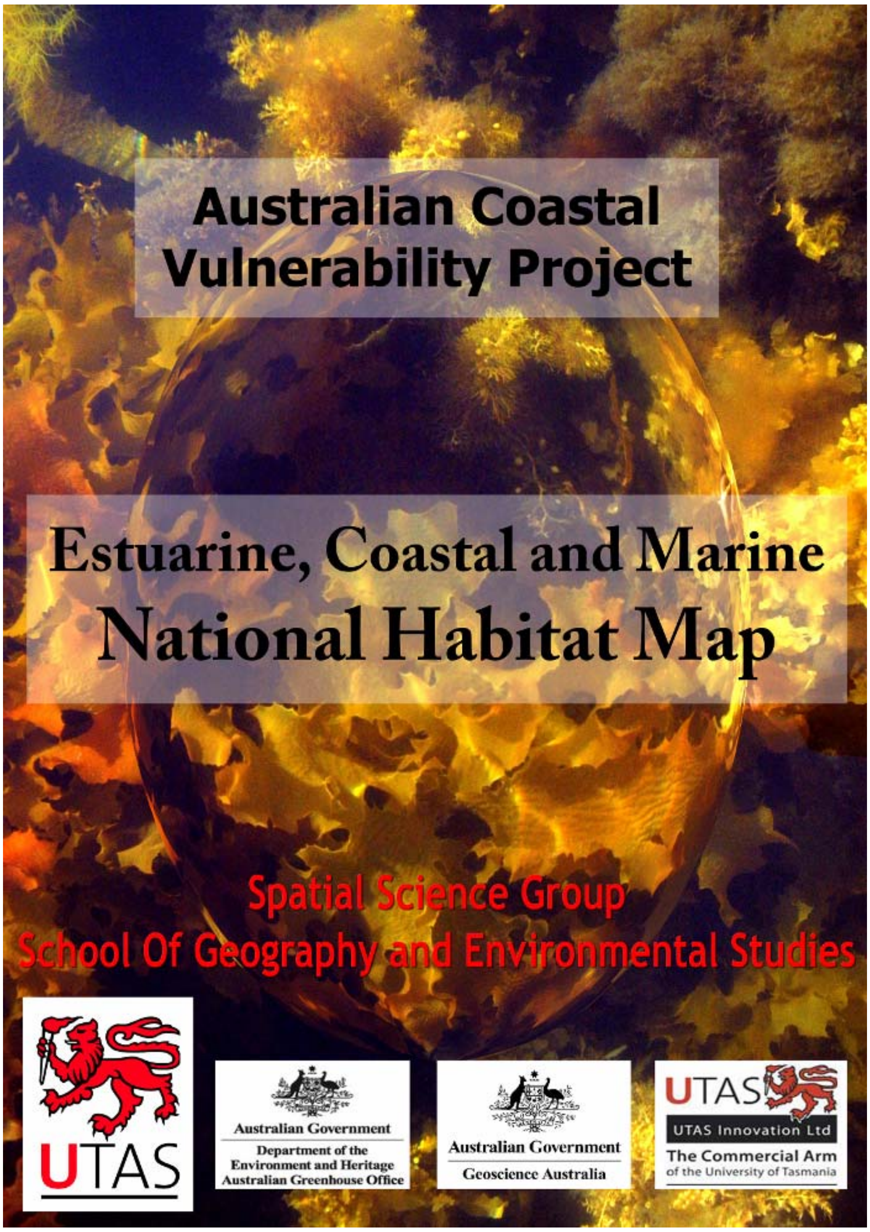


National Land & Water Resources Audit
An Initiative of the Natural Heritage Trust

Contents

Executive Summary

- There are a series of uses for a national intertidal/subtidal benthic habitat classification scheme. These include supporting the assessment of the vulnerability of Australia's shores to climate change impacts. Currently, a number of habitat classification schemes are in use around Australia. These schemes have many characteristics in common, though they are implemented differently to reflect current practise and management needs within each state and territory.
- The scheme is focused on the surface of the land and the seafloor between the highest astronomical tide (HAT) and the maximum depth at which approximate outer limit of the photic benthic zone (approximately 50-70 m deep). It is concerned with defining local scale "habitats" or "communities" for mapping purposes.
- The national scheme was developed by decomposing the state schemes into their component parts, establishing a conceptual model for habitat mapping and then synthesising a national scheme. This scheme is designed to be applied around the nation; be consistent with the existing schemes; and meet the requirements of producing a national map.
- It should be noted that while there are a large number of habitat properties that could be mapped, this scheme has focused on a subset of properties that are both feasible to map and are ecologically relevant; i.e. substrate and habitat-forming macrobiota. Mapping biodiversity or mobile biota is resource intensive and not usually undertaken across large areas. Environmental properties, such as depth, tidal limits, exposure and temperature are more available but are treated as "modifiers" rather than core properties for this classification. This provides simplicity in the core scheme and the flexibility to include them if required.
- A new term, *structural macrobiota* (SMB), was developed to more accurately describe the marine biota that fulfil the habitat-forming role played by vegetation in terrestrial environments. SMB covers macroalgae (protists), corals and other filter feeders (animals with algal symbionts), and marine plants (macrophytes such as seagrasses).
- The resulting scheme is hierarchical in structure with class descriptions defined for the higher level classes and the capacity to add classes further down the hierarchy. The **classes** are defined at the highest levels of the hierarchy by substrate properties, such as rock and sediment, and, at the lower levels, by the presence and dominance of various SMB. The SMB classes targeted for the national map include mangroves, saltmarsh, coral, macroalgae and seagrass. **Decision rules** are defined for most boundaries between classes, though further refinement is required, in particular the definition of reference areas for some classes. If required, attributes of any observed substrate, biotic and environmental properties can be added at any level of the hierarchy in the form of "**modifiers**". There are a very large number of potential modifiers and a small subset is addressed here.
- Great flexibility is conferred by the hierarchical nature of the scheme as maps can be produced that represent classes from differing levels of the hierarchy. This means that where greater resolution data is available, or particular purposes need to be met, the maps can display a matching amount of detail.

Acronyms

AGO	Australian Greenhouse Office
CMA	Catchment Management Authority
CSIRO	Commonwealth Scientific and Industrial Research Organisation
ECM	Estuarine, Coastal and Marine
GRU	Ground Resolution Unit
HAT	Highest Astronomical Tide
ISB	Intertidal/Subtidal Benthic
MDU	Minimum Discernable Unit
MMU	Minimum Mapping Unit
NISB	National Intertidal/Subtidal Benthic
NISBHCS	National Intertidal/Subtidal Benthic Habitat Classification Scheme
NLWRA	National Land and Water Resources Audit (Audit)
NOO	National Oceans Office
NRM	Natural Resource Management
NVIS	National Vegetation Information System
SMB	Structural Macrobiota

1. Introduction

Intertidal and shallow water benthic habitat mapping is conducted in all Australian states and the Northern Territory by a variety of agencies and for a range of purposes. The various classification schemes used are designed for these specific purposes and there is not necessarily consistency between the resultant mappings. Typically, the States and NT have focused their mapping efforts on defining habitat extent at various resolutions (see discussion below), while Commonwealth Government agencies have been focused on bioregionalisation at very broad extents and resolutions, such as biomes, bioregions and upwards to provinces (Butler et al., 2001). A series of national initiatives would benefit from access to finer resolution estuarine, coastal and marine (ECM) key habitat maps that have a nationally consistent classification and, ideally, national coverage. These include the Australian Greenhouse Office's *Australian Coastal Vulnerability to Climate Change* project and the Audit's national ECM resource condition assessments (see Project Aims below). At the same time, a nationally consistent system would enable comparisons among state and regional habitat maps.

Given the continuing development of many states' and NT's mapping programs and the increasing interest of NRM regions (CMAs) in the marine environment, a nationally consistent classification scheme is considered a useful tool for habitat reporting. The primary focus is on achieving consistency at a high level of the intertidal/subtidal benthic habitat classification hierarchy (e.g. mangrove, reef, sediment and seagrass) rather than the more detailed levels (e.g. species, modifiers, etc). However, a nationally consistent scheme needs to be flexible enough that the existing habitat classification schemes can be mapped across to it, so as to avoid undermining the substantial and valuable body of habitat classification work that has been completed and is continuing around Australia.

The wide variety of benthic sensing techniques used across Australia poses an additional challenge to creating a consistent scheme. For example, definitions of seagrass density vary according to whether the seagrass is mapped from aerial photographs, acoustic soundings, underwater video or dive samples (Bancroft, 2003; Ball et al., 2006). The decision rules associated with the various classes need to be framed so that they are as independent of platform sensor as possible.

1.1. Background to the development of the scheme

The development of a national habitat classification scheme has been pursued for a number of years in many different forums…

[More needed here re current schemes and the previous workshops and the reports by Bancroft (2003) and Ball (2006).]

1.2. Classification scheme objectives

The objective of this scheme is to enable the **creation of a national level map** including the National Habitat Map identified by the AGO/NLWRA Partnership Project. Thus agreement by the various state and NRM regions is not needed on all levels within the national scheme; though classes lower in the hierarchy (i.e. more detailed classes) needed to be considered to ensure that the existing data produced with state classification schemes could map across to a national scheme.

This objective requires the definition of both **habitat classes** and d**ecision rules** for differentiating classes in the resulting scheme.

The key estuarine, coastal and marine (ECM) intertidal/subtidal benthic **habitat types** identified for inclusion in the National Habitat Map include, at least:

a. mangroves
b. saltmarshes
c. seagrasses
d. macroalgae
e. rocky reefs
f. coral reefs
g. unconsolidated sediments

The National Intertidal/Subtidal Benthic (NISB) Habitat Classification Scheme will support the AGO/NLWRA partnership project by providing a nationally consistent scheme for those habitats between the highest astronomical tide mark (HAT) and the approximate outer limit of the photic benthic zone (approximately 50 – 70 m depth contour). This area is broadly equivalent to the “inner” and “mid-shelf” regions identified by Geoscience Australia (REFS XXXX).

1.3. Purposes for habitat mapping:

At a workshop held in Hobart in August 2007, attended by representatives of state marine habitat mapping agencies, the following groups of purposes were identified:

Low Resolution Mapping (<1:40 000):
- Marine regional planning

Medium Resolution Mapping (1:25 000 – 1:40 000):
This resolution of mapping is regarded as “**general purpose**” mapping and has many uses, including
- Aquaculture planning
- Emergency response (for example, oil spills)
- Natural Resource Management Regions
- Marine Protected Areas (planning
- Fisheries Management

High Resolution Mapping (>1:25 000):
- Environmental Impact Assessment
- Environmental monitoring

2. Definitions

Accuracy: The closeness of an observed value to a true value. This term is here used in two ways:

- *Positional accuracy:* The difference between observed and true location (usually expressed as ± X distance).
- *Attribute accuracy:* The likelihood that the attribute label is correct at any location.

Extent: The total area under consideration. This term is here used in three ways:

- Observational extent: The area covered by a given sensor.
- Representational extent: The area covered by a map/data layer.
- Management extent: The area of interest to a particular management body (e.g. all of Australia's coasts, or all the waters in a particular NRM region).

Habitat: This term is used in two primary senses.

(1) Most strictly, "habitat" is an environment used by a particular organism or assemblage, e.g. habitat *for* dugongs or habitat *for* seagrass (Kvitek et al., 1999).

(2) "Habitat" can also be used to denote a relatively homogeneous environment that is inhabited either permanently or temporarily by organisms. This is the sense in which generalised habitat mapping is conducted by Australian government agencies (e.g. Ball et al., 2006; Rule et al., 2007) and the meaning which is used throughout this document, unless otherwise stated. Diaz et al (2004) identify habitat as the intersection of three components:

- *The substrate* (i.e. topography and textural characteristics)
- *The biota* (species life histories and preferences)
- *The environmental processes* acting on the location (e.g. temperature, salinity, pressure, exposure, etc.)

It should be noted that habitats are repetitive physical or biophysical units found within ecosystems, so the same habitat could be found in more than one bioregion (Kvitek et al., 1999). For the purposes of this scheme, "habitat" is broadly equivalent to Biotope (primary or secondary) and Biological Facies (Butler et al, 2001).

Habitat mapping: This term can refer to either species-specific habitat mapping (e.g. seagrass beds as dugong habitat) or, as in this scheme, generalised mapping of broad habitat types, as is practised by state and territory agencies around Australia and the world. This involves classifying landscape into relatively homogeneous units (Bancroft, 2003; Ball, 2006).

Habitat mapping classifications: The classification schemes that are applied at state, territory and Natural Resource Management (NRM) Region scales.

Modifiers: Attributes of a habitat or ecosystem that are not used for primary classification. This may be because they are considered to be less significant ecological forcers, or because they are not so easily mapped and hence data are only available for some areas of the total extent to which a classification scheme is being applied.

Resolution: A measure of the closest distance between two unique identifiable features or the size of the smallest feature that can be mapped or sampled (Burrough and McDonnell, 2000; Delaney and Van Niel, 2007). It is here divided into four subcategories:

- *Observational resolution:* the size of the smallest feature that can be mapped or sampled (also known as Ground Resolution Unit (GRU) or Minimum Discernable Unit (MDU)).
- *Representational resolution:* The smallest object that can be shown in a map/data layer (also known as the Minimum Mapping Unit (MMU)).
- *Management resolution:* The smallest unit of relevance to a given management consideration (e.g. a biotope or a microcommunity).
- *Temporal resolution:* The frequency of observations through time.

Scale: Within habitat mapping circles many different and often contradictory meanings are given to the term “scale”. Scale generally involves some kind of measure of extent, area and/or resolution. For clarity, this document uses the terms extent, resolution and accuracy in place of scale.

Scale ratio: Many available datasets do not contain specific metadata on accuracy or resolution. Instead, data is described as being mapped at “1:25,000 scale” or “1:1,000,000 scale”. In the absence of more explicit metadata, it is assumed that this refers to a paper map scale ratio. As a rule of thumb, the smallest object that can be drawn on a paper map is 0.5 mm wide (Longley et al., 2005). Thus the accuracy of data can be calculated as ½ the second integer in the scale. For example, a 1:25,000 scale map is likely to be accurate to ±12,500 mm (or ±12.5 m). This assumes that the data was originally gathered at an appropriate level of accuracy, and this assumption often cannot be assessed.

Structural Macrobiota (SMB): Sessile habitat-forming species that, by their presence, increase spatial complexity and alter local environmental conditions, often facilitating a diversified assemblage of organisms (Lilley and Schiel, 2006). This class is similar to the “vegetated” class used in terrestrial habitat classifications. In the marine environment, this class includes seagrasses, macroalgae, stromatolites, corals, sponges and other macroinvertebrates that form large enough patches to provide places for other organisms to live (Cocito 2004). These structures and patches may be monospecific; formed by a single primary species such as serpulid reefs, or may consist of a number of primary species such as coral reefs. More specifically, the term “macrobiota” implies that an organism must be visible to the naked eye. The structuring role of SMB can include both three dimensional structure, as provided by coral or macroalgae, and two-dimensional structure, as provided by crust- or mat-forming biota (e.g. turfing algae and encrusting sponges).

Environment	Structural Macrobiotic Groups
Terrestrial	Plants
Aquatic	Plants (macrophytes), Protists (macroalgae), Animals (e.g. corals, sponges, ascidians and tunicates)

3. Conceptual Basis of the Scheme

It is widely recognised that ecosystems and their management need to be viewed as multi-scale processes (Butler et al., 2001). It has also long been recognised that any classification system involves an attempt to impose artificial boundaries on natural continuums for the purposes of inventory, evaluation and management (Cowardin, 1979). However, classification provides a valuable framework that allows habitats to be quantified and monitored.

Habitat and land cover classification maps are widely used in both terrestrial and marine environments and a large range of schemes have been created for specific purposes and environments. These are most strongly developed for terrestrial environments. In Australia, such schemes include the National Vegetation Information System (NVIS) and the Land Cover classification scheme (DEWR, 2007; ACLUMP, 2006). Globally, the UN's *Land Cover Classification System* (Gregorio, 2005) is used to classify land, including those areas of land that are permanently or regularly flooded (e.g. wetlands, shallow marine waters).

In its strictest sense, the term habitat mapping refers to habitat *for* a particular species or assemblage (e.g. shark habitat). However, in a more general sense, habitat mapping is used to refer to a system of classifying landscape into relatively homogeneous units (Bancroft, 2003; Ball, 2006). This definition is used here, so that an area which is spatially dominated by seagrass is classed as "seagrass dominated habitat" whereas an area which contains small amounts of seagrass is classed as "sediment dominated habitat". For a particular species, e.g. dugongs, both of these sites may form valuable habitat.

In the marine environment, the difficulty of gathering data about the benthos means that many of the environmental and biotic attributes that contribute to a habitat cannot be readily quantified or mapped. Therefore, a mixture of geomorphological and structural macrobiotic attributes form the basis of most aquatic habitat classification schemes, including the one presented here.

Conceptually, a number of steps are involved in the creation of any kind of classification scheme can be created. Gregorio (2005) warned against conflating land use, habitat and land cover classifications, despite their superficial similarities. While they all involve the classification of the "real-world" into relatively uniform units, the purposes are different. As a result, the classification rules differ, as do the final maps. After a comparison of existing classification schemes from around Australia, we came to a similar conclusion. The way in which any kind of classification scheme is created can be conceptualised as:

1. With a given purpose in mind,
2. Make observations (with sensors) of "real world" properties (attributes) in time and space
3. Map observations using decision rules as
    - discrete (polygon) maps via
        - Categorising (classification scheme), OR

- continuous field (surface) maps via
    - Modelling
    - Interpolation
    - Categorising (classification scheme)

"Real world" properties are grouped along the lines of Diaz et al. (2004) into substrate, biotic and environmental processes. Note that some sensors allow more properties to be observed. The collected observations can then be classed in many ways including into habitat, geomorphological or land cover classes. Some worked examples of this conceptual model are presented in Appendix B.

3.1. Current classification systems

3.1.1. National approaches

In Australia, national approaches to classifying coastal and marine ecosystems have involved very coarse spatial resolutions and have been limited by lack of data (Hilbert et al., 2007). These have typically involved bioregionalisation rather than habitat mapping. Bioregionalisation involves dividing up the environment into large (3000 – 240 000 km²) units, each of which is unique (IMCRA 1997). However, in a recent national review of biodiversity conservation research in the face of climate change, Hilbert et al (2007) argue that the mesoscale IMCRA bioregions are "too coarse to detect change or loss of individual habitats and communities". The authors recommended a need:

- To identify a "uniform definition of communities, habitats and ecosystems", and
- To "define 'ecoregions' to provide spatial units suitable for integrating both science and management around critical climate change issues".

Habitat mapping, in contrast, is focused on finer resolutions and smaller extents –from 10s m² to multiple km². It attempts to identify non-contiguous areas of similar substrate, biota and environment. The definition of habitats as "repetitive physical or biophysical units found within ecosystems" means that individual habitats may be found in more than one biogeographical province (Kvitek et al., 1999).

3.1.2. State approaches

Habitat classification schemes have been individually developed in several Australian states and these have been tailored to local conditions and needs (e.g. Bancroft, 2003; Ball et al., 2006; SEAMAP, 2007). It should be noted that there are many ways to explore, measure and describe the marine environment, and that there is no single best method for dividing it into homogeneous regions (Butler et al., 2001). One result of the diversity of schemes is that existing habitat maps cannot be compared among the states, territory and regions.

Scheme Similarities:

The available schemes are typically hierarchical – both in terms of the detail of the categories and in terms of the spatial extent and resolution (e.g. Banks and Skilleter, 2002; Bancroft, 2003; Ball et al, 2006). There are commonalities between many of the systems, especially at the more general levels of the classification. For example, the distinction between consolidated substrate (rock/reef) and unconsolidated substrate (sediment) is typically the first step in a classification process (e.g. Butler et al., 2001; Banks and Skilleter, 2002; Bancroft, 2003; SEAMAP, 2007). However, some schemes recognise three distinct classes at this level – consolidated, unconsolidated and mixed (Ball et al., 2006). Most schemes also make use of so-called “modifiers”, which are properties of the habitat under observation that are not central to the chosen classification scheme. Note that any of the modifiers *could* be used to derive distinct classification schemes (e.g. a geological map of marine habitats). The properties chosen as key classifiers for the habitat classification scheme, rather than modifiers, are typically those that are strong ecological forcers and that are readily observed and mapped using existing technologies.

Scheme Differences:

There are also some key differences between the available schemes. These include the relative importance assigned to variables such as:

- Water depth (including intertidal/subtidal divisions)
- continuity/patchiness,
- high/low profile (reefs),
- geology and
- biotic groups.

These variables are considered to be primary classifiers in some schemes and either modifiers or subsidiary classifiers in others. For a national scheme, primary classifiers need to be features that are readily mapped for all or most of Australia’s marine environments as well as being ecologically significant. A key characteristic of habitat classification schemes is the respective contribution of biotic and abiotic features. For example, Diaz et al. (2004) point out that it is relatively easy to conduct broad mapping of geomorphic structure with remote sensing techniques but harder to detect biological features (e.g. video drops may be required). The variety of sensing techniques used around Australia creates a range of mapping methods that will allow greater or lesser detail in reporting the ecological condition of any specific mapping unit.

Extent:

Another issue that limits comparisons among existing classification schemes is that they are designed for different spatial extents. Some schemes investigate the transition zone between terrestrial and marine environments, including the intertidal zone (e.g. Bancroft, 2003; Gregorio, 2005; Ball et al., 2006) while others are concerned exclusively with the subtidal zones (e.g. Butler et al., 2001; SEAMAP). The outer depth limit also varies significantly, and is dependent on water clarity, sensing techniques and the extent of the area of interest for a particular mapping agency. It may not be specified (Bancroft, 2003) but can be anywhere between 25 m and 100 m (D. Ball, V. Lucieer and D. Miller, pers. comm.).

There is also considerable overlap with terrestrial vegetation classification schemes, especially for the mangrove and saltmarsh classes (DEWR, 2007).

Resolution:

No state in Australia relies on a single sensing technique for its benthic habitat mapping efforts. Therefore, all mapping efforts involve an amalgamation of data with different resolutions. This variation within and among states and NT means that decision rules on classifiers need to be drafted in such a way that they can be mapped using all, or at least the majority of the available sensing techniques.

Geographic consistency of classes:

Each scheme is designed for a particular geographical area, purpose and set of available data. Each of these criteria potentially limits the applicability of an individual scheme to other areas, datasets and uses. For example, the SEAMAP scheme does not classify coral, because there is so little coral in Tasmania. A national scheme needs to be drawn broadly enough to encompass all possible habitats occurring in Australia, as well as the range of mapping purposes and the wide variety of sensing equipment used around the coast.

3.2. Ideal characteristics of a marine habitat classification scheme

In a review of habitat classifications, Ball et al. (2006) identified the following characteristics of successful classification schemes:

- The scheme should be hierarchical (to avoid duplication of categories)
- Classes should be mutually exclusive and exhaustive at each level in the hierarchy (so that each habitat type is accounted for and unique)
- The scheme should be comprehensive (at least at the upper levels of the scheme)
- The scheme should provide a common and easily-understood language for descriptions
- All sensing techniques should result in the same classifications, though the level to which a habitat can be classified will be dependent on the resolution of the sensor
- Habitat variables that change slowly (e.g. substrate) should be placed higher in the scheme than those that change rapidly (e.g. biota)
- Classes should be sufficiently fine to be of practical use for local managers, but also be sufficiently broad (through the hierarchy) as to allow summary information to be presented at national or international scales or to non-specialists
- The scheme should be flexible enough that it can be modified when new information is presented, but also be stable enough that it can support ongoing use. Changes should be clearly documented and related back to earlier categories.

3.3. The basis for a national approach

The proposed National Intertidal/Subtidal Benthic Habitat Classification Scheme (NISBHCS) has been designed to integrate the existing classification schemes. It does this by creating a common system for the highest levels of hierarchy. These broad classes meet the criteria of being hierarchical, comprehensive, mutually exclusive, relatively sensor independent and well defined. It is designed to allow national reporting and comparisons, while leaving space for states, NT and regions to define finer levels of classifications for local condition reporting. Thus the scheme meets the criterion of being both sufficiently broad and (by proxy of the states/NT) detailed enough to meet a range of uses. At the same time, it is designed to operate in parallel with the existing schemes, so that each state and region can continue to use the classifications it has already developed.

Marine habitat mapping is conducted in both vector and raster data models. It is anticipated that the new classification can be implemented as extra attributes in vector-based data models or as straightforward reclassifications of existing raster datasets.

Extent:

The proposed scheme covers all of Australia's territorial waters between the High Astronomical Tide (HAT) mark and the approximate outer limit of the photic zone (50 – 70 m depth). It thus incorporates data from all existing shallow-water benthic habitat classification schemes. It also covers some vegetation classes already by NVIS. To maintain consistency, the proposed scheme will use the NVIS class descriptions for mangrove and salt marsh habitats.

Resolution:

Decision rules for the classes have been framed so as to be as sensor-independent as possible. A reference area of $9m^2$ is used for determining dominance of substrate or biota. At the Hobart workshop (the workshop report is in Appendix A), this area was determined to be appropriate for a range of sensing techniques, either as a 3 m by 3 m quadrat, or its equivalent in transect mapping.

Geographic consistency of classes:

Because the proposed scheme was designed for use in all Australian intertidal and shallow water subtidal areas, the classes were created to account for all the major habitat types that are known to occur in these waters.

4. The National Intertidal/Subtidal Benthic (NISB) Habitat Classification Scheme

The National Intertidal/Subtidal Benthic Habitat Classification Scheme (NISB Habitat Classes) is designed to support the production of maps for the purpose of representing areas of marine and coastal habitats at the national scale. To achieve this, the scheme must be compatible with the mapping classification schemes used by the major producers of habitat maps in Australia, that is, state and NT agencies and, more recently, NRM regional bodies.

The scheme is hierarchical and initially divides habitats according to broad substrate type, and then according to whether they are spatially dominated by “structural macrobiota” (SMB) or by the substrate (i.e. largely “bare” of visible biota).

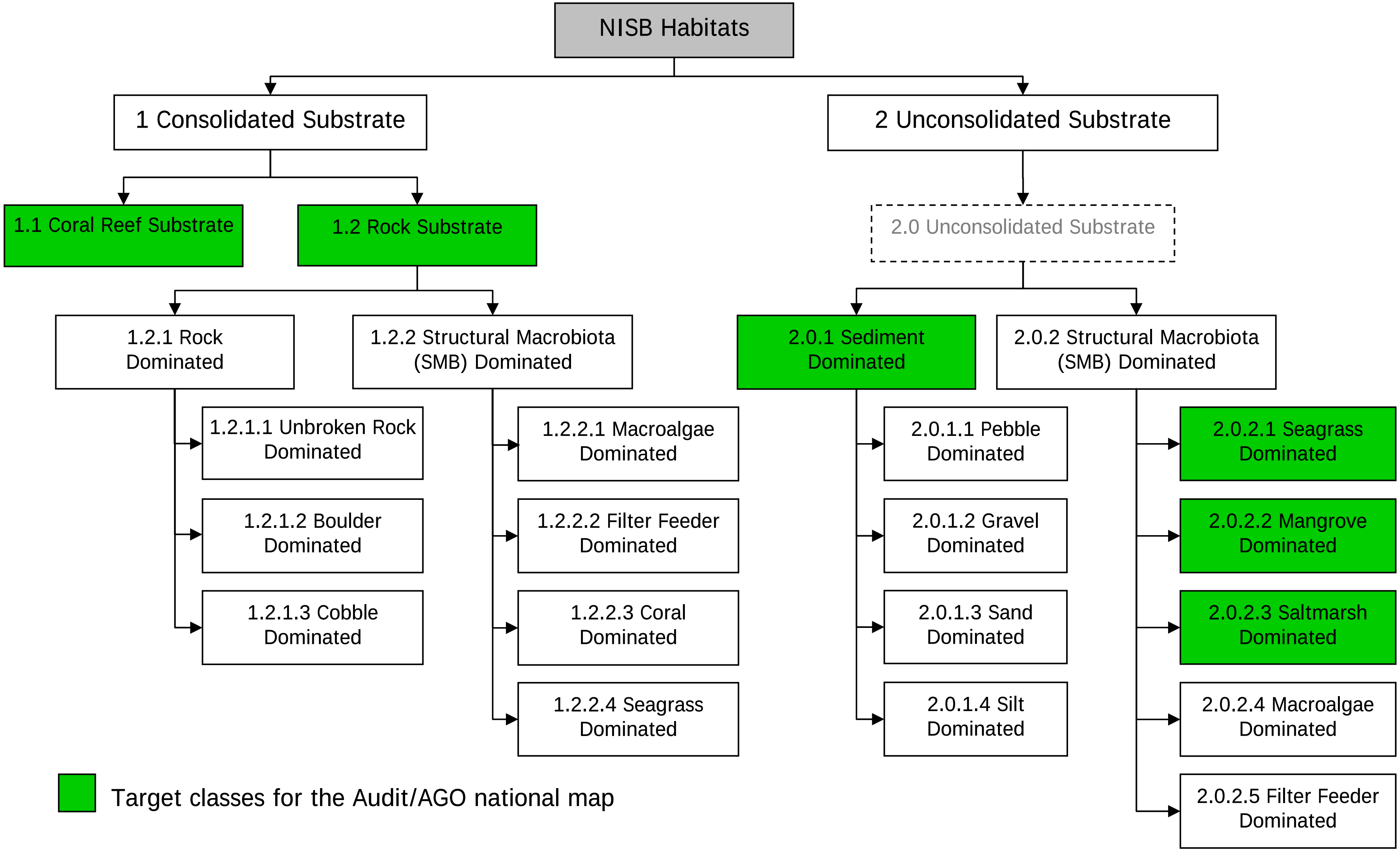
For **consolidated substrates**, there is a primary division between coral reef and rocky substrates. This split is determined on the substrate or structure of the reef, rather than its ecology. The rocky substrates are divided into SMB dominated or rock dominated habitats. The SMB dominated category is divided into classes according to the dominant habitat-forming life forms of macroalgae, sponges, corals, ascidians or seagrass respectively.

For **unconsolidated substrates**, the SMB dominated class is then divided according to the spatially dominant life form (seagrass, mangrove, saltmarsh, macroalgae or filter feeders). The non-SMB dominated class is also divided, this time according to particle size using the Wentworth Scale.

The **modifiers** can be applied at any level of the hierarchy and can be used as the basis of other classification schemes. It is worth noting that maps can legitimately be created using virtually any combination of classes and modifiers to meet a required purpose. Indeed, the intention of defining this national scheme is to provide some consistency for national mapping projects.

The scheme is presented as a flow chart and then a series of tables listing the class descriptions, the decision rules dividing the classes and a partial list of the “modifiers” used by various mapping agencies.

4.1. National Intertidal/Subtidal Benthic (NISB) habitat classification scheme Version 1



4.2. Class descriptions and decision rules for the classification scheme

Table 1: **Class descriptions** for habitats on **consolidated** substrates

Class No.	Class Name	Description
1	Consolidated	Any habitat in which the substrate is predominantly made up of particles of cobble size (>64 mm diameter) or larger. This includes coral reefs, solid rock and boulders
1.1	Coral reef	Any habitat in which the structure is predominantly formed by a coral framework. As all coral reef has some kind of rock substrate, coral reef is here defined as an object that has more than 50% coral cover.
1.2	Rock substrate	A structure that is predominantly formed by a rock framework. Here it is defined as a consolidated substrate that has 50% or less coral cover
1.2.1	Rock dominated	A rocky substrate on which there is less than 5% seagrass or 10% other SMB cover
1.2.1.1	Unbroken rock dominated	A rock dominated substrate where the cover is dominated by continuous outcropping rock.
1.2.1.2	Boulder dominated	A rock dominated substrate where the cover is dominated by rocks larger than 256 mm diameter.
1.2.1.3	Cobble dominated	A rock dominated substrate where the cover is dominated by rocks between 64 mm and 256 mm diameter.
1.2.2	Structural macrobiota (SMB) dominated	A habitat in which seagrass covers more than 5% of the substrate or one or more groups of other SMB cover more than 10% of the substrate
1.2.2.1	Macroalgae dominated	SMB dominated habitat in which macroalgae has greater substrate cover than other SMB
1.2.2.2	Filter feeder dominated	SMB dominated habitat in which sessile filter feeders (e.g. sponges, ascidians and tunicates) have greater substrate cover than other SMB
1.2.2.3	Coral dominated	SMB dominated habitat in which coral has greater substrate cover than other SMB
1.2.2.4	Seagrass dominated	SMB dominated habitat in which seagrass has greater substrate cover than other SMB

Important note: definitions that include **percent cover** or **predominant cover** imply a reference extent within which the percent cover is estimated. For the purposes of the NISB Habitat Classification Scheme, the reference extent is 9 m² - either a 3 x 3 m quadrat, a 9 x 1 m transect or an equivalent - unless otherwise stated. This area equates to a practical measure that can be easily made in the field with the current observation sensors and methods, such as videography and diver observations.

Table 2: **Decision rules** for dividing habitat classes on **consolidated** substrates

Class Names	Decision Rule
Consolidated / Unconsolidated	These classes are separated according to the size of the particles with majority cover, using the Wentworth scale. Particles the size of cobbles or larger (>64 mm diameter) are consolidated, while pebbles and smaller particles are unconsolidated.
Coral reef / Rock substrate	These classes are separated according the substrate, as determined by the relative cover of corals. If corals cover > 50% of the surface, the substrate is classed as coral reef. If there is any doubt about the dominance of coral, then the habitat is to be classed as rock substrate.
SMB dominated / Rock dominated	SMB dominated habitat is classed as habitat with 10% or more of the rocky substrate covered by structural macrobiota. Less than 10% SMB cover is classified as rock dominated. (Note: as this classification sits at a lower level in the hierarchy than the split between coral reef and rock substrates, any habitat with more than 50% coral cover would be classified as coral reef, not SMB dominated rock.)
Unbroken rock / Boulder / Cobble dominated	These classes are separated according to the size of the substrate particles with majority cover, according to the Wentworth scale. Unbroken rock is defined as a habitat predominantly covered by a continuous rock surface.
Macroalgae / Seagrass / Coral / Filter feeder dominated	In an SMB dominated habitat, the group (macroalgae / seagrass / coral / filter feeders) with the greatest proportion of cover determines the class into which a habitat is placed.

Table 3: **Class descriptions** for habitats on **unconsolidated** substrates

Class Number	Class Name	Description
2	Unconsolidated	A substrate that is predominantly made up of particles of pebble size (<64 mm diameter) or smaller. This includes gravels, sands and silts
2.0	Unconsolidated substrate	A dummy class “holder” at the second level of the hierarchy to enable consistency in the numbering throughout the class hierarchy
2.0.1	Sediment dominated	An unconsolidated habitat with either <5% seagrass cover or <10% other SMB cover
2.0.1.1	Pebble dominated	A sediment dominated habitat which predominantly consists of particles 4 to 64 mm diameter
2.0.1.2	Gravel dominated	A sediment dominated habitat which predominantly consists of particles 2 to 4 mm diameter
2.0.1.3	Sand dominated	A sediment dominated habitat which predominantly consists of particles 63 μm to 2 mm diameter
2.0.1.4	Mud dominated	A sediment dominated habitat which predominantly consists of particles <63 μm diameter
2.0.2	Structural macrobiota (SMB) dominated	A habitat in which >= 5% the substrate is covered by seagrass or >=10% by any other SMB (Seagrass has a lower threshold than other SMB because a significant amount of the biomass occurs below the surface (Duarte and Chiscano, 1999).
2.0.2.1	Salt marsh dominated	Extensive damp and water-logged flats, mostly in near-estuarine areas. The vegetation is dominated by hardy low shrubs, especially samphire communities (DEWR, 2007).
2.0.2.2	Mangrove dominated	Intertidal tall forests to shrublands, in areas with low wave energy. This habitat comprises more than 30 species, with most concentrated in Australia’s north (DEWR, 2007). NB: Even though mangroves can occur on rocky shores, the substrate under mangroves is rarely mapped. Therefore, an arbitrary decision has been made here to class all mangroves as occurring on unconsolidated substrates.
2.0.2.3	Seagrass dominated	An SMB dominated habitat in which seagrasses have greater substrate cover than other SMB. For seagrass, dominance is defined at 5%, compared with 10% for other SMB.
2.0.2.4	Macroalgae dominated	An SMB dominated habitat in which macroalgae have greater substrate cover than other SMB.
2.0.2.5	Filter feeder dominated	An SMB dominated habitat in which filter feeders have greater substrate cover than other SMB.

Table 4: **Decision rules** for habitats on **unconsolidated** substrates

Class Names	Decision Rule
Consolidated / Unconsolidated	These classes are separated according to the size of the particles which cover the majority of a habitat. Particles larger than cobbles (>64 mm diameter) fit in the consolidated class, while pebbles and smaller particles are considered to be unconsolidated.
SMB / Sediment dominated	These classes are separated according to the proportion of SMB cover. If either seagrasses cover 5% or more of the substrate, or other SMB cover more than 10% of the substrate then the habitat is classed as SMB dominated. Otherwise, the habitat is classed as sediment dominated.
Pebble / Gravel / Sand / Mud dominated	Sediment dominated habitats are classified according to the particle size, as defined on the Wentworth scale. The classification is applied to the particle size with the greatest cover.
Mangrove / Saltmarsh / Seagrass / Filter feeder / Macroalgae dominated	SMB dominated habitats are classified according to the SMB group with the greatest cover.

4.3. Modifiers

This section presents a list of the most common modifiers used by existing Australian habitat classification schemes, along with decision rules, where these could be agreed at the Hobart workshop. The modifiers and their decision rules vary significantly among agencies, so this list is provided here as a guide to the kinds of modifiers available.

Table 5: Geomodifiers

Class	Modifier Group	Potential Descriptors	Comments
Rock (> 64 mm grains; basement outcrop)	Profile/Morphometry/Texture/etc (geomorphology?)	High/low; gutters, cracks, crevices, cliff, platform, peak, pit, ridge, pass etc etc. *Could include Vanessa's scheme or other quantitative texture descriptors/measurements.*	The scale of the texture is also important – a crack could be 1 mm across or 100's metres!!
	Slope	Angle in degrees; or slight, moderate, steep classes.	
	Composition	The sky's the limit here: e.g.'s sandstone, calcarenite, granite, concrete breakwall etc. Or even more detailed such as Ordovician turbidites, or garnet schist….. *Origins and some properties are implied in name*.	
	Spatial distribution	Continuous/patchy; % cover?	
Sediment (<64 mm)	Grain size	Udden-Wentworth size classes; actual quantitative grain size descriptors	
	Sorting	Poor, moderate, well etc., or quantitative grain size standard deviation.	
	Composition	%CaCO3, quartz, feldspar etc; fossil content e.g. mollusc fragments, foraminiferal ooze	
	Density/geotechnical properties	Bulk Density (g/cc); penetrometer readings; inferred from acoustics.	
	Geomorphology	Ripples/dunes, ridges, ribbons, channels, gutters, flats, mounds, pits/depressions etc etc. *Sediment areas could also be described using quantitative textural analyses.*	
	Slope	Angle in degrees; or slight, moderate, steep classes.	

Table 6: Biomodifiers

Biomodifiers	
DENSITY	Dense
	Moderate
	Sparse
SPATIAL DISTRIBUTION (BIOTA)	Continuous
	Patchy
SPONGE	
CORAL	
RHODOLITHS ETC ETC	

Table 7: Environmental modifiers

Environmental Modifiers	
EXPOSURE	High
	Medium
	Low
WATER CLARITY PLUS DEPTH	
CURRENT FLOW	
DEPTH ZONE	Intertidal
	Subtidal
ESTUARINE/RIVERINE PLUMES	Plume influenced
	Not plume influenced
TEMPERATURE	Tropical
	Subtropical
	Warm Temperate
	Cold Temperate
ETC ETC	

4.4. Decision rules for the modifiers

Table 8. Decision rules for Geomodifiers

Geomodifier	Decision Rule
Origin	Geology maps
Spatial Distribution (substrate)	[TBC]
Topography / Macropattern / Morphometry (consolidated substrates)	[TBC]
Topography / Macropattern / Morphometry (unconsolidated substrates)	Ripples are defined as dune systems with a wavelength =< 0.6 m. If the wavelength > 0.6 m and the height >= 0.075, the substrate is classed as a dune (Ashley, 1990).
Slope	[TBC (Wilson et al. (2007) talk about multi-scale slope analysis, but do not provide guidelines on an appropriate rise/horizontal distance ratio.)]
Profile / Morphometry	[High profile reefs are >=1 m above the surrounding substrate. Low profile reefs are <1 m above the surrounding substrate. Is this correct?]
Texture	Wentworth Scale
Complexity	[The scheme used in Vanessa Lucieer's PhD (to be published soon)]

Table 9. Decision rules for Biomodifiers

Biomodifier	Decision Rule
Density	[This varies between species and agencies. For Victorian seagrass, dense = benthos cannot be seen; medium = leaves of adjacent plants touch but benthos can be seen; sparse = leaves of individual plants do not touch. For SA: sparse = 0-25%; Medium = 26-85%; Dense = >85% cover]
Spatial Distribution (biota)	[Continuity/patchiness is driven by resolution of mapping units. TBC]
Sponge	[These categories were listed as biomodifiers. However, we are unsure as to how they'd be used to modify the categories listed in the classification scheme.]
Coral	
Rhodoliths	

Table 10. Decision rules for Environmental modifiers

Environmental Modifier	Decision Rule
Wave Exposure	[TBC]
Water Clarity + Depth	[TBC]
Current Flow	[TBC]
Depth Zone	Inner-shelf: 0-20 m; Mid-shelf: 20-60 m; Outer-shelf: 60-200 m.
Estuarine / Riverine Plumes	[TBC]
Temperature	These categories are distinguished using the IMCRA bioregionalisation (IMCRA, V 4.0, 2006)

Acknowledgements

This scheme is the result of the work of many people including those who, over the years, have led the development of habitat mapping in the challenging coastal and marine environments. We would like to particularly acknowledge the following people who have directly contributed to the production of this scheme: Gina Newton, AGO; Chris Simpson and Kevin Bancroft, WA; and, especially, all the NISB habitat classification workshop participants.

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National Land & Water Resources Audit
An Initiative of the Natural Heritage Trust

An Australian Greenhouse Office and NLWRA Partnership project

Appendix A: Workshop Report

National Intertidal/Subtidal Benthic Habitat Classification Workshop

August 7/8 2007, CSIRO Headquarters, Castray Esplanade, Hobart

Executive Summary

There were two objectives for the workshop. The first was:

- To identify a practical, valid habitat classification scheme (including the decision rules) that will enable the collation of data sets into a national map of key intertidal and subtidal estuarine, coastal and marine (ECM) habitat types, including mangroves, saltmarshes, seagrasses, macroalgae, rocky reefs and coral reefs.

The second objective was:

- To identify a pathway towards the adoption and application of such a scheme, including identifying ECM habitat data sets and their custodians and identifying a work plan.

The scope of the workshop subject matter was limited to the habitats between the highest astronomical tide (HAT) and approximately 50 - 70 m depth. The classes of the scheme are those typically used for habitat mapping and are conceptually similar to terrestrial land cover mapping. They are not bioregionalisation or ecosystem classes though they may contribute to the development of both. They are also not micro-community classes, as the intention is to limit the scheme to habitat mapping rather than species mapping.

Participants came from each of the states, the NT and the project partners: the Australian Greenhouse Office, the National Land and Water Resources Audit, Geoscience Australia and the CSIRO (See Appendix A for a complete list). Each participant identified the purposes (uses) of a habitat classification scheme within the state or territory that they represented. Common definitions were established, conceptual models of habitat mapping were outlined and a benthic habitat classification scheme synthesised from existing state schemes was presented as a starting point. The participants then proceeded to develop a new national scheme including decision rules to assist with defining the boundary between classes.

The outcomes of the workshop included:

- A draft national intertidal/subtidal benthic habitat classification scheme with decision rules.
- In principle agreement by the participants to the national classification scheme.

- The agreement of the participants to form a reference group for the continued development and oversight of the national classification system.
- A work plan was formed for establishing the national scheme and implementing the scheme through the collation of a national habitat map.

Note: the national scheme itself will be written up in detail in the scheme documentation – the following is a brief record of the workshop.

Workshop Preparation

During the preparation phase of the workshop, key habitat mapping experts were contacted and consulted besides the workshop participants including Chris Simpson, Kevin Bancroft, Gary Kendrick, Doug Fotheringham, Bryan McDonald, Rob Williams, Ray Lawrie, Malcolm Dunning and John Beumer. This group provided input into the collation of habitat classifications and their decision rules. Potential workshop participants were also identified. Prior to the workshop, participants were asked to provide resource documents and respond to questions about both the purposes to which habitat mapping is put in their state or territory as well as the sensors used to map the habitats. Based on this knowledge, a habitat mapping conceptual model was produced to assist the workshop. A draft national classification scheme was synthesised from the existing state schemes by identifying both the commonalities and ambiguous or unresolved aspects of the schemes. A discussion paper was distributed to all participants prior to the workshop.

Workshop Agenda

Day 1:

- Introduction
- Discussion of purposes for habitat mapping (AGO, NLWRA, GA, state agencies, research)
- Workshop scope (physical and thematic)
- Definitions
- Presentation of conceptual model for habitat, geomorphological and biotic mapping
- Presentation of proposed national habitat classification scheme
- Group discussion of proposed national habitat classification scheme

Day 2:

- Group discussion about decision rules for the classification scheme
- In principle agreement on classification scheme and decision rules?
- Identification of a work plan for adoption and implementation

Purposes for Habitat Classification

Collation of responses from participants resulted in the following broad categories:

Low Resolution Mapping (<1:40 000):

- Marine regional planning

Medium Resolution Mapping (1:25 000 – 1:40 000):

- This resolution of mapping is regarded as "**general purpose**" mapping and has many uses, such as aquaculture planning and emergency response (for example, oil spills)
- Natural Resource Management Regions
- Marine Protected Areas (planning
- Fisheries Management

High Resolution Mapping (>1:25 000):

- Environmental Impact Assessment
- Environmental monitoring

Workshop Presentations, Processes and Discussions

Please note: the entire scheme will be written up in detail in the scheme documentation – the following is a brief record of the workshop.

Workshop Scope:

Benthic habitats from the Highest Astronomical Tide (HAT) to a depth of approximately 50 - 70 metres were recognised as the scope of the scheme. This is commonly regarded as the most productive region biologically and is broadly related to the photic zone or "inner shelf".

In terms of the broad Australian hierarchal classification scheme for marine habitats presented by the National Oceans Office (NOO, 2002; adapted from Butler et al, 2001), the workshop focussed on the primary and secondary biotope and biological facies levels. This is the usual domain of "habitat mapping" as carried out on a broadscale by state and territory governments. The conceptual similarity of this form of mapping to terrestrial land cover mapping was noted a number of times during the workshop, and assisted in making decision about classes and decision rules.

Definitions:

To establish common understandings among the workshop participants the workshop discussed and adopted some common definitions. These will be presented in the Scheme documentation. A key definition introduced a new term – "structural macrobiota", which is, in essence, an attempt to define the marine version of the role that terrestrial vegetation (i.e. plants) plays in forming habitats. Structural macrobiota are habitat-forming species (i.e. those that create habitats for other species by significantly altering the spatial complexity of a site) and include plants (e.g. seagrasses, mangroves), attached protists (e.g. macroalgae) and attached macrofauna (e.g. corals, sponges, ascidians).

Habitat Mapping Conceptual Model:

After a comparison of existing classification schemes from around Australia, a conceptual scheme was synthesised using the component parts of the schemes. The model is defined verbally as:

4. With a given purpose in mind,
5. Make observations (with sensors) of "real world" properties (attributes) in time and space
6. Map observations using decision rules as

- discrete (polygon) maps via
    - Categorising (classification scheme)
- continuous field (surface) maps via
    - Categorising (classification scheme)
    - Modelling
    - Interpolation

"Real world" properties were grouped along the lines of Diaz et al (2004) into substrate, biota and environmental processes. Note that some sensors allow more properties to be observed. The collected observations can then be classed in many ways including into "habitat map" classes.

National Habitat Classification Scheme:

The synthesised national scheme was proposed to the workshop as a starting point for discussion. The participants then proceeded to evaluate the proposed scheme and modify it to make it consistent with their respective individual schemes. This process was designed to enable the collation of the various agencies' data into a national data set. It involved identifying the scheme **classes** and their position in the hierarchy. A key point to note here is that almost any of the observable properties (attributes) could be used at any point in the classification. For example, reef profile could be placed high in the hierarchy or be simply added to the list of modifiers. Those attributes incorporated into the scheme are those that are easily and widely mapped as well as being ecologically significant.

A suggestion was made to develop a national catalogue of reference images that would hold images that represented clear examples of the agreed classes

Decision rules were defined to provide guidance on where the class boundaries should occur. This is a particularly challenging process as most classes intergrade, and specific examples can often be found that confound the rules. This is the nature of crisp classification systems and some divisions are more arbitrary than others. Boundaries between the classes were defined using observable or readily mapped properties. These properties included, primarily, percentage coverage and particle size. Note that percent cover estimates require a reference size for the area used to define the percent cover – in most cases reference areas were also set.

The following morning, the National Tidal/Subtidal Benthic Habitat Classification Scheme for habitats between the HAT and 50 – 70 metres, was agreed to in principle. Decision rules to separate classes were also agreed upon. Extensive discussion of properties (referred to as modifiers) identified national standards wherever possible. Further work is required on the definition of these modifiers.

The participants all identified the most suitable data sources and custodians.

Colour schemes for mapping were discussed, though no firm conclusions were reached – however it was noted that there was a preference for colour schemes that were intuitively easy to interpret i.e. greens for seagrass, yellows for sand and browns for rock.

Work Plan:

1. The workshop participants agreed to form a reference group for the further development of the national scheme.

2. The NLWRA/AGO partnership will be the secretariat to the reference group and will facilitate the creation of the National Scheme, including:
   - Documenting the national scheme (classes, decision rules, modifiers),
   - Facilitate the development of a national habitat mapping reference image catalogue. This could be modelled on, for example, the representative photos on the SEAMAP web page (http://www.utas.edu.au/tafi/seamap/).
3. The NLWRA/AGO partnership will generate a National ECM Habitat Map. Firstly, they will collaborate with the workshop participants and the key custodians to collate a national ECM data set. Then, the national classification scheme will be applied to the data set to produce a National ECM Habitat Map. It was noted that some participants anticipated applying the scheme to their own data sets as simply another set of attributes.

Workshop Outcomes

1. Unanimous agreement, in principle, to the adoption of the National Intertidal/Subtidal Benthic Habitat Classification Scheme developed at the workshop.
2. A reference group to oversee the documentation of the National Habitat Classification Scheme was established.
3. A Work Plan for creating the National Habitat Map was produced.

References

Butler, A., P. Harris, V. Lyne, A. Heap, V. Passlow and R. Porter-Smith (2001). An Interim Bioregionalisation for the continental slope and deeper waters of the South-East Marine Region of Australia., National Oceans Office.

Diaz, R. J., M. Solan and R. Valente (2004). "A review of approaches for classifying benthic habitats and evaluating habitat quality." Journal of Environmental Management(73): 165-181.

Appendix A. Workshop Participants:

Name	Org	State	Phone	email
Richard Mount	UTAS/NLWRA	Tas	03 6226 2106	Richard.Mount@utas.edu.au
David Ball	PIRVic	Vic	03 5258 0210	David.Ball@dpi.vic.gov.au
Alan Jordan	NSW	NSW	02 4916 3874	alan.jordan@environment.nsw.gov.au
Vanessa Lucieer	TAFI, UTAS	Tas	03 6227 7219	v_halley@utas.edu.au
Neil Smit	NRETA	NT	08 8920 9271	Neil.Smit@nt.gov.au
Len McKenzie	DPI	Qld	07 4057 3731	Len.McKenzie@dpi.qld.gov.au
Ewan Buckley	DEC	WA	08 9336 0108	Ewan.Buckley@dec.wa.gov.au
Elvira Poloczanska	CSIRO	Tas	03 6226 1708	Elvira.Poloczanska@csiro.au
David Miller		SA	08 8124 4899	miller.david2@saugov.sa.gov.au
Rob Thorman	NLWRA, AG	ACT	02 6263 6039	Rob.Thorman@nlwra.gov.au
David Ryan	Geoscience Australia, AG	ACT	02 6274	David.Ryan@ga.gov.au
Phillippa Bricher	UTAS	Tas	03 6226 1981	pbricher@utas.edu.au
Jenny Newton	UTAS	Tas	03 6226 1981	jbnewton@utas.edu.au

Appendix B. Components of the habitat mapping process, which moves from left to right across the table.

"Real world"	Potentially observable properties (i.e. attributes)			Sensor/s	Observed properties	Decision Rules	Classifications A = Assumed, O = Observed		
	Substrate	**Biota**	**Processes**				**Habitat Mapping**	**Biodiversity**	**Geomorphology**
Sand Habitat	Soft sediment fine sand calcareous macropattern/ relief etc	benthic microalgae diatoms invertebrates vertebrates etc	depth temperature exposure hydrology salinity light offshore/ nearshore	e.g. aerial photography	Soft sediment	Re feature detection (i.e. with depth)	1- Soft sediment (O) 2 - no structural macrobiota (O) 3 – sand (A)	soft bottom assemblage (A)	Fabric: sand (A)
				e.g. u/water video	Soft sediment Sand Fine sand Benthic microalgae invertebrates	Re particle sizes Re biota	1- Soft sediment (O) 2 - no structural macrobiota (O) 3 – sand (O) Mod – fine sand (O)	soft bottom assemblage (O)	Fabric: fine sand (O)
				e.g. acoustic swath mapper	Soft sediment macropattern	Re hardness/ roughness Re topographic definitions	1- Soft sediment (O) 2 - no structural macrobiota (A) 3 – sand (A)	soft bottom assemblage (A)	Fabric: sand (A) Form: mega ripples (O) Processes: paleo inundation (A)
Seagrass Habitat	Soft sediment fine sand silicaceous macropattern/ relief etc	seagrass algae invertebrates vertebrates fish etc	depth temperature exposure hydrology salinity light	e.g. aerial photography	Submerged aquatic vegetation (SAV)	Re density, patchiness, percent cover	1 - Soft sediment (A) 2 - structural macrobiota (O) 3 – seagrass (A)	seagrass associated assemblage (A)	Fabric: sand (A)
				e.g. u/water video	Soft sediment Sand seagrass seagrass spp. Epiphytic macroalgae vertebrates	Re epiphytic loading Re density, patchiness, percent cover Re biota	1 - Soft sediment (A) 2 - structural macrobiota (O) 3 – seagrass (O) Mod – seagrass spp. (O)	seagrass associated assemblage (O)	Fabric: fine sand (A)

2. Appendix 2. Data Sources Acknowledgement List

Summary List of Data Custodians

For the whole *ECM National Habitat Map Series* all the following contributors must be acknowledged:

<u>Subset of contributors for the *National Intertidal/Subtidal (NISB) Habitat Map*:</u>

Department of Natural Resources, Environment and the Arts, Northern Territory Government of Australia
Queensland Department of Primary Industries and Fisheries
Queensland Parks and Wildlife Services Environmental Protection Agency
Great Barrier Reef Marine Park Authority
National Oceans Office
Western Australia Department of Environment and Conservation
South Australian Department of Environment and Heritage
New South Wales Department of Environment and Conservation
New South Wales Department of Primary Industries: Fisheries
Conservation Commission of the Northern Territory Land Conservation Unit
Victorian Department of Primary Industries
Parks Victoria
Tasmanian Aquaculture and Fisheries Institute

<u>Subset of contributors for the Coastal Wetlands Collection:</u>

Queensland Environmental Protection Agency
Australian Government Department of the Environment and Heritage
NSW Department of Planning

<u>Subset of contributors for the Estuaries Collection:</u>

Geoscience Australia

<u>Subset of contributors for the Dune and Dune Vegetation Collection:</u>

Australian Government Department of the Environment and Heritage
Department of Natural Resources, Environment and the Arts, Northern Territory Government of Australia
Queensland Department of Primary Industries and Fisheries
WA Department of Industry and Resources
WA Department of Minerals and Energy
WA Department of Mineral and Petroleum Resources
Victorian Department of Primary Industries
SA DEH - Natural and Cultural Heritage
Queensland Herbarium, Environmental Protection Agency
NSW Department of Primary Industries, Mineral Resources
NSW Department of Mineral Resources (DMR)

2.1. NISB Habitat Map Collection

Custodians	Datasets	Contact person
Department of Natural Resources, Environment and the Arts, Northern Territory Government of Australia PO Box 30 Palmerston, NT 0831 General Enquiries Tel: (08) 8999 5511	Cape Arnhem Vegetation Survey Ludmilla Creek Mangrove Survey Mangrove Mapping Bynoe Harbour Mangrove Mapping of Darwin Harbour Northern Territory Coastal Wetlands Rapid Creek Catchment Vegetation Survey Classification, distribution and environmental relationships of coastal floodplain vegetation, Northern Territory, Australia, March-May 1990	Athina Pascoe-Bell Athina.Pascoe-Bell@nt.gov.au
Conservation Commission of the Northern Territory Land Conservation Unit PO Box 496 Palmerston, NT 0813	Classification, distribution and environmental relationships of coastal floodplain vegetation, Northern Territory, Australia, March-May 1990	
Queensland Department of Primary Industries and Fisheries GPO Box 46 Brisbane Qld 4001	Northern Territory Coastal Wetlands Queensland Coastal Wetland Vegetation Queensland Wetland Data Version 1.0 – Wetlands Queensland Wetland Data Version 1.1 – Wetlands	Nadia Engstrom, 07 3224 2175 nadia.engstrom@dpi.qld.gov.au Katherine Zamel katherine.zamel@dpi.qld.gov.au
Queensland Parks and Wildlife Services Environmental Protection Agency PO Box 15155 City East QLD 4002 1300 130 372	Moreton Bay Coral 2004 Moreton Bay Seagrass 2004 The Riparian Assessment Program – Mapping the Status of Estuarine Habitat Pumicestone Passage Seagrass 2002	Mike Ronan 07 3227 6147 michael.ronan@epa.qld.gov.au Steve Jones07 3227 6447 steve.jones@epa.qld.gov.au
Great Barrier Reef Marine Park Authority 2-68 Flinders Street PO Box 1379 Townsville QLD 4810	Dryreef_2003	Sharon King Sharon.King@gbrmpa.qld.gov.au
National Oceans Office Edgar Waite Building 203 Channel Highway Kingston TAS 7050	ATT N04 Arnhem Land meadows_region ATT N04 Kakadu meadows_region ATT N04 Gulf of Carpentaria meadows_region	Alicja Mosbauer 03 6208 2912 alicja.mosbauer@environment.gov.au

Western Australia Department of Environment and Conservation Locked Bag 104 Bentley Delivery Centre Western Australia 6983	Marine Habitats of the Recherché Archipelago Marine Benthic Habitats of the Rowley Shoals Marine Park and Mermaid Reef National Marine Nature Reserve Marine Benthic Habitats of the Shark Bay Region Marine Benthic Habitats of the Jurien Bay Marine Park Marine Benthic Habitats of the Marmion Marine Park Marine Benthic Habitats of the Swan Estuary Marine Park Marine Benthic Habitats of the Shoalwater Islands Marine Park Regional Marine Benthic Habitat Mapping: Geographe Bay/Capes Area Major Marine Habitats of Ningaloo Reef Area Major Marine Habitats of the Montebello/Lowendal/Barrow Island's Area Major Marine Habitats of the Cape Preston/Dampier Archipelago/Cape Lambert Area Shoreline Habitats of the Marmion Marine Park Shoreline Habitats of Ningaloo Reef Area Onshore Coastline Habitats of Shark Bay Area Onshore Coastline Habitats of the Swan Estuary Marine Park Onshore Coastline Habitats of the Shoalwater Islands Marine Park	Ewan Buckley 08 9336 0108 Ewan.Buckley@dec.wa.gov.au
South Australian Department for Environment and Heritage, Coast and Marine Conservation Branch GPO Box 1047 Adelaide SA 5001	Nearshore Marine Benthic Habitat Mapping	David Miller 08 8124 4899 miller.david2@saugov.sa.gov.au
New South Wales Department of Environment and Conservation Waters and Catchment Section, Port Stephens Fisheries Centre, Locked Bag 1, Nelson Bay, NSW 2315	Marine Park Habitat Mapping	Alan Jordan 02 4916 3874 alan.jordan@environment.nsw.gov.au
New South Wales Department of Primary Industries: Fisheries PO Box 21, Cronulla, NSW 2230	Estuarine Macrophytes of the Northern and Southern CCA regions Extract of Estuarine Macrophytes for the Central Region of New South Wales, Australia	Rob Williams 02 9527 8535 robert.williams@dpi.nsw.gov.au

Victorian Department of Primary Industries PO Box 114, Queenscliff, Victoria 3225	Cape Howe General Biota Map, Smoothed Cape Howe General Substrate Map, Smoothed Discovery Bay General Biota Map, Smoothed Discovery Bay General Substrate Map, Smoothed Point Addis General Substrate Map, Smoothed Point Addis General Biota Map Point Hicks General Biota Map, Smoothed Point Hicks General Substrate Map, Smoothed Twelve Apostles General Biota Map, Smoothed Twelve Apostles General Substrate Map, Smoothed Eastern Minor Inlet Seagrass Distribution Port Phillip Bay Seagrass Western Port Seagrass Distribution	David Ball 03 5258 0210 David.Ball@dpi.vic.gov.au
Parks Victoria Level 10/535, Bourke Street Melbourne, Victoria 3000	Cape Howe General Biota Map, Smoothed Cape Howe General Substrate Map, Smoothed Discovery Bay General Biota Map, Smoothed Discovery Bay General Substrate Map, Smoothed Point Addis General Substrate Map, Smoothed Point Addis General Biota Map Point Hicks General Biota Map, Smoothed Point Hicks General Substrate Map, Smoothed Twelve Apostles General Biota Map, Smoothed Twelve Apostles General Substrate Map, Smoothed Eastern Minor Inlet Seagrass Distribution Port Phillip Bay Seagrass Western Port Seagrass Distribution	Rae Poules rae.poules@parks.vic.gov.au
Department of Sustainability & Environment 2/8 Nicholson St, East, Melbourne, Victoria 3002	Cape Howe General Biota Map, Smoothed Cape Howe General Substrate Map, Smoothed Discovery Bay General Biota Map, Smoothed	Jo Klemke jo.klemke@dse.vic.gov.au

	Discovery Bay General Substrate Map, Smoothed Point Addis General Substrate Map, Smoothed Point Addis General Biota Map Point Hicks General Biota Map, Smoothed Point Hicks General Substrate Map, Smoothed Twelve Apostles General Biota Map, Smoothed Twelve Apostles General Substrate Map, Smoothed Eastern Minor Inlet Seagrass Distribution Port Phillip Bay Seagrass Western Port Seagrass Distribution Victorian Wetland Environments and Extent - up to 1994 (WETLAND_1994/WET1994)	
Tasmanian Aquaculture and Fisheries Institute Private Bag 49, Hobart, Tasmania 7053	SeaMap Tasmania Merged Habitat Layers for the Australian Coastal Vulnerability Project 2007	Vanessa Lucieer 62 277219 v_halley@utas.edu.au

2.2. Estuaries collection

Custodians	Datasets	Contact person
Geoscience Australia GPO Box 378 Canberra ACT Australia 2601 +61 2 6249 9966 +61 2 6249 9960 sales@ga.gov.au	New South Wales coastal waterways geomorphic habitat mapping (1:100 000 scale digital data) Northern Territory coastal waterways geomorphic habitat mapping (1:100 000 scale digital data) South Australian coastal waterways geomorphic habitat mapping (1:100 000 scale digital data) Tasmanian coastal waterways geomorphic habitat mapping (1:100 000 scale digital data) Victorian coastal waterways geomorphic habitat mapping (1:100 000 scale digital data) Western Australia coastal waterways geomorphic habitat mapping (1:100 000 scale digital data) Queensland coastal waterways geomorphic habitat mapping, Version 2 (1:100 000 scale digital data)	

2.3. Dunes Collection

Custodians	Datasets	Contact person
Department of Natural Resources, Environment and the Arts, Northern Territory Government of Australia PO Box 30 Palmerston, NT 0831 General Enquiries Tel: (08) 8999 5511	North_NT_94	Athina Pascoe-Bell Athina.Pascoe-Bell@nt.gov.au
Queensland Department of Primary Industries and Fisheries GPO Box 46 Brisbane Qld 4001	Survey and Mapping of 2003 Remnant Vegetation Communities and Regional Ecosystems of Queensland, Version 5.0 (December 2005).	
Australian Government Department of the Environment and Heritage	NVIS Stage 1, Version 3.1 - Albers	
WA Department of Industry and Resources	1:50 000 environmental map - ALBANY (2427-I, 2428-II, 2527-IV, 2528-III) 1:50 000 environmental map - BROOME_ROEBUCK PLAINS (3362 II and PT 3362 III and 3361 IV) 1:50 000 environmental map - BUSSELTON (1930-I) 1:50 000 environmental map - FREMANTLE (2033-I, 2033-IV) 1:50 000 environmental map - LAKE CLIFTON - HAMEL (2032-II, 2032-III) 1:50 000 environmental map - PERTH (2034-II, 2034-III, 2134-III) 1:50 000 environmental map - ROTTNEST ISLAND (1934-II, 2034-III, 1933-I, 2033-IV) 1:50 000 environmental map - TORBAY (2427-IV, 2428-III) 1:50 000 environmental map - YALLINGUP (1930-IV, 1830-I) 1:50 000 environmental map - YANCHEP (2034-IV) 1:50 000 urban map - Bunbury - Burekup (2031-III, 2031-II)	

	1:50 000 urban map - Harvey - Lake Preston (2031-I, 2031-IV) 1:50 000 urban map - Mandurah (2032-IV) 1:50 000 urban map - Moore River - Cape Leschenault (1935-II, 2035-III) 1:100 000 geological map - ARROWSMITH-BEAGLE ISLANDS (1938), first edition 1:100 000 geological map - COCANARUP (2830), first edition 1:100 000 geological map - DAMPIER (2256), first edition 1:100 000 geological map - DE GREY (2757), first edition - version 2 1:100 000 geological map - HILL RIVER-GREEN HEAD (1937 and 1938), first edition 1:100 000 geological map - MINGENEW-DONGARA (1939 and part 1839), first edition 1:100 000 geological map - PARDOO (2857), first edition - version 2 1:100 000 geological map - PRESTON (2156), first edition 1:100 000 geological map - RAVENSTHORPE (2930), first edition 1:100 000 geological map - RIVERINA (3038), first edition 1:100 000 geological map - ROEBOURNE (2356), first edition 1:100 000 geological map - SHERLOCK (2456), first edition 1:100 000 geological map - WEDGE ISLAND (1936), first edition 1:250 000 geological map - BALLADONIA (SI51-03), first edition 1:250 000 geological map - BUSSELTON-AUGUSTA (part SI50-05 and part SI50-09), first edition 1:250 000 geological map - DAMPIER_BARROW ISLAND (SF50-02 & PT SF50-01), second edition	

	1:250 000 geological map - PERTH (SH50-14 and part SH50-13), first edition 1:250 000 geological map - ROEBOURNE (SF50-03), second edition 1:250 000 geological map - WINNING POOL - MINILYA (SF50-13 and part SF49-16), second edition	
WA Dept. of Mineral and Petroleum Resources	1:500 000 regolith map of Western Australia south of the 26th parallel 1:2 500 000 Atlas of Mineral Deposits and Petroleum Fields 2001	
WA Dept. of Mineral and Energy	1:50 000 environmental map - Capel (2030-IV)	
Victorian Department of Primary Industries	Geological polygons and lines (1:250,000)	
	Arthur – Pieman Conservation Area Tracks Map (apcatracks_v1gda) Coastal Quaternary Sediments and Landforms Map (apcaquat_v1gda) Tasmanian Quaternary Coastal Sediments Digital Polygon Map version 5.0 (2007) (TASCOASTSED_V5GDA)	Chris Sharples
SA DEH - Natural and Cultural Heritage, GPO Box 1047, ADELAIDE SA 5001	Coastal Hazard Areas	Doug Fotheringham
NSW Department of Primary Industries, Mineral Resources	Comprehensive Coastal Assessment Coastal Quaternary Geology – Northern Comprehensive Coastal Assessment Coastal Quaternary Geology – Southern Port Hacking 1:100,000 geological map Newcastle Coalfield Regional Geology 1:100,000 geological map Wollongong 1:100,000 geological map	

2.4. Coastal Wetlands Collection

Custodians	Datasets	Contact person
Australian Government Department of the Environment and Heritage GPO Box 787 Canberra ACT Australia 2601	Australia - A Directory of Important Wetlands in Australia Spatial Database Directory of Ramsar Wetlands in Australia	
Queensland Environmental Protection Agency Floor 6, 160 Ann St BRISBANE QLD AUSTRALIA 4000 07 3277 8765 wetlands@epa.qld.gov.au	Queensland Wetland Data Version 1.0 – Springs Queensland Wetland Data Version 1.0 – Streams Queensland Wetland Data Version 1.0 – Wetlands Queensland Wetland Data Version 1.1 – Streams Queensland Wetland Data Version 1.1 – Wetlands	
NSW Department of Planning GPO 39 23-33 Bridge Street Sydney NSW Australia 2001	Coastal Wetlands (State Environmental Planning Policy No. 14) - SEPP 14 Coastal Protection (State Environmental Planning Policy No. 71) - SEPP 71	

3. Appendix 3: Inventory of Data Sources

3.1. New South Wales

Data Set	Extent	Accuracy	Details	Further contact
Estuarine Macrophytes of the Northern and Southern CCA regions	Northern and southern thirds of New South Wales coastline.	All data was mapped at a scale of 1:1500 derived from orthorectified aerial photographs with a positional accuracy of less than 10 metres.	Distribution and abundance of seagrass, mangrove and saltmarsh in the Northern and Southern CCA regions.	New South Wales Department of Primary Industries (NSW DPI) Scientific Officer – Habitat Mapping Port Stephens Research Centre Private Bag 1 Nelson Bay NSW
Extract of Estuarine Macrophytes for the Central Region of New South Wales, Australia.	Central estuaries and embayments of the New South Wales coast.	**Positional accuracy**: All data was mapped at a scale of 1:1500 derived from orthorectified aerial photographs with a positional accuracy of approximately 6 metres. **Attribute accuracy**: Vegetation boundaries were identified on orthorectified aerial photographs (1997 - 2004). Boundary location and species identification were verified in the field. Families or in some case species of vegetation were mapped in the following categories: Posidonia australis, Zosteraceae (including Zostera capricorni, Zostera muelleri and Heterozostera tasmanica), Halophila, Ruppia megacarpa, Mangrove (Avicennia marina, Aegiceras corniculatum, Bruguiera gymnorrhiza, Rhizophora stylosa), Mangrove Fern (Acrostichum speciosum) and saltmarsh (all species combined). Area calculations were determined in Arcview using XTools.	Distribution and abundance of seagrass, mangrove and saltmarsh in 11 central estuaries and embayments of the New South Wales coast.	NSWDPI Data Manager 202 Nicholson Parade Cronulla NSW 2230
nearreef_v5	Entire NSW coast	Scale of source map 1:25 000 Attribute accuracy remains unvalidated.	Distribution of reef, sand, emergents, urchin barrens and fringe reefs to the AMBIS low water mark.	NPWS GIS Support Manager or Ron Avery c/o National Parks & Wildlife Service Hurstville NSW

3.2. Northern Territory

Data Set	Extent	Accuracy	Details	Further contact
ATT N04 Arnhem Land meadows_region	Arnhem Land; Goulburn Islands; Coastal Northern Territory	Generally less than 100 metres for seagrass meadow boundaries. Determined through a combination of GPS fix, aerial photography, 1:250,000 topographical maps and satellite imagery (30 metre pixel accuracy).	Intertidal seagrass meadows within coastal bounds from Goulburn Islands to Milingimbi in Arnhem Land, Northern Territory.	Queensland Department of Primary Industries & Fisheries Principal Senior Scientist P.O. Box 5396 Cairns Qld 4870
ATT N04 Gulf of Carpentaria meadows_region	Gulf of Carpentaria; Coastal Northern Territory; West-coastal Queensland.	Generally less than 100 metres for seagrass meadow boundaries. Determined through a combination of GPS fix, aerial photography, 1:250,000 topographical maps and satellite imagery (30 metre pixel accuracy).	Intertidal seagrass meadows in Gulf of Carpentaria within coastal bounds from Gove, Northern Territory, to Horn Island, Queensland.	Queensland Department of Primary Industries & Fisheries Principal Senior Scientist P.O. Box 5396 Cairns Qld 4870
ATT N04 Kakadu meadows_region	Kakadu; Van Dieman Gulf; Coastal Northern Territory	Generally less than 100 metres for seagrass meadow boundaries. Determined through a combination of GPS fix, aerial photography, 1:250,000 topographical maps and satellite imagery (30 metre pixel accuracy).	Intertidal seagrass meadows within coastal bounds of Kakadu National Park.	Queensland Department of Primary Industries & Fisheries Principal Senior Scientist P.O. Box 5396 Cairns Qld 4870
Cape Arnhem Vegetation Survey	Cape Arnhem	**Positional Accuracy**: Good - Linework digitised and georeferenced using GPS ground control points. Registration/location information has been derived from topographic base map, NT cadastre and GPS based field survey. The summation of errors from all sources results in data with a standard deviation defined by scale used as ï¾±20m for well-defined points. **Attribute Accuracy**: High - The accuracy of the attribute information is considered high and conforms to the 'Australian Soil and	A floristic survey (1:5,000 scale dataset) describing/mapping vegetation communities for the Cape Arnhem area of the NT. Mapped information describes vegetation units and their attributes and provides a basis for identifying the extent and distribution of vegetation resources. (Vegetation Unit - A reasonably homogeneous part of the land surface, distinct from surrounding terrain with constant	Department of Natural Resources, Environment and The Arts Manager, Spatial Data and Mapping Branch - Land & Water Division GPO Box 30 Palmerston NT 0831

		Land Survey Field Handbook' at time of capture. Analysis of site data to provide community information.	properties in landform and vegetation) This survey was carried out as a joint project with Dhimurru Aboriginal Association to produce floristic and environmental data for Cape Arnhem area. Floristic and environmental data. A joint project with Dhimurru Aboriginal Association.	
Classification, distribution and environmental relationships of coastal floodplain vegetation, Northern Territory, Australia, March-May 1990	Floodplains of the major river systems of the Northern Territory between the Moyle and Clyde Rivers	See report	The vegetation of floodplains of the major river systems of the Northern Territory between the Moyle and Clyde Rivers was surveyed over the period March to May 1990. Maps showing the distribution of plant communities are presented.	Land Conservation Unit Conservation Commission of the Northern Territory PO Box 496 Palmerston NT 0813
Ludmilla Creek Mangrove Survey	Ludmilla Creek and its environments	**Positional Accuracy:** Good - Derived from topographic basemap, NT cadastre and GPS. The summation of errors from all sources results in data with a standard deviation defined by scale used as ï¾±25m for well-defined points. **Attribute Accuracy:** High - The accuracy of the attribute information is considered high	a high resolution survey (1:5,000 scale dataset) describing/mapping vegetation communities for the upper region of Ludmilla Creek and its environs. Mapped information describes mangrove communities/vegetation units and their	Department of Natural Resources, Environment and The Arts Manager, Spatial Data and Mapping Branch - Land & Water Division GPO Box 30 Palmerston NT 0831

		and conforms to the 'Australian Soil and Land Survey Field Handbook' at time of capture. Analysis of site data to provide community information.	attributes as floristic and environmental data and provides a basis for identifying the extent and distribution of vegetation resources. (Vegetation Unit - A reasonably homogeneous part of the land surface, distinct from surrounding terrain with constant properties in landform and vegetation)	
Mangrove Mapping Bynoe Harbour	Bynoe Harbour	**Positional Accuracy:** Good - Derived from topographic basemap, NT cadastre and GPS. The summation of errors from all sources results in data with a standard deviation defined by scale used as ï¾±50m for well-defined points. **Attribute Accuracy:** High - The accuracy of the attribute information is considered high and conforms to the 'Australian Soil and Land Survey Field Handbook' at time of capture.	A high resolution survey (1:25,000 scale dataset) describing/mapping mangrove communities for Bynoe Harbour and its environs. Mapped information describes mangrove communities/vegetation units and their attributes as floristic and environmental data and provides a basis for identifying the extent and distribution of mangrove community resources for Bynoe Harbour and its environs. (Vegetation Unit - A reasonably	Department of Natural Resources, Environment and The Arts Manager, Spatial Data and Mapping Branch - Land & Water Division GPO Box 30 Palmerston NT 0831

			homogeneous part of the land surface, distinct from surrounding terrain with constant properties in landform and vegetation)	
Mangrove Mapping of Darwin Harbour	Darwin Harbour	**Positional Accuracy**: Good - Derived from topographic basemap, NT cadastre and GPS. The summation of errors from all sources results in data with a standard deviation defined by scale used as ï¾±50m for well-defined **Attribute Accuracy**: High - The accuracy of the attribute information is considered high and conforms to the 'Australian Soil and Land Survey Field Handbook' at time of capture.	A high resolution survey (1:25,000 scale dataset) describing/mapping mangrove communities for Darwin Harbour and its environs. Mapped information describes mangrove communities/vegetation units and their attributes as floristic and environmental data and provides a basis for identifying the extent and distribution of mangrove community resources for Darwin Harbour and its environs. (Vegetation Unit - A reasonably homogeneous part of the land surface, distinct from surrounding terrain with constant properties in landform and vegetation)	Department of Natural Resources, Environment and The Arts Manager, Spatial Data and Mapping Branch - Land & Water Division GPO Box 30 Palmerston NT 0831

Northern Territory Coastal Wetlands	Northern Territory Coast	**Positional Accuracy**: Base data Landsat ETM+ imagery. Problems with the positional accuracy of Landsat imagery at the Zone 52/53 boundary and the WA border required that mapping be registered to Northern Territory coastline data. **Attribute Accuracy**: Various. Reliability field indicates the reliability of the attribute assigned based on the level of ground truth data available. A - highest reliability,B - high reliability, C average reliability, D - reliability unknown, further grouth truthing required. See report for more details.	A coastal wetland community classification produced as the first phase of the FRDC funded project, Methods for monitoring the abundance and habitat of the northern Australian mud crab, Scylla serrata. The Landsat TM/ETM+ derived classification includes mangroves and saltmarsh communities.	Assessment & Monitoring Unit Fisheries Data Coordinator Level 2 80 Ann Street Brisbane Qld 4001
Rapid Creek Catchment Vegetation Survey	Rapid Creek catchment	**Positional Accuracy**: Good - Derived from cadastrel basemap, GPS and NT cadastre. The summation of errors from all sources results in data with a standard deviation defined by scale used as ï¾±20m for well-defined points. **Attribute Accuracy**: High - The accuracy of the attribute information is considered high and conforms to the 'Australian Soil and Land Survey Field Handbook' at time of capture. Analysis of site data to provide community information.	A high resolution survey (1:5,000 scale dataset) describing/mapping vegetation for the Rapid Creek catchment area. Mapped information describes vegetation units and their attributes as floristic and environmental data and provides a basis for identifying the extent and distribution of vegetation resources for the Rapid Creek catchment area. (Vegetation Unit - A reasonably	Department of Natural Resources, Environment and The Arts Manager, Spatial Data and Mapping Branch - Land & Water Division GPO Box 30 Palmerston NT 0831

			homogeneous part of the land surface, distinct from surrounding terrain with constant properties in landform and vegetation)	

3.3. Queensland

Data Set	Extent	Accuracy	Details	Further contact
Central Queensland Coast Biodiversity Planning Assessment Version 1.3 Released on 29 January 2007	Central Queensland Coast Bioregion, Queensland	Positional Accuracy: The positional accuracy is primarily dependant on the accuracy of the Herbarium Regional Ecosystem Mapping Version 5.0 (December 2005) recorded in that metadata as a scale of 1:100,000 which has a minimum remnant polygon area of 5 hectares or minimum remnant width of 75 metres. The precision of polygon boundaries or positional accuracy of linework is 100 metres. Positional accuracies of other datasets is unknown, but at 1:100000 scale, at least 100 metres should be anticipated. Attribute Accuracy: Accuracy of Status and level of conservation is dependent on the Herbarium Regional Ecosystem Mapping..	This dataset represents Version 1.3 of the Central Queensland Coast Biodiversity Planning Assessment. The methodology has application for identifying areas with various levels of significance solely for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes. While natural resource values such as dryland salinity, soil erosion potential or land capability are not dealt with explicitly, they are included to some extent within the Biodiversity	Environmental Protection Agency Queensland Data Coordinator PO Box 155 Brisbane Queensland 4002

			Status of REs recognised by the EPA.	
DPA M99 Meadows	Great Barrier Reef Marine Park (Central Section); East-Coastal Queensland	**Positional Accuracy**: Varies up to 15 to 70 metres Largest variation mostly dependent on distances between sites. **Attribute Accuracy**: Contains Biomass attributes which refer to a visual estimate of aboveground seagrass biomass (grams dry weight) of seagrass in a square metre. Area_in_ha attribute refers to our estimate of the total meadow area. Seagrass species names updated. Information finalized.	Seagrass meadows in the Dugong Protection Areas of Upstart Bay, Newry Region and Sand Bay, Llewellyn and Ince Bays and the Clairview Region, April/May 1999	Len McKenzie Department of Primary Industries and Fisheries Principal Scientist P.O. Box 5396 Cairns Queensland 4870
DPA O99 Meadows	Great Barrier Reef Marine Park (Central Section); East-Coastal Queensland.	**Positional Accuracy**: Varies up to 15 to 70 metres Largest variation mostly dependent on distances between sites. **Attribute Accuracy**: Contains Biomass attributes which refer to a visual estimate of aboveground seagrass biomass (grams dry weight) of seagrass in a square metre. Area_in_ha attribute refers to our estimate of the total meadow area. Seagrass species names updated. Information finalized.	Seagrass meadows in the Dugong Protection Areas of Upstart Bay, Newry Region and Sand Bay, and Llewellyn and Ince Bays: October 1999.	Len McKenzie Department of Primary Industries and Fisheries Principal Scientist P.O. Box 5396 Cairns Queensland 4870
Dryreef_2003	Great Barrier Reef World Heritage Area	**Positional Accuracy:** varies considerably but coverage can be regarded as having a nominal scale of 1:250 000 **Attribute Accuracy**: estimated to be better than 95% correct	Major coral reef structures (as defined by the reef shoal edge) and tidal, drying or emergent reef areas within the Great Barrier	Great Barrier Reef Marine Park Authority Data Administrator Spatial Data Centre PO Box 1379 TOWNSVILLE

			Reef World Heritage Area.	QLD 4810
Dunk-Cleveland Oct96 - meadows	Great Barrier Reef Marine Park (Cairns and Central sections); East-Coastal Queensland.	**Positional Accuracy**: Estimates of mapping reliability were assigned to each meadow, based on the range of mapping techniques used and associated spatial errors. Boundaries of meadows in intertidal depths were usually mapped with greatest reliability (identified from surface observations, from dive sites usually less than 100 m apart, and sometimes interpreted from aerial photos). Boundaries in sub-tidal depths (e.g., the outer boundaries of large meadows) were mapped with less reliability because of a) very gradual changes in habitat and b) poor underwater visibility. Where the depth of outer boundaries were established, bathymetry was used to help outline the meadow boundary between survey sites. Estimates of mapping reliability ranged from 10 m to 500 m and were recorded in the GIS. **Attribute Accuracy**: Contains Av_mdw_biomass and Area attributes which refer to mean above ground biomass (g DW m-2) of seagrass in a meadow and the distribution of the meadow (ha), respectively. Codes for seagrass species names are: CR6 = Cymodocea rotundata, CS1 = Cymodocea serrulata , HP11 = Halodule pinifolia, HUW5 = Halodule uninervis (wide), HUT7 =	Seagrass communities of the coastal and island waters from Dunk Island to Cleveland Bay surveyed 7 - 16 October 1996.	Len McKenzie Department of Primary Industries and Fisheries Principal Scientist P.O. Box 5396 Cairns Queensland 4870

		Halodule uninervis (thin), SI8 = Syringodium isoetifolium, ZC14 = Zostera capricorni, HD10 = Halophila decipiens, HO4 = Halophila ovalis, HM16 = Halophila minor, HS3 = Halophila spinulosa, HT13 = Halophila tricostate, H 15 = Halophila spp., TH9 = Thalassia hemprichiiupdated. Meadow habitat and community types are listed in the source publication. Information finalized.		
Moreton Bay Coral 2004	Moreton Bay	Positional Accuracy: Polygons +/- 10m. Positional accuracy of polygon linework noted in the field “Pos_Acc” which gives a reliability code as either A, B, C or D for high, moderate, low and very low confidence in accuracy. The level is derived on the basis of positioning and the frequency of survey sites and the distinctiveness of discrete boundaries. Attribute Accuracy: Attribute accuracy of polygons, in particular the fields denoting species and cover, is noted in the field “Att_Acc”. This reliability code is given as either A, B, C or D for high, moderate, low and very low confidence in accuracy. The level is determined on the basis of reliability of field observations and interpretation from the oblique aerial photos.	Benthic habitat mapping of Moreton Bay, from Comboyuro Point to Jacobs Well. Mapping conducted as part of the Ecosystem Health Monitoring Program.	Environmental Protection Agency Queensland Data Coordinator PO Box 155 Brisbane Queensland 4002
Moreton Bay Seagrass 2004	Bribie Island bridge to Kangaroo Island.	Positional Accuracy: Polygons +/- 10m. Positional accuracy of polygon linework is noted in the	Seagrass mapping of Moreton Bay between the Bribie Island bridge	Environmental Protection Agency Queensland Data Coordinator

		field 'Pos_Acc' which gives a reliability code of high, moderate, or low confidence in accuracy for polygons derived from the EHMP field survey sites. The level is derived on the basis of positioning and the frequency of survey sites, the distinctiveness of discrete boundaries evident from the field surveys and the georeferencing accuracy of the satellite image. Attribute Accuracy: Attribute accuracy for the field denoting cover, is provided in the field "Att_acc". It gives, for the polygons derived from the EHMP survey sites, a reliability code of high, moderate, or low confidence in accuracy. The level is determined on the basis of reliability of field observations. For polygons derived from the classification of the satellite image, attribute accuracy is denoted as "OA 60%" or "OA 72%". Where OA stands for "Overall Accuracy" which is commonly expressed as the probability that a classified image pixel actually represents that category on the ground. Attribute accuracy for the field denoting seagrass species is provided in the field "Att_acc_sp" which gives a reliability code of high, moderate, or low confidence in accuracy. This level is determined on the basis of reliability of field observations.	and Kangaroo Island: Mapping conducted as part of the Ecosystem Health Monitoring Program (EHMP) in conjunction with research by the CRSSIS, UQ (funded by Coastal CRC).	PO Box 155 Brisbane Queensland 4002
Northern Territory Coastal Wetlands	Northern Territory Coast	**Positional Accuracy**: Base data Landsat ETM+ imagery.	A coastal wetland community	Department of Primary Industries and Fisheries - Assessment & Monitoring

		Problems with the positional accuracy of Landsat imagery at the Zone 52/53 boundary and the WA border required that mapping be registered to Northern Territory coastline data. **Attribute Accuracy**: Various. Reliability field indicates the reliability of the attribute assigned based on the level of ground truth data available. A - highest reliability,B - high reliability, C average reliability, D - reliability unknown, further grouth truthing required. See report for more details.	classification produced as the first phase of the FRDC funded project, Methods for monitoring the abundance and habitat of the northern Australian mud crab, Scylla serrata. The Landsat TM/ETM+ derived classification includes mangroves and saltmarsh communities.	Unit Fisheries Data Coordinator Level 2 80 Ann Street Brisbane Qld 4001
Pumicestone Passage seagrass 2002	Pumicestone Passage between Caloundra and the Bribie Island bridge, including several of the major creeks	**Positional Accuracy**: Polygons +/- 10m **Attribute accuracy** of polygons, in particular the fields denoting species and cover, is noted in the field "Att_Acc".	Seagrass mapping of Pumicestone Passage between Caloundra and the Bribie Island bridge, including several of the major creeks: Mapping conducted as part of the Ecosystem Health Monitoring Program.	Environmental Protection Agency Queensland Data Coordinator PO Box 155 Brisbane Queensland 4002
Queensland Coastal Wetland Vegetation	Queensland Coast	**Positional Accuracy**: Mangroves: +/- 100 meters **Attribute Accuracy**: Mangroves: approximately 80%	1:100,000 coastal wetland vegetation mapping for Queensland including mangrove communities, saltpans and saline grasslands. Mapping taken from Landsat TM images with ground truthing.	Department of Primary Industries and Fisheries - Assessment & Monitoring Unit Remote Sensing Officer Level 2 80 Ann Street Brisbane Qld 4001
Queensland Seagrass Meadows 1984-1988	Queensland Coast	**Positional Accuracy:** Boundaries of meadows were determined based on the positions of survey sites and the presence of seagrass, coupled	Coastal seagrass meadows along the Queensland coast. Survey Dates: Tarrant Point to Cape York -	Len McKenzie Department of Primary Industries and Fisheries Principal Scientist

		with depth contours and other available information. Accuracy varies from 10-100 metres, as it relies partly on locational accuracy of RADAR. **Attribute Accuracy**: Information finalized.	October/November 1986 Cape York to Cairns - November 1984 Cairns to Bowen - October/November 1987 Bowen to Water Park Point - March/April 1987 Water Park Point to Hervey Bay - October/November 1988 Noosa to Coolangatta - August/December 1987 Please note that recent seagrass survey data may be available and that users should ensure that they are using the most recent data available. Please contact the custodian for further information.	P.O. Box 5396 Cairns Queensland 4870
Queensland Wetland Data Version 1.0 – Wetlands	Great Barrier Reef Catchment	**Positional accuracy** of wetland data mapped at a scale of 1:100 000 is +/-100 metres with a minimum polygon size of 5 ha or 75 metres wide for linear features, except for areas along the east coast which are mapped at the 1:50 000 scale with a positional accuracy of +/-50 metres, with a minimum polygon size of 1 ha or 35 metres wide for linear features. Wetlands smaller than 1 ha are not delineated on the wetland data.	This dataset provides mapping of water bodies and wetland regional ecosystems at 1:100,000 scale across the Great Barrier Reef Catchment.	Department of Primary Industries and Fisheries - Environmental Protection Agency Wetland Project Support Officer Floor 6, 160 Ann St BRISBANE QLD 4000
Queensland Wetland Data Version 1.1 – Wetlands	Wide Bay	**Positional accuracy** of wetland data mapped at a scale of 1:100 000 is +/-100 metres with a minimum polygon size of 5 ha or 75 metres wide for linear features, except for areas along the east	This dataset provides mapping of water bodies and wetland regional ecosystems at 1:100,000 scale across the Wide Bay area.	Department of Primary Industries and Fisheries - Environmental Protection Agency Wetland Project Support Officer Floor 6, 160 Ann St BRISBANE

		coast which are mapped at the 1:50 000 scale with a positional accuracy of +/-50 metres, with a minimum polygon size of 1 ha or 35 metres wide for linear features. Wetlands smaller than 1 ha are not delineated on the wetland data.		QLD 4000
South East Queensland Biodiversity Planning Assessment Version 3.4 Released 7 March 2005	South East Queensland Bioregion, Queensland	**Positional Accuracy**: The positional accuracy is primarily dependant on the accuracy of the Herbarium Regional Ecosystem Mapping (Version 4.0 (September 2003) and in part, version 4.1 (March 2004)) recorded in that metadata as a scale of 1:100,000 which has a minimum remnant polygon area of 5 hectares or minimum remnant width of 75 metres. The precision of polygon boundaries or positional accuracy of linework is 100 metres. Positional accuracies of other datasets is unknown, but at 1:100000 scale, at least 100 metres should be anticipated. **Attribute Accuracy**: Accuracy of Status and level of conservation is dependent on the Herbarium Regional Ecosystem Mapping.	The methodology has application for identifying areas with various levels of significance solely for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes. While natural resource values such as dryland salinity, soil erosion potential or land capability are not dealt with explicitly, they are included to some extent within the Biodiversity Status of REs recognised by the EPA.	Environmental Protection Agency Queensland Data Coordinator PO Box 155 Brisbane Queensland 4002
Swbsep95 (Shoalwater Bay seagrass meadows September 1995)	Shoalwater Bay; East-Coastal Queensland.	**Positional Accuracy**: A differential Global Positioning System (dGPS) was used to accurately determine geographic location of sampling sites (±5 m) (see also Table 2 in source	Seagrass meadows in Shoalwater Bay coastal waters mapped from 1068 ground truth sites examined between 13 September 1995 and	Len McKenzie Department of Primary Industries and Fisheries Principal Scientist

		document). **Attribute Accuracy:** Contains seagrass biomass (average for all species pooled) in a 50cmx50cm quadrat and extent. Information finalized. Coulmns are: ID=unique meadow code, SPECIES= seagrass community, MAPPING_QU=boundary mapping quality (see Table 2 in source document), AREA=hectares, BIOMASS_AV=mean seagrass biomass m-2, BIOMASS_SE= mean seagrass biomass standard error, BIOMASS_MI= minimum seagrass biomass m-2, BIOMASS_MA= maximum seagrass biomass m-2, NUMBER_OF_=number of ground truth sites within meadow. Biomass is mean above ground biomass (g DW m-2) of seagrass in a quadrat. Meadow habitat and community types are listed in the source publication. Information finalized.	20 September 1995. 13,076 +/-800 ha of seagrass habitat was mapped in September 1995 between Macdonald Point (north-western Shoalwater Bay) and Port Clinton (south-east of Shoalwater Bay).	P.O. Box 5396 Cairns Queensland 4870
swbapr96 (Shoalwater Bay seagrass meadows April 1996)	Shoalwater Bay; East-Coastal Queensland	**Positional Accuracy**: A differential Global Positioning System (dGPS) was used to accurately determine geographic location of sampling sites (±5 m) (see also Table 2 in source document). **Attribute Accuracy**: Contains seagrass biomass (average for all species pooled) in	Seagrass meadows in Shoalwater Bay coastal waters mapped from 1799 ground truth sites examined between 4 March 1996 to 10 April 1996. 13,001 +/-890 ha of seagrass habitat was mapped in April 1996 between Macdonald	Len McKenzie Department of Primary Industries and Fisheries Principal Scientist P.O. Box 5396 Cairns Queensland 4870

		a 50cmx50cm quadrat and extent. Information finalized. Coulmns are: ID=unique meadow code, SPECIES= seagrass community, MAPPING_QU=boundary mapping quality (see Table 2 in source document), AREA=hectares, BIOMASS_AV=mean seagrass biomass m-2, BIOMASS_SE= mean seagrass biomass standard error, BIOMASS_MI= minimum seagrass biomass m-2, BIOMASS_MA= maximum seagrass biomass m-2, NUMBER_OF_=number of ground truth sites within meadow. Biomass is mean above ground biomass (g DW m-2) of seagrass in a quadrat. Meadow habitat and community types are listed in the source publication. Information finalized.	Point (north-western Shoalwater Bay) and Port Clinton (south-east of Shoalwater Bay), and including the Cannibal Island group (north of Shoalwater Bay).	
The Riparian Assessment Program – Mapping the Status of Estuarine Habitat	Estuaries in South East Queensland	NA	A software -based monitoring tool which allows an operator with limited exposure to riparian assessment techniques and vegetation knowledge to rapidly assess the riparian habitat.	Queensland Environmental Protection Agency Data Coordinator PO Box 155 Brisbane Queensland 4002
Whitsunday Jan99_00 - meadows	Great Barrier Reef Marine Park (Central section); East-Coastal Queensland	**Positional Accuracy:** Estimates of mapping reliability (Mapping_quality) were assigned to each meadow, based on the range of mapping techniques used and associated spatial errors (see Table 1 in citation).	Seagrass Resources of the coastal and island waters from Hydeaway Bay to Midge Point surveyed 8 - 15 January 1999 and 24 – 30 January 2000.	Len McKenzie Department of Primary Industries and Fisheries Principal Scientist P.O. Box 5396

		Boundaries of meadows in intertidal depths were usually mapped with greatest reliability (identified from surface observations, from dive sites usually less than 100 m apart, and sometimes interpreted from aerial photos). Boundaries in sub-tidal depths (e.g., the outer boundaries of large meadows) were mapped with less reliability because of a) very gradual changes in habitat and b) poor underwater visibility. Where the depth of outer boundaries were established, bathymetry was used to help outline the meadow boundary between survey sites. Estimates of mapping reliability ranged from 10 m to 500 m and were recorded in the GIS. **Attribute Accuracy:** Contains Average_biomass and Area_in_ha attributes which refer to mean above ground biomass (g DW m-2) of seagrass in a meadow and the distribution of the meadow (ha), respectively. Codes for seagrass species names are: CR6 = Cymodocea rotundata, CS1 = Cymodocea serrulata , HP11 = Halodule pinifolia, HUW5 = Halodule uninervis (wide), HUT7 = Halodule uninervis (thin), SI8 = Syringodium isoetifolium, ZC14 = Zostera capricorni, HD10 = Halophila decipiens, HO4 = Halophila ovalis, HM16 = Halophila minor, HS3 = Halophila spinulosa, HT13 = Halophila tricostata, H15 = Halophila spp.,		Cairns Queensland 4870

		TH9 = Thalassia hemprichii updated. Meadow habitat and community types are listed in the source publication. Information finalized.		

3.4. South Australia

Data Set	Extent	Accuracy	Details	Further contact
Nearshore Marine Benthic Habitat Mapping	Northern and Yorke Region including Spencer Gulf and Gulf St. Vincent	Mapping for this project was undertaken at scales between 1: 5000 and 1: 10 000. Seasonal variations, depending on the time of year that the aerial photos were taken, can also be quite significant. The process becomes increasingly subjective as the water deepens. Due to the difficulties associated with discerning features on aerial photography in deep water, a bathymetry map was used to highlight those areas that were deeper than 15m. Areas deeper than 15m were considered unreliable and not mapped.	A number of data sets complement the marine benthic habitat mapping. These include: • Benthic Survey Data, 2006 (DEH) • SA Saltmarsh Mangrove Habitat Mapping, 2006 (DEH) • SA Benthic Habitat Mapping, 2004 (DEH - CSIRO/SARDI) • Benthic Survey Sites, 1996 (DEH - CSIRO/SARDI)	Coast and Marine Conservation Branch Department for Environment and Heritage GPO Box 1047 Adelaide SA 5001 Website: www.environment.sa.gov.au/coasts

3.5. Tasmania

Data Set	Extent	Accuracy	Details	Further contact
SeaMap Tasmania Merged Habitat Layers for the Australian Coastal Vulnerability Project 2007	Tasmania	**Positional Accuracy**: The positional accuracy of the GPS was found to vary 1.5m in the horizontal plane when left to record for a period of 60minutes. **Attribute Accuracy**: The attributes assigned to the 1:25000 Habitat Mapping Series were based on the interpretation of	The SeaMap Tasmania merged marine habitat layer depicts marine habitats mapped by the Tasmanian Aquaculture and Fisheries Institute from the year 2000 to 2007. The datasets have been merged for the purposes of the National Land and Water Resources Audit for the	Tasmanian Aquaculture and Fisheries Institute Geographical Information Systems Officer Nubeena Cresent Taroona Tasmania 03 62277 277

		the acoustic signal using EchoView software (Sonar Data TM). These attributes were cross-referenced with underwater video information used to ground truth the sounder interpretations.	Australian Coastal Vulnerability Project. The habitat types depicted in the dataset include rocky reef, unconsolidated substrates and seagrass. The use of underwater camera equipment, echo sounder data, side scan sonar and a Differential GPS unit allowed for the extensive area to be surveyed. The dataset is intended to be used to fulfil coastal management objectives according to The Living Marine Resources Act 1995.	v_halley@utas.edu.au
Tasmanian Oil Spill Response Wetlands Susceptible to Marine Oiling	Tasmania	**Positional Accuracy**: The positional accuracy of the LIST data is well defined and has an accuracy of 17.5m to true geographic position. The centroids assigned to each wetland were generated automatically using GIS software routines. These were checked visually and with spatial queries to ensure they fell within the originating wetland. Becuase the data consists of point locations no indication of the size of the polygon is provided. it is assumed this coverage will be used in conjunction with the LIST data with which it was created. **Attribute Accuracy**: Attribute accuracy is estimated to be	This data set spatially depicts wetlands susceptible to marine oiling necessary for any response to an oil spill in Tasmanian State coastal waters as specified by the Oil Spill Response Atlas project. The need for identifying coastal wetland areas that are subject to marine influence is important in the management and their protection and for the protection of the vulnerable and endemic species that utilise them. This data set contains the point locations of the centre of both actual and probable coastal wetland areas within Tasmania that are susceptible to a marine oil spills. Coastal	Resource Management and Conservation Wildlife Biologist, Nature Conservation GPO Box 44 Hobart TAS 7001 Australia 03 6233 6585- Stewart.Blackhall@dpiwe.tas.gov.au

		95%.The RAMSAR sites are very accurately attributed. The Wetlands of National Importance had some problems in the source data are slightly less accurately attributed. The accuracy of the attribute JAMBA and CAMBA	wet areas such as wetlands, saline flats, estuaries, watercourses and waterbodies that are below 10 metres above Mean High Water Mark (MHWM) and are either connected to, or within 250 metres of, the MHWM were all identified as having the potential for oil damage if a spill was to occur nearby. Any wetlands with international, national and state significance have been attributed as such. For example, where known, the points are attributed with the conservation significance of the wetlands including RAMSAR sites and areas frequented by Japanese Australia Migratory Bird Agreement (JAMBA) and China Australia Migratory Bird Agreement (CAMBA) bird species. The base data is currently held in AGD66 geographicals (ie Latitude Longitude).	

3.6. Victoria

Data Set	Extent	Accuracy	Details	Further contact
ADDIS_HAB	Point Addis Marine National Park	**Positional Accuracy**: PIRVic orthorectified the 2002 and 2004 aerial photography for Point Addis using	Shallow marine habitat mapping at Point Addis Marine National Park by PIRVic Marine and	David Ball DPI

		ground-control points (GCPs) primarily derived from the Vicmap Transport and Property layers. Additional ground-control points were collected with a GPS by PIRVic scientists at Bells Beach and Point Addis. The DEM was created from the Vicmap Elevation layer and bathymetry from the Depth_250 layer. RMS error (Root Mean Square) denotes the difference between an output location for a GCP and the real coordinates for the same point when the point is transformed. The RMS error is expressed in the image's pixel size. The ortho-rectification of the 2002 photography had an average RMS error of 3.6 with a pixel size of 0.9 m, and the 2004 photography had an average RMS error of 3.2 with a pixel size 0.4 m. **Attribute Accuracy**: The classification scheme primarily differentiates between reef and sediment and these habitats typically presented very different pixel values (colour and texture) in the photography raster images. The comparison of the initial habitat classifications from the manual digitising with the underwater video showed a high degree of accuracy in differentiating reef from sediment (typically >90% accuracy). The mapping represents the distribution of habitats at the time the aerial photography and underwater video was collected and is a baseline against which future changes can be compared.	Freshwater Systems from aerial photography and underwater video.	PO Box 114 Queenscliff Victoria 3225
BARWON_HAB	Barwon Bluff Marine Sanctuary	**Positional Accuracy:** The metadata for the source Fugro ortho-rectified aerial photography stated that it achieved a target accuracy of +/- 1.5 m	Shallow marine habitat mapping atBarwon Bluff Marine Sanctuary by PIRVic Marine and	David Ball, PIRVic Marine and Freshwater Systems

		for areas with 10 m contour intervals where the supplied DEM surface was accurate to half the contour interval and this is believed to apply to the Barwon Bluff area. The Fugro metadata also noted that every 1 m error in the supplied DEM might result in a plan error of up to 0.5 m in the ortho-imagery. **Attribute Accuracy:** Ball et al. (2006) adopted a two-stage approach to marine habitat classification whereby a primary habitat classification scheme was used to classify observations from the underwater video and a reduced set of modifiers was used to classify the habitats mapped from the aerial photography in the GIS. The GIS mapping classification scheme consisted of a hierarchy with two levels of modifiers. The first level (substratum type) was consistent with the primary habitat classification table. The second level (substratum/biota category) was divided into intertidal and subtidal habitats and featured elements of the substratum category and texture for reef and dominant biota for sediments from the primary classification table. The habitat polygons mapped from the aerial photography in this layer were only classified according to these modifiers. The habitat polygons could be further classified in the future through the use of acoustic mapping systems and additional ground-truthing to include all levels of the primary habitat classification table. The classification scheme primarily differentiates between reef and sediment and these habitats typically present very different pixel values (colour and texture) in the photography raster images.	FreshwaterSystems from Aerial photography and underwater video.	

		However, differences in depth may influence pixel reflectance values for similar habitats within a site in aerial photography (e.g. sediment in deeper water may have a similar appearance to low-profile reef in shallow water). As a consequence the aerial photography was divided into shallow (<2 m) and deep (2-5 m) mapping regions to reduce misclassification of habitats due to light attenuation in the water column. The comparison of the initial habitat classifications from the unsupervised classification process with the underwater video showed a high degree of accuracy in differentiating reef from sediment and seagrass from bare sediment (typically >90% accuracy). Differentiating dense seagrass on sediment from reef was more difficult and we relied on contextual editing where sites known to have large areas of seagrass from previous studies (e.g. Corner Inlet MNP) could be reliably classified as being seagrass with confirmation of the classification from the underwater video. Sites where beds of seagrass grew over reef and amongst sandy sediment between patches of reef were assigned a combined category of Seagrass / Reef – Sediment where it was not possible to accurately delineate separate seagrass and reef features from the aerial photography. The seagrass in this category was predominantly Amphibolis antarctica, particularly where it extended from patchy reef into adjacent sediment. Small stands of Zostera spp. were also observed in more sheltered areas (e.g. Mushroom Reef and Nepean Bay). It should be noted that marine habitats		

		are highly dynamic and some habitat boundaries and characteristics are constantly changing due to influences such as erosion and accretion of sediments, wave erosion of rocky reefs and variation in distribution and/or density of biota. The mapping represents a 'best-fit' of linear boundaries to natural features, which in some cases may show a gradual transition from one feature to another or are constantly varying over time. The mapping therefore represents the distribution of habitats at the time the aerial photography and underwater video was collected and is a baseline against which future changes can be compared.		
Cape Howe General Biota Map, Smoothed	Cape Howe MNP	**Positional accuracy** is dependent on hydroacoustic survey accuracy (average +/- 3 m), and tow video locational accuracy (maximum of +/- 5 m) **Attribute accuracy** is dependent on modelling accuracy and errors compounded from combining multiple modelled surfaces- please refer to the Habitat Mapping Technical Report.	This grid shows the distribution of the basic categories identifiable from tow video for Biota at Cape Howe, assembled from modelled binary grids and smoothed by assigning the marjority cell value in a 10-m radius circle.	Parks Victoria
Cape Howe General Substrate Map, Smoothed	Cape Howe MNP	Positional accuracy is dependent on hydroacoustic survey accuracy (average +/- 3 m), and tow video locational accuracy (maximum of +/- 5 m) Attribute accuracy is dependent on modelling accuracy and errors compounded from combining multiple modelled surfaces- please refer to the Habitat Mapping Technical Report.	This grid shows the distribution of the basic categories identifiable from tow video for Substrate at Cape Howe, assembled from modelled binary grids and smoothed by assigning the marjority cell value in a 10-m radius circle.	Parks Victoria
Corner Inlet Marine National Park	Corner Inlet Marine National Park	**Positional Accuracy:** QASCO orthorectified the aerial	Shallow marine habitat mapping at Corner Inlet	David Ball, PIRVic Marine and Freshwater Systems

		photography using ground-control points (GCPs) primarily derived from Vicmap layers and positions of navigation structures provided by Gippsland Ports. The DEM was created from the Vicmap Elevation layer and depths from the Corner Inlet bathymetry layer. RMS error (Root Mean Square) denotes the difference between an output location for a GCP and the real coordinates for the same point when the point is transformed. The RMS error is expressed in the image's pixel size. There were limited ground-control points visible in the Corner Inlet photography and ortho-rectification of the northern site had an average RMS error of 24.5 with a pixel size of 0.6 m, and ortho-rectification for the southern site had an average RMS error of 20.9 also with a pixel size 0.6 m. **Attribute Accuracy:** Ball et al. (2006) adopted a two-stage approach to marine habitat classification whereby a primary habitat classification scheme was used to classify observations from the underwater video and a reduced set of modifiers was used to classify the habitats mapped from the aerial photography in the GIS. The GIS mapping classification scheme consisted of a hierarchy with two levels of modifiers. The first level (substratum type) was consistent with the primary habitat classification table. The second level (substratum/biota category) was divided into intertidal and subtidal habitats and featured elements of the substratum category and texture for reef and dominant biota for sediments from the primary classification table. The habitat polygons mapped from the aerial	Marine National Park by PIRVic Marine and Freshwater Systems from aerial photography and underwater video.	

		photography in this layer were only classified according to these modifiers. The habitat polygons could be further classified in the future through the use of acoustic mapping systems and additional ground-truthing to include all levels of the primary habitat classification table. The comparison of the initial habitat classifications from the unsupervised classification process with the underwater video showed a high degree of accuracy in differentiating reef from sediment and seagrass from bare sediment (typically >90% accuracy). Differentiating dense seagrass on sediment from reef was more difficult and we relied on contextual editing where sites known to have large areas of seagrass from previous studies (e.g. Corner Inlet MNP) could be reliably classified as being seagrass with confirmation of the classification from the underwater video. The aerial photography for Corner Inlet MNP was flown at low-tide under calm conditions and provided a clear view of the seagrass habitat up to depths of about 5 m. The northern site was characterised by extensive beds of Posidonia australis with small areas of Zostera spp. on the very shallow sections of the central bank. The consistent colour and texture of the P. australis seagrass beds mapped from the aerial photography supported giving them a single habitat classification and this was confirmed by the ground-truthing. However, it is possible that small patches of Zostera spp. exist amongst the medium-dense P. australis at this site. The southern site displayed a more complex mosaic of seagrass patches of varying densities and sizes. It was not possible to ground-truth every patch of		

		seagrass visible in the photography, so we matched different colours, texture and shapes of seagrass patches in the aerial photography with the ground-truthing. We then extrapolated our field observations across the aerial photography to classify the habitat polygons. As a consequence there may be some differences in the species or density of seagrass at specific sites within the Park when compared to the mapping. The ground-truthing found very little P. australis in the southern site and as a consequence most of the seagrass was classified as Zostera spp. An area of seagrass on the northern boundary of the southern site, to the east of Bennison Island was classified as P. australis in the mapping. Although this area of seagrass was not ground-truthed, it displayed a similar colour and texture in the aerial photography to areas found to be P. australis at the northern site. It should be noted that marine habitats are highly dynamic and some habitat boundaries and characteristics are constantly changing due to influences such as erosion and accretion of sediments, wave erosion of rocky reefs and variation in distribution and/or density of biota. The mapping represents a 'best-fit' of linear boundaries to natural features, which in some cases may show a gradual transition from one feature to another or are constantly varying over time. The mapping therefore represents the distribution of habitats at the time the aerial photography and underwater video was collected and is a baseline against which future changes can be compared.		

DANGER_HAB	Point Danger Marine Sanctuary	**Positional Accuracy**: The 2003 Surf Coast Shire aerial photography used for the mapping had a positional accuracy of approximately +/- 1.5 m. **Attribute Accuracy**: The classification scheme primarily differentiates between reef and sediment and these habitats typically presented very different pixel values (colour and texture) in the photography raster images. The comparison of the initial habitat classifications from the manual digitising with the underwater video showed a high degree of accuracy in differentiating reef from sediment (typically >90% accuracy). The mapping represents the distribution of habitats at the time the aerial photography and underwater video was collected and is a baseline against which future changes can be compared.	Shallow marine habitat mapping at Point DangerMarine Sanctuary by PIRVic Marine and Freshwater Systems from aerial photography and underwater video.	David Ball DPI PO Box 114 Queenscliff Victoria 3225
DBAY_HAB	Discovery Bay Marine National Park	**Positional Accuracy:** PIRVic orthorectified the 2006 aerial photography for Discovery Bay using ground-control points (GCPs) derived from an aerial photography mosaic produced for the Glenelg Hopkins Catchment Management Authority with photography flown in November 2003. The DEM was created from the Vicmap Elevation layer and bathymetry from the Depth_250 layer. The positional accuracy of the 2003 GHCMA aerial photography was not stated in the documentation provided	Shallow marine habitat mapping at Discovery Bay Marine National Park by PIRVic Marine and Freshwater Systems from aerial photography and underwater video.	David Ball, PIRVic Marine and Freshwater Systems

		with this photography. It is estimated that the positional accuracy is < 10 m. RMS error (Root Mean Square) denotes the difference between an output location for a GCP and the real coordinates for the same point when the point is transformed. The RMS error is expressed in the image's pixel size. The ortho-rectification of the 2006 photography against the 2003 photography had an average RMS error of 1.7 with a pixel size of 0.3 m. **Attribute Accuracy:** Ball et al. (2006) adopted a two-stage approach to marine habitat classification whereby a primary habitat classification scheme was used to classify observations from the underwater video and a reduced set of modifiers was used to classify the habitats mapped from the aerial photography in the GIS. The GIS mapping classification scheme consisted of a hierarchy with two levels of modifiers. The first level (substratum type) was consistent with the primary habitat classification table. The second level (substratum/biota category) was divided into intertidal and subtidal habitats and featured elements of the substratum category and texture for reef and dominant biota for sediments from the primary classification table. The habitat polygons mapped from the aerial photography in this layer were only classified according to these modifiers. The habitat polygons could be further classified in the future through the use of acoustic mapping systems and additional ground-truthing to include all levels of the primary habitat classification table. The classification scheme primarily		

		differentiated between reef and sediment and these habitats typically presented very different pixel values (colour and texture) in the photography raster images. The comparison of the initial habitat classifications from the manual digitising with the underwater video showed a high degree of accuracy in differentiating reef from sediment (typically >90% accuracy). It should be noted that marine habitats are highly dynamic and some habitat boundaries and characteristics are constantly changing due to influences such as erosion and accretion of sediments, wave erosion of rocky reefs and variation in distribution and/or density of biota. The mapping represents a 'best-fit' of linear boundaries to natural features, which in some cases may show a gradual transition from one feature to another or are constantly varying over time. The mapping therefore represents the distribution of habitats at the time the aerial photography and underwater video was collected and is a baseline against which future changes can be compared.		
Discovery Bay General Biota Map, Smoothed	Discovery Bay MNP	**Positional accuracy** is dependent on hydroacoustic survey accuracy (average +/- 3 m), and tow video locational accuracy (maximum of +/- 5 m) **Attribute accuracy** is dependent on modelling accuracy - please refer to the Habitat Mapping Technical Report.	This grid shows the distribution of all categories identifiable from tow video for Biota at Discovery Bay, assembled from modelled binary grids and smoothed by assigning the marjority cell value in a 10-m radius circle.	Parks Victoria
Discovery Bay General Substrate Map, Smoothed	Discovery Bay MNP	**Positional accuracy** is dependent on hydroacoustic survey accuracy (average +/- 3 m), and tow video locational accuracy (maximum of +/- 5 m)	This grid shows the distribution of all categories identifiable from tow video for Substrate at Discovery	Parks Victoria

		Attribute accuracy is dependent on modelling accuracy - please refer to the Habitat Mapping Technical Report.	Bay, assembled from modelled binary grids and smoothed by assigning the marjority cell value in a 10-m radius circle.	
EAGLE_HAB	Eagle Rock Marine Sanctuary	**Positional Accuracy:** The 2003 Surf Coast Shire aerial photography used for the mapping had a positional accuracy of approximately +/- 1.5 m. **Vertical Accuracy**: **Attribute Accuracy:** Ball et al. (2006) adopted a two-stage approach to marine habitat classification whereby a primary habitat classification scheme was used to classify observations from the underwater video and a reduced set of modifiers was used to classify the habitats mapped from the aerial photography in the GIS. The GIS mapping classification scheme consisted of a hierarchy with two levels of modifiers. The first level (substratum type) was consistent with the primary habitat classification table. The second level (substratum/biota category) was divided into intertidal and subtidal habitats and featured elements of the substratum category and texture for reef and dominant biota for sediments from the primary classification table. The habitat polygons mapped from the aerial photography in this layer were only classified according to these modifiers. The habitat polygons could be further classified in the future through the use of acoustic mapping systems and additional ground-truthing to include all levels of the primary habitat classification table. The comparison of the initial habitat classifications from the unsupervised classification process with the underwater	Shallow marine habitat mapping at Eagle Rock Marine Sanctuary by PIRVic Marine and Freshwater Systems from aerial photography and underwater video.	David Ball, PIRVic Marine and Freshwater Systems

		video showed a high degree of accuracy in differentiating reef from sediment (typically >90% accuracy). The aerial photography for Eagle Rock MS was flown under almost optimum conditions for marine habitat mapping with predominantly clear water and a low tide. Despite this, some small waves could be observed breaking on the seaward edge of the rocky platforms and some sediment in the water mobilised by these waves partially obscured the seabed at these areas. The intertidal zone is a dynamic system and evidence of a pattern of sand accretion and erosion at the pocket beach between Split Point and Eagle Rock was confirmed by comparing aerial photography flown at the site 12 months apart. The habitat at this location was classified as sand beach/low profile platform to account for the constantly changing coastline. It should be noted that marine habitats are highly dynamic and some habitat boundaries and characteristics are constantly changing due to influences such as erosion and accretion of sediments, wave erosion of rocky reefs and variation in distribution and/or density of biota. The mapping represents a 'best-fit' of linear boundaries to natural features, which in some cases may show a gradual transition from one feature to another or are constantly varying over time. The mapping therefore represents the distribution of habitats at the time the aerial photography and underwater video was collected and is a baseline against which future changes can be compared.		
Eastern Minor Inlet Seagrass Distribution	Anderson Inlet, Shallow Inlet, Sydenham Inlet, Tamboon	**Positional Accuracy**: Precision:Horizontal accuracy of 5m to	This layer contains polygons	Parks Victoria

	Inlet, Wingan Inlet and Mallacoota Inlet	10m. **Vertical Accuracy**: NA Attribute Accuracy: Attributes have been verified by MAFRI.	definingthe spatial extent, species distribution and density of seagrass meadows within Victoria's minor inlets east of Western Port.	
GL_SEAGSS_97G	Gippsland Lakes, Lake Tyers	**Positional Accuracy:** Precision:Horizontal accuracy of 5-10 m. Vertical accuracy NA Determination:Digital: Any departure between the digital and source material (measured between centrelines) will not exceed 1 mm at the map scale of 1:25,000. **Attribute Accuracy:** There has been no assessment of attribute accuracy.	This layer presents the spatial extent, species distribution and density of seagrass/submerged aquatic vegetation at Gippsland Lakes mapped from 1997 aerial photography and field observations.	David Ball DPI PO Box 114 Queenscliff Victoria 3225
HICKS_HAB	Point Hicks Marine National Park	**Positional Accuracy**: The IKONOS imagery was supplied in a geo-corrected format with a positional accuracy of approximately 15 m, excluding the effects of terrain (Space Imaging 2004). We used Imagine OrthoBase to ortho-rectify this imagery with its rational polynomial coefficient (rpc) file and a DEM derived from the Vicmap topographic data. We used the position of the Point Hicks lighthouse, roads and other buildings identified from Vicmap layers to identify ground-control points to further improve the positional accuracy of the ortho-rectification to be approximately 5–10 m. We used the ortho-rectified Ikonos image	Shallow marine habitat mapping at Point Hicks Marine National Park by PIRVic Marine and Freshwater Systems from aerial photography and underwater video.	David Ball DPI PO Box 114 Queenscliff Victoria 3225

		as a base map to ortho-rectify the 2004 aerial photography. RMS error (Root Mean Square) denotes the difference between an output location for a GCP and the real coordinates for the same point when the point is transformed. The RMS error is expressed in the image's pixel size. The ortho-rectification of the 2004 photography using the Ikonos imagery as a base map had an average RMS error of 5.8 with a pixel size of 0.3 m. **Attribute Accuracy**: The classification scheme primarily differentiates between reef and sediment and these habitats typically presented very different pixel values (colour and texture) in the photography raster images. The comparison of the initial habitat classifications from the manual digitising with the underwater video showed a high degree of accuracy in differentiating reef from sediment (typically >90% accuracy). The mapping represents the distribution of habitats at the time the aerial photography and underwater video was collected and is a baseline against which future changes can be compared.		
HOWE_HAB	Cape Howe Marine National Park	**Positional Accuracy:** The IKONOS imagery was supplied in a geo-corrected format with a positional accuracy of approximately 15 m, excluding the effects of terrain (Space Imaging 2004). There were no identifiable ground-control points for this area in either the Vicmap or cadastral GIS data which prevented us from improving the positional accuracy of the IKONOS imagery. The aerial photography was orthorectified against the IKONOS imagery and as a result the positional accuracy of mapping at this site is lower	Shallow marine habitat mapping at Cape Howe Marine National Park by PIRVic Marine and Freshwater Systems from aerial photography and underwater video.	David Ball, PIRVic Marine and Freshwater Systems

		than other sites in this study where accurate ground control points were available. We used the ortho-rectified Ikonos image as a base map to ortho-rectify the 2004 aerial photography. RMS error (Root Mean Square) denotes the difference between an output location for a GCP and the real coordinates for the same point when the point is transformed. The RMS error is expressed in the image's pixel size. The ortho-rectification of the 2004 photography using the Ikonos imagery as a base map had an average RMS error of 2.8 with a pixel size of 0.3 m. **Attribute Accuracy:** Ball et al. (2006) adopted a two-stage approach to marine habitat classification whereby a primary habitat classification scheme was used to classify observations from the underwater video and a reduced set of modifiers was used to classify the habitats mapped from the aerial photography in the GIS. The GIS mapping classification scheme consisted of a hierarchy with two levels of modifiers. The first level (substratum type) was consistent with the primary habitat classification table. The second level (substratum/biota category) was divided into intertidal and subtidal habitats and featured elements of the substratum category and texture for reef and dominant biota for sediments from the primary classification table. The habitat polygons mapped from the aerial photography in this layer were only classified according to these modifiers. The habitat polygons could be further classified in the future through the use of acoustic mapping systems and additional		

		ground-truthing to include all levels of the primary habitat classification table. The classification scheme primarily differentiated between reef and sediment and these habitats typically presented very different pixel values (colour and texture) in the photography raster images. The comparison of the initial habitat classifications from the manual digitising with the underwater video showed a high degree of accuracy in differentiating reef from sediment (typically >90% accuracy). It should be noted that marine habitats are highly dynamic and some habitat boundaries and characteristics are constantly changing due to influences such as erosion and accretion of sediments, wave erosion of rocky reefs and variation in distribution and/or density of biota. The mapping represents a 'best-fit' of linear boundaries to natural features, which in some cases may show a gradual transition from one feature to another or are constantly varying over time. The mapping therefore represents the distribution of habitats at the time the aerial photography and underwater video was collected and is a baseline against which future changes can be compared.		
LONSDALE_HAB	Port Phillip Heads Marine National Park - Point Lonsdale	Positional Accuracy: QASCO orthorectified the 1997 and 2004 aerial photography for Point Lonsdale using ground-control points (GCPs) derived from the Vicmap Transport and Property layers. The DEM was created from the Vicmap Elevation layer. RMS error (Root Mean Square) denotes the difference between an output location for a GCP and the real coordinates for the	Shallow marine habitat mapping at Port Phillip Heads Marine National Park - Point Lonsdale by PIRVic Marine and Freshwater Systems from aerial photography and	David Ball DPI PO Box 114 Queenscliff Victoria 3225

		same point when the point is transformed. The RMS error is expressed in the image's pixel size. The ortho-rectification of the 1997 photography had an average RMS error of 5.1 with a pixel size of 0.4 m, and the 2004 photography had an average RMS error of 7.6 with a pixel size 0.6 m. **Attribute Accuracy**: The classification scheme primarily differentiates between reef and sediment and these habitats typically presented very different pixel values (colour and texture) in the photography raster images. The comparison of the initial habitat classifications from the manual digitising with the underwater video showed a high degree of accuracy in differentiating reef from sediment (typically >90% accuracy). The mapping represents the distribution of habitats at the time the aerial photography and underwater video was collected and is a baseline against which future changes can be compared.	underwater video.	
MARENGO_HAB	Marengo Reefs Marine Sanctuary	**Positional Accuracy**: The digital ortho-rectified aerial photography for Marengo Reefs MS flown by AEROmetrex Pty Ltd on 1st November 2004 and used in the marine habitat mapping had a positional accuracy of +/- 4 m. **Attribute Accuracy**: Ball et al. (2006) adopted a two-stage approach to marine habitat classification whereby a primary habitat classification scheme was used to classify observations from the underwater video and a reduced set of modifiers was used to classify the habitats mapped from the aerial	Shallow marine habitat mapping at Marengo Reefs Marine Sanctuary by PIRVic Marine and Freshwater Systems from aerial photography and underwater video.	David Ball DPI PO Box 114 Queenscliff Victoria 3225

		photography in the GIS. The GIS mapping classification scheme consisted of a hierarchy with two levels of modifiers. The first level (substratum type) was consistent with the primary habitat classification table. The second level (substratum/biota category) was divided into intertidal and subtidal habitats and featured elements of the substratum category and texture for reef and dominant biota for sediments from the primary classification table. The habitat polygons mapped from the aerial photography in this layer were only classified according to these modifiers. The habitat polygons could be further classified in the future through the use of acoustic mapping systems and additional ground-truthing to include all levels of the primary habitat classification table. The comparison of the initial habitat classifications from the unsupervised classification process with the underwater video showed a high degree of accuracy in differentiating reef from sediment (typically >90% accuracy). The aerial photography for Marengo Reefs MS had excellent visibility for marine mapping. Despite the relatively calm conditions on the day of the photography, a small area of the seabed around the exposed coast on the outer island was obscured by small breaking waves It should be noted that marine habitats are highly dynamic and some habitat boundaries and characteristics are constantly changing due to influences such as erosion and accretion of sediments, wave erosion of rocky reefs and variation in distribution and/or density		

		of biota. The mapping represents a 'best-fit' of linear boundaries to natural features, which in some cases may show a gradual transition from one feature to another or are constantly varying over time. The mapping therefore represents the distribution of habitats at the time the aerial photography and underwater video was collected and is a baseline against which future changes can be compared.		
MERRI_HAB	Merri Marine Sanctuary	**Positional Accuracy:** The digital ortho-rectified aerial photography for Merri MS flown by QASCO Pty Ltd on 1st December 2004 and used in the marine habitat mapping had a positional accuracy of +/- 4 m. **Attribute Accuracy:** Ball et al. (2006) adopted a two-stage approach to marine habitat classification whereby a primary habitat classification scheme was used to classify observations from underwater video and a reduced set of modifiers was used to classify the habitats mapped from the aerial photography in the GIS. The GIS mapping classification scheme consisted of a hierarchy with two levels of modifiers. The first level (substratum type) was consistent with the primary habitat classification table. The second level (substratum/biota category) was divided into intertidal and subtidal habitats and featured elements of the substratum category and texture for reef and dominant biota for sediments from the primary classification table. The habitat polygons mapped from the aerial photography in this layer were only classified according to these modifiers.	Shallow marine habitat mapping at Merri Marine Sanctuary by PIRVic Marine and Freshwater Systems from aerial photography.	David Ball DPI PO Box 114 Queenscliff Victoria 3225

		The habitat polygons could be further classified in the future through the use of acoustic mapping systems and additional ground-truthing to include all levels of the primary habitat classification table. The classification scheme primarily differentiated between reef and sediment and these habitats typically presented very different pixel values (colour and texture) in the photography raster images. We did not have underwater video for this site to ground-truth the habitat classification from the aerial photography. However, comparison of the mapping of reef habitat from aerial photography with underwater video at the other MNP and MS sites showed a high degree of accuracy in differentiating reef from sediment (typically >90% accuracy). It should be noted that marine habitats are highly dynamic and some habitat boundaries and characteristics are constantly changing due to influences such as erosion and accretion of sediments, wave erosion of rocky reefs and variation in distribution and/or density of biota. The mapping represents a 'best-fit' of linear boundaries to natural features, which in some cases may show a gradual transition from one feature to another or are constantly varying over time. The mapping therefore represents the distribution of habitats at the time the aerial photography and underwater video was collected and is a baseline against which future changes can be compared.		
MUSHROOM_HAB	Mushroom Reef Marine Sanctuary	**Positional Accuracy**: QASCO orthorectified the aerial	Shallow marine habitat mapping at Mushroom Reef	David Ball

		photography using ground-control points (GCPs) derived from the Vicmap Transport and Property layers. The DEM was created from the Vicmap Elevation layer. RMS error (Root Mean Square) denotes the difference between an output location for a GCP and the real coordinates for the same point when the point is transformed. The RMS error is expressed in the image's pixel size. The ortho-rectification of the 1998 photography had an average RMS error of 8.8 with a pixel size of 0.27 m, and the 2004 photography had an average RMS error of 15.9 with a pixel size 0.6 m. **Attribute Accuracy**: The classification scheme primarily differentiates between reef and sediment and these habitats typically present very different pixel values (colour and texture) in the photography raster images. The comparison of the initial habitat classifications from the unsupervised classification process with the underwater video showed a high degree of accuracy in differentiating reef from sediment and seagrass from bare sediment (typically >90% accuracy). The mapping represents the distribution of habitats at the time the aerial photography and underwater video was collected and is a baseline against which future changes can be compared.	Marine Sanctuary by PIRVic Marine and Freshwater Systems from aerial photography and underwater video.	DPI PO Box 114 Queenscliff Victoria 3225
NEPEAN_HAB	Port Phillip Heads Marine National Park - Point Nepean	**Positional Accuracy**: The 2003 aerial photography was sourced from Hydro Tasmania and was provided as an ortho-	Shallow marine habitat mapping at Port Phillip Heads Marine National Park - Point Nepean by PIRVic Marine and Freshwater Systems from	David Ball DPI PO Box 114 Queenscliff

		rectified digital mosaic. The metadata provided with the 2003 aerial photography states that the Orthophoto TriangulationResiduals include: Easting: 0.95 m, Northing: 0.975 m, Elevation: 1.1 m. The ground sample distance was 0.15 m and ground control locations identified to +/- 1 pixel (pixel size 0.2 m). Intended Scale of the ortho-rectified photography was 1:1,500. PIRvic orthorectified the 2000 and 2001 aerial photography using ground-control points identified from the 2003 Hydro Tasmania photography and a DEM also created by Hydro Tasmania. RMS error (Root Mean Square) denotes the difference between an output location for a GCP and the real coordinates for the same point when the point is transformed. The RMS error is expressed in the image's pixel size. The ortho-rectification of the 2000 photography had an average RMS error of < 5 with a pixel size of 0.4 m, and the 2001 photography had an average RMS error of 3.8 with a pixel size 0.35 m. **Attribute Accuracy**: The classification scheme primarily differentiates between reef and sediment and these habitats typically presented very different pixel values (colour and texture) in the photography raster images. The comparison of the initial habitat classifications from the manual digitising with the underwater video showed a high degree of accuracy in differentiating reef from sediment (typically >90% accuracy). The mapping represents the distribution of habitats at the time the aerial	aerial photography and underwater video.	Victoria 3225

		photography and underwater video was collected and is a baseline against which future changes can be compared.		
Point Addis General Biota Map	Point Addis MNP	**Positional accuracy** is dependent on hydroacoustic survey accuracy (average +/- 3 m), and tow video locational accuracy (maximum of +/- 5 m) **Attribute accuracy** is dependent on modelling accuracy - please refer to the Habitat Mapping Technical Report.	This grid shows the distribution of the basic categories identifiable from tow video for Biota classes at Point Addis, assembled from modelled binary grids.	Parks Victoria
Point Addis General Substrate Map, Smoothed	Point Addis MNP	**Positional accuracy** is dependent on hydroacoustic survey accuracy (average +/- 3 m), and tow video locational accuracy (maximum of +/- 5 m) **Attribute accuracy** is dependent on modelling accuracy - please refer to the Habitat Mapping Technical Report.	This grid shows the distribution of the basic categories identifiable from tow video for Substrate at Point Addis, assembled from modelled binary grids and smoothed by assigning the marjority cell value in a 10-m radius circle.	Parks Victoria
Point Hicks General Biota Map, Smoothed	Point Hicks MNP	**Positional accuracy** is dependent on hydroacoustic survey accuracy (average +/- 3 m), and tow video locational accuracy (maximum of +/- 5 m) **Attribute accuracy** is dependent on modelling accuracy and errors compounded from combining multiple modelled surfaces- please refer to the Habitat Mapping Technical Report.	This grid shows the distribution of the basic categories identifiable from tow video for Biota at Point Hicks, assembled from modelled binary grids and smoothed by assigning the marjority cell value in a 10-m radius circle.	Parks Victoria
Point Hicks General Substrate Map, Smoothed	Point Hicks MNP	**Positional accuracy** is dependent on hydroacoustic survey accuracy (average +/- 3 m), and tow video locational accuracy (maximum of +/- 5 m) **Attribute accuracy** is dependent on modelling accuracy and errors compounded from combining multiple modelled surfaces- please refer to the Habitat Mapping Technical Report.	This grid shows the distribution of the basic categories identifiable from tow video for Substrate at Point Hicks, assembled from modelled binary grids and smoothed by assigning the marjority cell value in a 10-m radius circle.	Parks Victoria

Port Phillip Bay Seagrass	Port Phillip	**Positional Accuracy**: Precision: Horizontal accuracy of 5 to 10 m. Vertical accuracy NA **Attribute Accuracy**: Attributes were verified by MAFRI.	PP_SGRASS2000 is a polygon layer defining the spatial extent, species distribution and density of seagrass and macroalgae within Port Phillip Bay mapped from aerial photography in 2000.	David Ball DPI PO Box 114 Queenscliff Victoria 3225
SEAGRASS25	Anderson Inlet, Shallow Inlet, Sydenham Inlet, Tamboon Inlet, Wingan Inlet and Mallacoota Inlet	**Positional Accuracy:** Precision: Vertical accuracy NA **Attribute Accuracy:** Attributes have been verified by MAFRI.	This layer contains polygons defining the spatial extent, species distribution and density of seagrass meadows within Victoria's minor inlets east of Western Port.	David Ball MAFRI, Weeroona Parade, Queenscliff 3225
Seagrass at Corner Inlet and Nooramunga	Corner Inlet and Nooramunga	**Positional Accuracy**: Precision:Horizontal accuracy of 5 - 10m. Vertical accuracy NA Determination: Digital: Any departure between the digital and source material (measured between centrelines) will not exceed 1mm at the map scale of 1:25,000. **Attribute Accuracy**: There has been no assessment of attribute accuracy.	This layer presents the spatial extent, species distribution and density of seagrass meadows at Corner Inlet and Nooramunga mapped from 1998 aerial photography and field observations.	David Ball DPI PO Box 114 Queenscliff Victoria 3225
Twelve Apostles General Biota Map, Smoothed	Twelve Apostles MNP	**Positional accuracy** is dependent on hydroacoustic survey accuracy (average +/- 3 m), and tow video locational accuracy (maximum of +/- 5 m) **Attribute accuracy** is dependent on	This grid shows the distribution of the basic categories identifiable from tow video for Biota at Twelve Apostles,	Parks Victoria

		modelling accuracy and errors compounded from combining multiple modelled surfaces- please refer to the Habitat Mapping Technical Report.	assembled from modelled binary grids and smoothed by assigning the marjority cell value in a 10-m radius circle.	
Twelve Apostles General Substrate Map, Smoothed	Twelve Apostles MNP	**Positional accuracy** is dependent on hydroacoustic survey accuracy (average +/- 3 m), and tow video locational accuracy (maximum of +/- 5 m) **Attribute accuracy** is dependent on modelling accuracy and errors compounded from combining multiple modelled surfaces- please refer to the Habitat Mapping Technical Report.	This grid shows the distribution of the basic categories identifiable from tow video for Substrate at Twelve Apostles, assembled from modelled binary grids and smoothed by assigning the marjority cell value in a 10-m radius circle.	Parks Victoria
UWA_2006(1)	Cape Howe MNP, Discovery Bay MNP, Point Addis MNP, Point Hicks MNP, Twelve Apostles MNP, Wilson’s Promontory MNP	**Positional accuracy** is dependent on hydroacoustic survey accuracy (average +/- 3 m), and tow video locational accuracy (maximum of +/- 5 m) **Attribute accuracy** is dependent on modelling accuracy and errors compounded from combining multiple modelled surfaces- please refer to the Habitat Mapping Technical Report.	A collection of datasets showing the distribution of macroalgae, ascidians, boulders, broken reef, sand, reef, sessile invertebrates, gravel, sea whips and sediments. Datasets have been developed from either towed video, multibeam, hydroacoustics or modeled data.	Parks Victoria
Victorian Wetland Environments and Extent - up to 1994 (WETLAND_1994/WET1994)	Victoria	**Positional Accuracy:** Precision:10m to 100m Determination: Deductive estimate. Ad-hoc comparisons with 1:25,000 layer data and various sorts of imagery indicated good correlation in terms of shape and size but with errors of the order indicated above in terms of position and/or rotation. When resources permit, the 1:25,000 library hydrology and roads layers should be	Polygons showing the extent and types of wetlands in Victoria based on photography taken during the 1970's and 80's. Wetlands are classified into primary categories based on water regimes and subdivided into sub areas based on vegetation or hydrologic	Department of Sustainability and Environment mark.o'brien@dse.vic.gov.au PO Box 500 East Melbourne Victoria 3002 (03) 8636 2385

		used to identify layer inconsistencies which may indicate specific wetlands which require translation, rotation or boundary modifications. **Attribute Accuracy:** The classification scheme used is based on photo interpretation and ground surveys carried out by Departmental research staff under the direction of research scientist Andrew Corrick	attributes. The polygon boundaries were derived from digitizing marked up aerial photography interpretation.	
Western Port Seagrass Distribution	Western Port	**Positional Accuracy**: Precision: Horizontal accuracy of 5 to 10 m. Vertical accuracy NA **Attribute Accuracy**: Attributes were verified by MAFRI.	WP_SGRASS99 is a polygon layer defining the spatial extent, species distribution and density of seagrass and macroalgae in Western Port mapped from aerial photography in 1999.	David Ball DPI PO Box 114 Queenscliff Victoria 3225

3.7. Western Australia

Data Set	Extent	Accuracy	Details	Further contact
Major Marine Habitats of Ningaloo Reef Area	Ningaloo IMCRA region	**Positional accuracy**: The rectified Landsat image used as a base to digitise the habitat boundaries is generally considered accurate to within 4 pixels or better. This equates to a positional accuracy of linework of +- 100 metres. Linework was digitised at scale 1:30 000 or better. While every effort was made to digitise	This dataset consists of polygons detailing the major marine habitats of WA's Ningaloo reef area and covers the offshore waters of approximately 370 kilometers of coastline from Red Bluff to Exmouth. Broad scale habitats extend from the shoreline to the boundary of the Ningaloo Marine Park over the northern part of the dataset, and from the shoreline to	Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160

		the datasets accurately, the large pixel size (25 m) of the Landsat image, and the resultant spectral response, sometimes made it difficult to interpret corresponding locations on aerial photography and Landsat image. Some positional in-accuracies may have resulted, however these are estimated to be in-frequent. Since this work was undertaken, high quality digital ortho-rectified aerial photography has become available over much of the area. The habitat mapping should be reviewed using this photography to provide significantly improved positional accuracy of habitat boundaries. **Attribute accuracy**: The classification system used for this project is broad scale only, and designed for interpretation at regional scales of 1:100 000. The development of the standard broad scale habitat classification system on a statewide basis is a large and ongoing task. This system is close to a robust system, but will be refined and improved as anomalies arise that warrant modification to the system. Several habitat polygons need further ground-truth work due to the potential for mis-interpretation from aerial photography as a result of using hard copy, unrectified photography and attempting to visually align this with 25m pixel satellite imagery. These are identified within a Processing dataset (see hab2_poly) in the field GT_NEEDED. Some polygons were difficult to attribute using the aerial photography, and the current knowledge and ground-truthing of the area. An interpretation of the marine habitat has been made on these polygons based on expert knowledge of marine biologists. This interpretation will remain	the Limit of Coastal Waters of the State over the southern extension to the Ningaloo Marine Park. The dataset is complemented by a linework dataset detailing shoreline habitats of the Ningaloo reef area. Habitats are identified at a broad scale only and are suitable for regional analysis and representation at 1:50 000. Habitats were delineated on a rectified Landsat 5 TM base using hard copy aerial photographs as a guide. Habitats were attributed using a combination of aerial photography, expert knowledge, and ground-truthing from several field trips. The original dataset was compiled by Mark Sheridan under direction from Ray Lawrie. The habitat classification system was developed by Dr Chris Simpson and Kevin Bancroft. Habitat attribution was undertaken by Kevin Bancroft. The project was undertaken in November 1999 - January 2000. Further refinement of the original dataset was carried out by Oliver Looker, under direction from Ray Lawrie, with additional habitat determination from Kevin Bancroft and Jennie Cary. This refinement was undertaken in April - May 2000. The dataset was further upgraded in June 2005.	

		until further work verifies otherwise. Since this work was undertaken, high quality digital ortho-rectified aerial photography has become available over much of the area. The habitat mapping should be reviewed using this photography to provide significantly improved accuracy of habitat interpretation.		
Major Marine Habitats of the Cape Preston/Dampier Archipelago/Cape Lambert Area	Pilbara (nearshore) IMCRA region	**Positional accuracy**: Habitats are identified at a broad scale only and are suitable for regional analysis and representation. The spatial accuracy varies across the dataset depending on the accuracy of the source dataset used in a particular area. Ideally orthorectified digital aerial photography would be used as a base on which to assess positional accuracy, however this was not available over the full extent of the study area. Further metadata was requested with supplied datasets, but was not readily available. Data suppliers informed us that information existed in several reports which would have to be located and interrogated for relevant metadata. Even then it would be difficult attaching each dataset to the detail in a particular report. Thus to acquire metadata as per the ANZLIC standard would require substantial work and resources. Due to the absence of detailed metadata, source data could not be assessed for spatial accuracy based on the methodology used to collect the data. Source dataset ground-truthing point data and a description of how this was collected was not available. Details of the backdrop used to delineate the boundaries of the source data habitat was also not available. As such, data processing had to proceed in the absence	This dataset consists of polygons detailing the major marine habitats of WA's Cape Preston/Dampier Archipelago/Cape Lambert area. This dataset was developed to assist in the planning process for the implementation of a proposed Dampier Archipelago/Cape Preston marine reserve. Habitats are identified at a broad scale only and are suitable for regional analysis and representation.	Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160

		of this information. Additional linework was added to the unioned dataset from a variety of reference sources, particularly for CALM interpolated habitats. Reference datasets were used based on the most accurate, or only available relevant data, and include bathymetry data from Dept of Transport and Apache Energy, coastline data from Dept of Land Administration (DOLA), cadastre data from DOLA, pipeline data from Dept of Minerals and Energy, hydrographic chart data from the Australian Hydrographic Office, digital satellite imagery from DOLA, and hard copy aerial photography from DOLA. Reference datasets were used by either incorporating original linework into the unioned dataset, or digitising linework using the source dataset as a guide. Linework was digitised at scale 1:30 000 or better. The spatial accuracy of these reference datasets varies both between and within these datasets. Detailed accuracy information is not readily available with most datasets. Available information on spatial accuracies is detailed below; - the Landsat imagery is generally considered accurate to within 4 pixels or better, i.e +- 100 metres. Major work still needs to be undertaken to align the data with the DOLA coast. This is particularly relevant to nearshore habitats, eg mangrove, salt marsh, beach, mudflat habitats. The DOLA coast high water mark, mean high water mark, and low water mark will be a useful surrogate for improving the spatial accuracy of the delineation of these habitats. **Attribute accuracy**: The classification system used for this		

		project is broad scale only, and designed for interpretation at regional scales. The development of the standard broad scale habitat classification system on a statewide basis is a large and ongoing task. This system is being developed to facilitate a more systematic and standardised approach to marine habitat classification and will be refined and improved as anomolies arise that warrant modification to the system. Due to the absence of detailed metadata, source data could not be assessed for attribute accuracy based on the methodology used to collect the data. The ground-truthing point data and a description of how this was collected was not available. As such, data processing had to proceed in its absence. It was thus assumed that attribute classification was correct. For every polygon in the unioned dataset, there were up to four habitat attributes. As part of the prioritising process, source data layers were assessed for their habitat attribute accuracy, and the priority layer moved into the group of primary attributes. Attribute accuracy of habitat polygons could potentially be affected by a shift in positional location in the source dataset. This was taken into account (where possible) by visual inspection and identification of corresponding habitat shapes on aerial photography/Landsat imagery. While every effort was made to accurately attribute habitat polygons, a balance had to be maintained between achieving accuracy on a regional scale (versus a local scale) and the time available to produce this dataset. Some polygons were difficult to attribute accurately using		

		the available data, aerial photography, and the current knowledge and ground-truthing of the area. In these cases, habitat boundary delineation was modelled based on either linear interpolation between points of known habitat type, or field verified bathymetric modelling. See Bancroft et al., (2000) for further details. This interpretation will remain until further field work verifies otherwise. The delineation between habitats is shown by abrupt changes in habitat classification. In reality some changes are more often a gradual transition from one habitat to another. As a result the location of some habitat boundaries should be considered as approximate only. These habitats include many of the extensive deeper subtidal (>10m depth) and nearshore subtidal habitats which were difficult to distinguish with remotely sensed information. In addition, relatively limited ground-truthing data has been used in determining these habitats due to their extensive area. See Bancroft et al., (2000) for further details.		
Major Marine Habitats of the Montebello/Lowendal/Barrow Island's Area	Pilbara (offshore) IMCRA region	**Positional accuracy**: Additional linework was added to the unioned dataset from a variety of reference sources, particularly for CALM interpolated habitats. Reference datasets were used based on the most accurate, or only available relevant data, and include bathymetry data from Dept of Transport and Apache Energy, coastline data from Dept of Land Administration (DOLA) and Apache Energy, habitat data from Australian Petroleum Production and Exploration Association Ltd (APPEA), digital satellite imagery from DOLA, hard copy aerial photography from DOLA, and	This dataset consists of polygons detailing the major marine habitats of WA's Montebello/Lowendal/Barrow Island's area. The dataset is complemented by a linework dataset detailing onshore coastline habitats of the same area (hab_montes_onshoreddmmyyyy_amg50_agd84). These datasets were developed to assist in the planning process for the implementation of a proposed Montebello/Barrow Island marine reserve. Habitats are identified at a broad scale only and are suitable for	Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160

		digital multi-spectral video(DMSV) data from Apache Energy. Reference datasets were used by either incorporating original linework into the unioned dataset, or digitising linework using the source dataset as a guide (see the field SOURCE_D* in the dataset for details). Linework was digitised at scale 1:30 000 or better. The spatial accuracy of these reference datasets varies both between and within these datasets. Detailed accuracy information is not readily available with most datasets. Available information on spatial accuracies is detailed below; - the Landsat imagery is generally considered accurate to within 4 pixels or better, i.e +- 100 metres. Attribute accuracy: The classification system used for this project is broad scale only, and designed for interpretation at regional scales. The development of the standard broad scale habitat classification system on a statewide basis is a large and ongoing task. This system is being developed to facilitate a more systematic and standardised approach to marine habitat classification and will be refined and improved as anomolies arise that warrant modification to the system. Specific sub-categories are being developed to provide the appropriate level of detail required for the marine reserve planning process. Due to the absence of detailed metadata, source datasets could not be assessed for attribute accuracy based on the methodology used to collect the data. The ground-truthing point data for these datasets, and a description of how this was collected was not available. As such, data processing had to proceed in its	regional analysis and representation.	

		absence. It was thus assumed that attribute classification was correct. For every polygon in the unioned dataset, there were up to four habitat attributes. As part of the prioritising process, source data layers were assessed for their habitat attribute accuracy, and the priority layer moved into the group of primary attributes. The source dataset from which every individual polygon was derived is detailed in the field SOURCE_D* in the dataset. When a new line was added to the data, the details of how it was derived are also detailed in the field SOURCE_D*. Attribute accuracy of habitat polygons could potentially be affected by a shift in positional location in the source dataset. This was taken into account (where possible) by visual inspection and identification of corresponding habitat shapes on aerial photography/Landsat imagery. While every effort was made to accurately attribute habitat polygons, a balance had to be maintained between achieving accuracy on a regional scale (versus a local scale) and the time available to produce this dataset. Some polygons were difficult to attribute accurately using the available data, aerial photography, and the current knowledge and ground-truthing of the area. In these cases, habitat boundary delineation was modelled based on either linear interpolation between points of known habitat type, or field verified bathymetric modelling. See Bancroft et al., (2000) for further details. This interpretation will remain until further field work verifies otherwise. The delineation between habitats is shown by abrupt changes in habitat		

		classification. In reality some changes are more often a gradual transition from one habitat to another. As a result the location of some habitat boundaries should be considered as approximate only. These habitats include many of the extensive deeper subtidal (>10m depth) and nearshore subtidal habitats which were difficult to distinguish with remotely sensed information. In addition, relatively limited ground-truthing data has been used in determining these habitats due to their extensive area. See Bancroft et al., (2000) for further details.		
Marine Benthic Habitats of the Jurien Bay Marine Park	Central West Coast (CWC) IMCRA Region	**Positional Accuracy**: The broad scale habitats for Beagle Islands to Two Rocks were digitised using 1:20000 aerial photos and a TM image (30m pixel). The TM image was processed by RSAC and is derived from 113-081 and 113-082 collected 19901115. Spatial accuracy of 50m. The original survey initially utilised a hardcopy of the TM image that had poorer resolution than on screen. Given the regional nature of the field work undertaken, use of the data at a local scale should be undertaken with caution. **Attribute Accuracy**: Marine habitats by their very nature are dynamic and subject to change due to natural and man-made forces, as such, the classification of habitats were attributed as at the time of the Further ground-truthing would need to be undertaken to determine habitats with greater accuracy. Application of the MCB classifaction scheme difficult due to lack of profile information for the habitat areas. Given the regional nature of the field work	This dataset consists of polygons detailing the marine benthic habitats of WA's Jurien Bay Marine Park at a regional scale. The data covers WA's Coastal Waters between Knobby Head and Two Rocks and is from two sources, Marine Conservation Branch field surveys and BSD, that meet at Wedge Island. The habitats are classified as Intertidal Reef, Sand, Seagrass (dense or medium), Subtidal Reef, Subtidal Reef (macroalgae dominated) and Subtidal Reef Pavement / Sand.	Department of Conservation and Land Management, Marine Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160

		undertaken, use of the data at a local scale should be undertaken with caution.		
Marine Benthic Habitats of the Marmion Marine Park	Marmion Marine Park, Perth, Western Australia Central West Coast (CWC) IMCRA region	**Positional Accuracy**: Habitat extents were delineated using automated techniques developed by the Dept. of Agriculture, Dept. of Transport and DOLA's Remote Sensing Application Centre and have not undergone field verification. As such the positional accuracy of the dataset can only be described as approximate until ground-truthing has been undertaken. **Attribute Accuracy**: Marine habitats by their very nature are dynamic and subject to change due to natural and man-made forces, as such, the classification of habitats were attributed as at the time of the Geoscan imagery (Feb 1993) and digital orthophotos (Jan 2001).	This dataset consists of polygons detailing the marine benthic habitats of Perth's Marmion Marine Park and was developed from the Geoscan habitat classification made by Alex Wiley and Associates. It has not yet undergone field verification. Hardcopy maps were generated containing the geoscan habitat classification, bathymetry and coastline. The hardcopy maps were then updated by Kevin Bancroft and the digital dataset modified by Ben Lamb in June 2002 using Arcview 3.2.	Department of Conservation and Land Management, Marine Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160
Marine Benthic Habitats of the Rowley Shoals Marine Park and Mermaid Reef National Marine Nature Reserve	WA's Rowley Shoals Marine Park (Clerke and Imerpieuse Reefs) and Mermaid Reef National Marine Nature Reserve.	**Positional Accuracy**: Habitat extents were delineated as accurately as is possible to determine from digital orthophotos (3/7/1996) and hardcopy water penetration aerial photography (4/7/96). The accuracy of the orthophotos is stated as being within 2-4m and as such the overall accuracy could not be better than this. Further ground-truthing would need to be undertaken to determine them with greater accuracy. Attribute Accuracy: Marine habitats by their very nature are dynamic and subject to change due to natural and man-made forces, as such, the classification of habitats were attributed as at the time of the orthophotos (3/7/1996), hardcopy water penetration aerial photography (4/7/96) and field surveys (Sept/Oct 1996 and Oct 2001). Further ground-truthing would	This dataset consists of polygons detailing the marine benthic habitats of WA's Rowley Shoals Marine Park (Clerke and Imerpieuse Reefs) and Mermaid Reef National Marine Nature Reserve.	Department of Conservation and Land Management, Marine Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160

		need to be undertaken to determine habitats with greater accuracy.		
Marine Benthic Habitats of the Shark Bay Region	Shark Bay and Zuytdorp IMCRA regions	**Positional Accuracy**: Habitat extents were delineated as accurately as is possible to determine from landsat imagery, unrectified aerial photography and field survey results. Further ground-truthing would need to be undertaken to determine them with greater accuracy. **Attribute Accuracy**: Marine habitats by their very nature are dynamic and subject to change due to natural and man-made forces, as such, the classification of habitats were attributed as at the time of the landsat imagery (1992) and subsequent field surveys	This dataset consists of polygons detailing the marine benthic habitats of WA's Shark Bay region and was developed from the existing habitat dataset based on ground truthing from several surveys.	Department of Conservation and Land Management, Marine Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160
Marine Benthic Habitats of the Shoalwater Islands Marine Park	Shoalwater Islands Marine Park, Perth, Western Australia Leeuwin-Naturaliste (LNE) IMCRA region	**Positional Accuracy**: Habitat extents were delineated using automated techniques developed by the Dept. of Agriculture, Dept. of Transport and DOLA's Remote Sensing Application Centre, Cell size 10 metre 10 metre, and have not undergone field verification. As such the positional accuracy of the dataset can only be described as approximate until ground-truthing has been undertaken. Furthermore : Rectification checked by CALM MCB against DOLA coastline, rectified imagery and other known features. There are some positional discrepancies (up to approx 100 metres, more than the 10m-30m accuracy error quoted) existing in the data. The islands seem to line up quite well however. The dataset needs to be rectified further before analysis in relation to other datasets. **Attribute Accuracy**:	This dataset consists of polygons detailing the marine benthic habitats of Perth's Shoalwater Islands Marine Park and was developed from the Geoscan habitat classification made by Alex Wiley and Associates. It has not yet undergone field verification.	Department of Conservation and Land Management, Marine Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160

		Marine habitats by their very nature are dynamic and subject to change due to natural and man-made forces, as such, the classification of habitats were attributed as at the time of the Geoscan imagery (Feb 1993) and digital orthophotos (Jan 2001).		
Marine Benthic Habitats of the Swan Estuary Marine Park	Swan Coastal Plain IBRA region	**Positional Accuracy**: Habitat extents were delineated as accurately as is possible to determine from the digital orthophoto mosaic. The accuracy of the orthophoto was stated by DOLA as being +/- 3m with a resolution of 0.4m. Further ground-truthing would need to be undertaken to determine them with greater accuracy.. **Attribute Accuracy**: Marine habitats by their very nature are dynamic and subject to change due to natural and man-made forces, as such, the classification of habitats were attributed as at the time of aerial photos (Dec 2001/Jan 2002).	This dataset consists of polygons detailing the marine benthic habitats of WA's Swan Estuary Marine Park. The habitat map covers the three areas of Pelican Point, Alfred Cove and Milyu which form the Swan Estuary Marine Park.	Department of Conservation and Land Management, Marine Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160
Marine Habitats of the Recherché Archipelago	WA South Coast (WSC) and Eucla (EUC) IMCRA regions	**Positional accuracy**: Habitat extents were delineated as accurately as is possible to determine from the available digital and hardcopy sources. Further Ground-truthing would need to be undertaken to determine them with greater accuracy **Attribute accuracy**: Classified as per habitat classification system held by CALMs Marine Conservation Branch -"draft as at time of capture"(See Additional Metadata).	This dataset consists of polygons detailing the offshore marine habitats of Southern Western Australia's Recherché Archipelago and covers an area extending from Stokes Inlet (121oE) eastward to Israelite Bay (124o15'E) and seawards to Western Australia's Coastal Waters boundary.	Department of Conservation and Land Management, Marine Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160
Onshore Coastline Habitats of Shark Bay Area	Shark Bay and Zuytdorp IMCRA regions	**Positional accuracy**: Habitats extents were delineated as accurately as is possible to determine from 1:50 000 scale aerial photography, and are estimated to be within 50 metres. Ground-truthing needs to be undertaken to determine them with greater accuracy. Accuracy of DOLA's coastline linework is	This dataset consists of linework detailing the onshore coastline habitats of WA's Shark Bay Marine Park and extensions and covers approximately 2324 kilometers of coastline extending from Carnarvon (24deg 30'S) around to Tamala (27deg S). Only 1077km (Bernier	Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160

		not stated. DOLA has compiled this dataset from a number of sources of best available information including 1:2 000, 1:50 000 and 1:100 000 scale datasets. These source datasets were collected at various levels of positional accuracy, and as such each individual line is as accurate as its source data. The source attribute in the shapefile identifies these sources. The DOLA coastline was modified in only a few small areas in order to generate a single continous polyline to represent the coastline. **Attribute accuracy**: Habitat classifications were determined visually from aerial photography, and while every effort has been made to assign these correctly, there may be some errors. The habitats are accurate as best determined at the time of aerial photography (29 June 1998). Coastlines by their very nature are dynamic and subject to change due to natural and man-made forces. This is particularly the case with the movement of sand up and down the coast, and as such beaches may form and dissappear with the passing of time.Ground-truthing needs to be undertaken to determine habitats with greater accuracy. - Beach widths were estimated from the aerial photography using a scaled adjustable magnifying glass. These widths are estimated to be accurate to within 5 metres. Ground-truthing needs to be undertaken to determine them with greater accuracy.	Island, Dorre Island, Dirk Hartog Island, Steep Point, Zuytdorp Cliffs, Bellefin Prong and other areas) of the total 2324 has been attributed with coastline habitat due to a lack of current aerial photography. The coastline is delineated into areas of Beach, Rocky intertidal, or Beach + Rocky intertidal and attributed accordingly (there are also small areas of Mangal, Mudflat and Salt marsh). Any habitats that could not be identified from the aerial photography have been attributed with an unknown until verification can be carried out to identify the habitat. Lines are further attributed with the direction the habitat is facing, habitat length (metres), beach width (maximum and average in metres). The base coastline linework was provided by DOLA. A source attribute has been added to each line based on DOLA's coastline source and/or method used to derive the coastline in any area. Habitats were identified from aerial photography. Beach widths were measured from the aerial photography using a scaled adjustable magnifying glass. Habitat facing directions were determined using an avenue script to compute a bearing from North. The dataset was compiled by Ben Lamb in January 2002.	
Onshore Coastline Habitats of the Shoalwater Islands	Leeuwin-Naturaliste (LNE) IMCRA region	**Positional accuracy**: Habitat extents were delineated as	This dataset consists of linework detailing the onshore coastline	Conservation Branch Marine GIS Co-

Marine Park		accurately as is possible to determine from the 0.4m resolution digital orthophoto mosaics. Ground-truthing needs to be undertaken to determine them with greater accuracy. Accuracy of DOLA's coastline linework is not stated. DOLA has compiled this dataset from a number of sources of best available information including 1:2 000, 1:50 000 and 1:100 000 scale datasets. These source datasets were collected at various levels of positional accuracy, and as such each individual line is as accurate as its source data. The source attribute in the shapefile identifies these sources. The DOLA coastline was modified in only a few small areas in order to generate a single continous polyline to represent the coastline or correct areas of gross deviation from the orthophotos. **Attribute accuracy**: Habitat classifications were determined visually from digital orthophoto mosaics, and while every effort has been made to assign these correctly, there may be some errors. The habitats are accurate as best determined at the time of aerial photography (January 2001) from which the orthophoto mosaics are derived. Coastlines by their very nature are dynamic and subject to change due to natural and man-made forces. This is particularly the case with the movement of sand up and down the coast, and as such beaches may form and dissappear with the passing of time.Ground-truthing needs to be undertaken to determine habitats with greater accuracy. - Beach widths were estimated from the orthophotos using Arcviews measure distance tool. These widths are estimated to be accurate to within 5 metres.	habitats of Western Australia's Shoalwater Islands Marine Park and covers approximately 33 kilometers of coastline extending from Mangles Bay, southward to Becher Point. The proposed extensions over Garden Island and Carnac Island have not yet been classified. The coastline is delineated into areas of beach, rocky shore, unclassified, groyne or beach + rocky shore and attributed accordingly. Lines are further attributed with the direction the habitat is facing, habitat length (metres), beach width (maximum and average in metres). The base coastline linework was provided by DOLA. A source attribute has been added to each line based on DOLA's coastline source and/or method used to derive the coastline in any area. Habitats were identified from digital orthophoto mosaics and unrectified digital aerial photography. Beach widths were measured from the digital orthophoto mosaics and digital aerial photography using the measure distance tool in Arcview. Habitat facing directions were determined by visually assessing the facing direction in conjunction with a transperancy of compass rose. The dataset was compiled by Ben Deeley in November 2001 and completed/modified by Ben Lamb in May 2002.	ordinator 47 Henry Street Fremantle WA 6160

		Ground-truthing needs to be undertaken to determine them with greater accuracy.		
Onshore Coastline Habitats of the Swan Estuary Marine Park	Swan Coastal Plain IBRA region	**Positional accuracy**: Habitat extents were delineated as accurately as is possible to determine from the digital orthophoto, and are estimated to be within ?? metres. Further Ground-truthing would need to be undertaken to determine them with greater accuracy. Accuracy of DOLA's coastline linework is not stated. DOLA has compiled this dataset from a number of sources of best available information including 1:2 000, 1:50 000 and 1:100 000 scale datasets. These source datasets were collected at various levels of positional accuracy, and as such each individual line is as accurate as its source data. The source attribute in the shapefile identifies these sources. **Attribute accuracy**: Habitat classifications were determined visually from aerial photography, and while every effort has been made to assign these correctly, there may be some errors. The habitats are accurate as best determined at the time of aerial photography (December 2001/January 2002). Coastlines by their very nature are dynamic and subject to change due to natural and man-made forces. This is particularly the case with the movement of sand up and down the coast, and as such beaches may form and disappear with the passing of time.Ground-truthing needs to be undertaken to determine habitats with greater accuracy. - Beach widths were estimated from the aerial photography using a scaled adjustable magnifying glass. These widths are estimated to be accurate to within 5 metres. Ground-truthing needs to	This dataset consists of linework detailing the onshore coastline habitats of WA's Swan Estuary Marine Park. The coastline is delineated into areas of Beach and Salt marsh. Lines are further attributed with the direction the habitat is facing, habitat length (metres), beach width (maximum and average in metres). The base coastline linework was provided by DOLA. A source attribute has been added to each line based on DOLA's coastline source and/or method used to derive the coastline in any area. Habitats were identified from a digital orthophoto mosaic. Beach widths were measured from the digital orthophoto mosaic using ArcView's measure tool. Habitat facing directions were determined using an avenue script to compute a bearing from North. The dataset was compiled by Ben Lamb in March 2002.	Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160

		be undertaken to determine them with greater accuracy.		
Regional Marine Benthic Habitat Mapping of the Geographe Bay/Capes Area	Leeuwin/Naturaliste (LNE) IMCRA Region	**Positional accuracy**: The rectified Landsat image used as a base to digitise the habitat boundaries is generally considered accurate to within 4 pixels or better. This equates to a positional accuracy of linework of +- 100 metres. Linework was digitised at scale 1:20 000 or better. While every effort was made to digitise the datasets accurately, the large pixel size (25 m) of the Landsat image, and the resultant spectral response, sometimes made it difficult to interpret corresponding locations on aerial photography and Landsat image. Some positional in-accuracies may have resulted, however these are estimated to be in-frequent. **Attribute accuracy**: The classification system used for this project is broad scale only, and designed for interpretation at regional scales of 1:100 000. The development of the standard broad scale habitat classification system on a statewide basis is a large and ongoing task. This system is close to a robust system, but will be refined and improved as anomolies arise that warrant modification to the system. Some polygons were difficult to attribute using only the aerial photography, and the current knowledge and ground-truthing of the area. An educated interpretation of the marine habitat has been made on these polygons. This interpretation will remain until further field work verifies otherwise.	The classification system used for this project is broad scale only, and designed for interpretation at regional scales of 1:100 000. The development of the standard broad scale habitat classification system on a statewide basis is a large and ongoing task. This system is close to a robust system, but will be refined and improved as anomolies arise that warrant modification to the system. Some polygons were difficult to attribute using only the aerial photography, and the current knowledge and ground-truthing of the area. An educated interpretation of the marine habitat has been made on these polygons. This interpretation will remain until further field work verifies otherwise.	Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160

Shoreline Habitats of the Marmion Marine Park	Marmion Marine Park, Perth, Western Australia Central West Coast (CWC) IMCRA region	**Positional accuracy**: Habitat extents were delineated as accurately as possible from the ortho-rectified mosaic, utilising a minimum scale of 1:4000. Habitats were delineated with a maximum length of two kilometres and a minimum length of 20 metres. Accuracy of DOLA's coastline linework is not stated. DOLA has compiled this dataset from a number of sources of best available information including 1:2 000, 1:50 000 and 1:100 000 scale datasets. These source datasets were collected at various levels of positional accuracy, and as such each individual line is as accurate as its source data. The source attribute in the shapefile identifies these sources. The DOLA coastline was modified in only a few small areas where there was large conflict with the Landsat image data and the aerial photography (eg Little Island). **Attribute accuracy**: Habitat classifications were determined visually from the ortho-rectified mosaic, and while every effort has been made to assign these correctly, there may be some errors. The habitats are accurate as best determined at the time of aerial photography (12-27 September 1994). It must also be appreciated that coastlines by their very nature are dynamic and subject to temoral and spatial change. Beach widths and habitat lengths were calculated using Arcview's 'measure' functionality. Habitats classified as beach + rocky shore were considerably harder to attribute beach width to compared to areas of uninterupted sand and thus measurements may exhibit a lower level of accuracy.	This dataset consists of linework detailing the shoreline habitats of WA's Marmion Marine Park and covers approximately 23 kilometres of coastline, extending from Trigg Point to Burns Beach. The coastline is delineated into areas of Beach, Rocky Intertidal, or Beach + Rocky Intertidal and attributed accordingly. Lines are further attributed with direction the habitat is facing, habitat length (metres), beach width (maximum and average in metres). The base coastline linework was provided by DOLA. A source attribute has been added to each line based on DOLA's coastline source and/or method used to derive the coastline in any area. Habitats were identified from an ortho-rectified mosaic of aerial photographs, which was viewed using Arcview 3.2. Beach widths were measured from the ortho-rectified mosaic using Arcview's 'measure' functionality. Habitat aspect was determined using a transparency of a compass rose (360 degree circle), which was overlaid upon the computer screen. The dataset was compiled by Ben Deeley under the supervision of Ray Lawrie and Kevin Bancroft (MCB) in the months of September and October 2001. The dataset was modified on 7/6/2002 by Ben Lamb to remove an xy shift error and bring the classification into line with the current classification as used for the other shoreline classifications	Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160

Shoreline Habitats of Ningaloo Reef Area	Ningaloo IMCRA region	**Positional accuracy**: Habitats extents were delineated as accurately as is possible to determine from 1:20 000 scale hard copy aerial photography, and are estimated to be within 20 metres of true position at the date of photography. Ground-truthing needs to be undertaken to verify and improve habitat positional accuracy. Since this work was undertaken, high quality digital ortho-rectified aerial photography has become available over much of the area. The habitat mapping should be reviewed using this photography to provide significantly improved positional accuracy of habitat delineation. Accuracy of DLI's 1999 coastline linework is not stated. DLI has compiled this dataset from a number of sources of best available information including 1:2 000, 1:50 000 and 1:100 000 scale datasets. These source datasets were collected at various levels of positional accuracy, and as such each individual line is as accurate as its source data. The source attribute in the dataset identifies these sources. The DLI coastline was modified in only a few small areas where there was large conflict with the Landsat image data and the aerial photography (eg Cape Farquhar). Since this work was undertaken, DLI have subsequently reviewed the delineation of the coastline along this stretch of WA coast. The habitat mapping needs to be upgraded to match this delineation. **Attribute accuracy**: Habitat classifications were determined visually from hard copy aerial	Habitat classifications were determined visually from hard copy aerial photography, and while every effort has been made to assign these correctly, there may be some errors. The habitats are accurate as best determined at the time of aerial photography (mainly 12-27 September 1994). Coastlines by their very nature are dynamic and subject to change due to natural and man-made forces. This is particularly the case with the movement of sand up and down the coast, and as such beaches may form and disappear with the passing of time. Ground-truthing needs to be undertaken to determine habitats with greater accuracy. Since this work was undertaken, high quality digital ortho-rectified aerial photography has become available over much of the area. The habitat mapping should be reviewed using this photography to provide significantly improved accuracy of habitat interpretation. The classification Beach + Rocky shore included both the following areas: 1) where there was a beach that had a rocky shore abutting it from the landward side, and may also have had the rocky shore extending into the beach, 2) where a beach was divided along its extent by the emergence of a rock platform through the beach. These classifications have not been discerned in the dataset. To determine which category a particular Beach + Rocky shore	Conservation Branch Marine GIS Co-ordinator 47 Henry Street Fremantle WA 6160

		photography, and while every effort has been made to assign these correctly, there may be some errors. The habitats are accurate as best determined at the time of aerial photography (mainly 12-27 September 1994). Coastlines by their very nature are dynamic and subject to change due to natural and man-made forces. This is particularly the case with the movement of sand up and down the coast, and as such beaches may form and disappear with the passing of time. Ground-truthing needs to be undertaken to determine habitats with greater accuracy. Since this work was undertaken, high quality digital ortho-rectified aerial photography has become available over much of the area. The habitat mapping should be reviewed using this photography to provide significantly improved accuracy of habitat interpretation. The classification Beach + Rocky shore included both the following areas: 1) where there was a beach that had a rocky shore abutting it from the landward side, and may also have had the rocky shore extending into the beach, 2) where a beach was divided along its extent by the emergence of a rock platform through the beach. These classifications have not been discerned in the dataset. To determine which category a particular Beach + Rocky shore classification falls into, the relevant aerial photograph would need to be viewed. Beach widths were estimated from the hard copy aerial photography using a scale rule, and a scaled adjustable	classification falls into, the relevant aerial photograph would need to be viewed. Beach widths were estimated from the hard copy aerial photography using a scale rule, and a scaled adjustable magnifying glass where necessary. These widths are estimated to be accurate to within 5 metres. Ground-truthing needs to be undertaken to determine them with greater accuracy.	

		magnifying glass where necessary. These widths are estimated to be accurate to within 5 metres. Ground-truthing needs to be undertaken to determine them with greater accuracy.		

4. Appendix 4: Listing of potential Wetlands data sets

Source: Doug Watkins, Wetlands International

Note: These 144 data sets are not necessarily coastal wetlands

Acid Sulfate Soil Risk Map, Albany-Torbay
Acid Sulphate Soils - Planning Maps
Acid Sulphate Soils (ASS) Priority Management Areas (Hot Spots) - North Coast
Additional Flora Studies for Homebush Bay: Abattoir Site and Brick Pit
An Estuarine Inventory for New South Wales, Australia
Annual Waterfowl Counts in the South-West of Western Australia
Aquatic invertebrates, waterbirds and water chemistry
AUSLIG Hydrological polygon information at 1:250,000 (HYDROP250/HYDRP250)
Barratta Wetland Study (BWS)
BARTRAM RD WETLAND BEENYUP RD SWAMP
BARTRAM RD WETLAND COMPLEX BEENYUP RD SWAMP
Bathymetry survey of the Lake Warden Wetland System, Esperance
BENGER SWAMP WETLAND
Biodiversity Significance Brigalow Belt
Biodiversity Significance Central Queensland Coast
Biodiversity Significance Desert Uplands
Biodiversity Significance South East Queensland
Biological Wetlands of the River Murray for South Australia Based on the Wetlands Atlas
Bioregional Corridor Buffers - New England Tableland
Bioregional Corridor Buffers - Southeast Queensland
Bore monitoring program in the Lake Warden Wetland System, Esperance
Brisbane Water Area Wetlands Management Study
Broadscale Classification of Marine Ecosystem and Habitat Classes
Catchments, Department of Environment, 2003.
Centennial Parklands Management Units 1998
Central Coast Heritage Inventory Report
Changes in peripheral vegetation of the Peel-Harvey Estuary 1994-1995
Changes in Peripheral Vegetation of the Peel-Harvey estuary 1994-1995, 1997

Clarence River Catchment Wetlands Inventory
Class Modification AML
Classification, Survey and Mapping of South Australias Coastal Saltmarsh and Mangrove habitats
Clearing Regulations - Schedule One Areas
Coastal Wetlands (State Environmental Planning Policy No. 14) - SEPP 14
Coastal Wetlands and Associated Communities Tweed Shire, Northern NSW
COASTAL, WETLAND FAUNA - SEABIRD BREEDING COLONIES, WATERBIRD BREEDING COLONIES AND ALL OTHER COASTAL WETLAND FAUNA
Conservation Status of Rare Plants in the Lake Macquarie area
Corangamite CMA: IWC Condition assessments - generates wetland maps; - Inventory (includes a mapping component)
CSIRO Wildlife and Ecology - Estimated Areas of Wetlands
Digital Multi Spectral Video (DMSV) over the Woody Lake Nature Reserve, Esperance
Directory of Important Wetlands in Australia (DIWA) Spatial Database
Directory of Important Wetlands Spatial Database including Wetlands Type and Criteria
Drainage Catchment Maps
Ecological Assessment and Evaluation of Wetlands in the System 5 Region, 1994
Ecological studies of the Canning River Wetland, 1984
Environmental Assessment - Werkenbergal Swamp
Environmental Flow Requirements of the Lower Darling River-Interim Report on Wetland Commence-to-Flow Levels
Environmental Flows - Summary of 1992/93 Findings - Lower Darling River
Environmental Impact Assessment Number - 1007, CRN: 94962
Environmental Impact Assessment Number - 1076, CRN: 103511
Environmental Impact Assessment Number - 1200, CRN: 122316
Environmental Impact Assessment Number - 1223, CRN: 127696
Environmental Impact Assessment Number - 1268, CRN: 138167
Environmental Impact Assessment Number - 1439, CRN: 181831
Environmental Impact Assessment Number - 616, CRN: 46943
Environmental Impact Assessment Number - 621, CRN: 47529
Environmental Impact Assessment Number - 729, CRN: 56556
Environmental Impact Assessment Number - 788, CRN: 63158
EPP, South West Agricultural Zone Wetlands
Estuarine Macrophytes of New South Wales, Australia
Estuarine Wetlands
Estuarine Wetlands

Evaluation of Flora and Fauna Constraints - Paterson Valley - June 1995
Eve Street Wetland, Arncliffe - Draft Plan of Management
Extant Fauna Habitats - Adelaide Plains
Final Report of the Amphibians and Reptiles at Homebush Bay
Flinders Island Vegetation Mapping
Flood Extent Mapping Index (FLMI_{YYYYMM}/)
Flood Mapping Limit of Study (FLD_LOS/)
FLOODPLAIN WETLANDS SURVEY OF THE NORTHERN TERRITORY
Floodways (FLOODWAY25/)
Flora and Fauna of the Eastern Part of the RANAD, Newington
Flora and Fauna Survey - Lake Coolah
Freshwater lagoons in the Darwin region have been documented in a desktop study based on aerial photography (Schult 2005)
Freshwater Wetland Survey - North Coast
Geodata Waterbodies, Geoscience Australia, 2004 1:250,000.
Geomorphic mapping of the River Murray floodplain, Lake Hume to the South Australia Border.
Geomorphic Wetlands, Augusta to Walpole
Geomorphic Wetlands, Swan Coastal Plain
Goulburn/Broken CMA: Mapped bogs, soaks; IWC Condition assessments - generates wetland maps)
Gwydir Watercourse Vegetation
Gwydir wetlands - mapped using landsat MSS and TM data since 1987 (1:100000)
Hawkesbury - Nepean Wetlands Assessment Database
Homebush Bay Avifauna Study: Part 1 - Waterbirds
Homebush Bay Ecological Studies : Fish Study
Homebush Bay Pilot Study : Wetlands and Benthos
Homebush Bay Saltmarsh Ecology and Transplantability Study
Hunter Central Coast CMA – Compilation of layers obtained from state and local government and environmental organisations
Hydrographic Catchments – Basins. Custodian: Department of Water (DoW) 1:25,000.
Hydrographic Catchments – Catchments. Custodian: Department of Water (DoW) 1:25,000.
Hydrography, Linear. Custodian: Department of Water (DoW) 1:25,000.
Indicators of Catchment Condition in the Intensive Land Use Zone of Australia - Impoundment density
Interpreted Environmental Sensitivity, Comprehensive Version
Investigation of Pest Mosquito Populations in the Homebush Bay Area
JANDAKOT (BARTRAM BEENYUP RD WETLAND COMPLEX)

Jandakot Structure Plan (DRAFT) - October 2001

Key Plan of Flood Geology Data (FLGI/)

KONDININ LAKES WETLAND

Lake - Vicmap Reference (LAKEVR/LAKEVR)

LAKE EGANU WETLAND

LAKE HINDS WETLAND

LAKE VIEW FARM WETLAND

Land Use in Queensland

Land Use in the Maroochy catchment, Queensland

Land Use in the Mary River catchment, Queensland

LIST Hydrographic Closure Digital Topographic Series

LIST Water Body Digital Topographic Series

LIST Water Line Digital Topographic Series

LIST Wetland Digital Topographic Series

Listing of Bird Species for the Lowbidgee Wetlands

Local Environmental Study - Belmont - Redhead

Local Environmental Study - Jewells Wetland

Lowry & Finlayson (2004) gives a comparison of wetland datasets for Northern Australia and Kakadu National Park and contains a good map of AUSLIG Topo 1:250,000 map of wetlands

Macquarie Marshes – mapped using landsat MSS and TM data every year since 1979 (1:100000)

Mallee CMA: Corrected old mapping; IWC Condition assessments - generates wetland maps)

Merrowie Creek Wetland Management Plan Draft Document for Public Comment (June 1993)

Monitoring River Health Initiative

Multi Attribute Data - Landform and Condition Dataset - Richmond River Catchment

Multi Attribute Data - Landform and Condition Dataset - Tweed/Brunswick River Catchments

Murray Riparian Vegetation Mapping

NARROGIN LAKE WETLAND

Native Vegetation (Floristic) - Coongie

Native Vegetation (Floristic) - Kanowana Wetlands

Native Vegetation Assessment Database

Natural Area Study - Lake Macquarie

Natural Diversity Recovery Catchment - South West and Buntine Marchagee

Natural Resources of the Murrumbidgee Irrigation Area, Tabbita and Benerembah Irrigation Districts.

Natural Vegetation of Homebush Bay - two hundred years of changes.
North Scarborough Park Remedial Works Report
Northeast CMA: IWC Condition assessments - generates wetland maps
Northern Rivers CMA - Compilation of layers obtained from state and local government and environmental organisations
Northern Territory Ramsar sites
Percentage area of land adjacent to waterways within SEPP14 wetlands
Phytosociology of Coastal Saltmarsh Vegetation in NSW.
Plan of Management - Jerrara Dam - Draft
Plan of Management - Mason Park Wetlands
Plan of Management - Significant Areas
Plan of Management - Spring Creek - Draft
Plan of Management - Warriewood Wetlands - Draft
Plant Species - Richness and Invasion by exotics in relation to disturbance of wetland communities on the Riverine Plain, NSW
Priority 5 Mapping Area (P5MA) - Vegetation Extent
Proposed Jandakot Botanical Park; Overview of Botanical Communities and their Significance I Anstey Road Wetlands 1993
Queensland Coastal Wetland Vegetation
Rainforest Remnants on headlands in the Manning Valley: their composition and conservation significance
Ramsar Sites Western Australia
Ramsar Sites Western Australia
Ramsar Wetland Areas
Regional Environmental Plan - REP 17 - Kurnell Peninsula - Revised
Regional NRM Investment Plan-South Coast Wetlands - Albany, Esperance urban- future urban areas, South Coast
Resource Map
Restoration of Estuarine Fisheries Habitat
Richmond Catchment Wetlands Inventory
Riparian Health Report - Wetland Inundation - Barwon-Darling River
River Murray (Below Lake Hume) Wetlands GIS 1996
River Murray Flood Mapping
Riverine Rainforest Remnants in the Manning Valley
Salinity Action Plan (SAP) - Wetland Monitoring
Salinity Action Plan Monitoring Project - Wheatbelt and Southwest focus
Salinity Action Plan Survey Project
Saltmarsh Vegetation in the Homebush Bay Study Area

South Coast Significant Wetlands
South Coast Wetland Mapping
South Coast Wetland Survey - Field Data
Southeast NSW Native Vegetation Classification and Mapping - SCIVI
Springs of Queensland - Distribution and Assessment (v3.0)
State of the Environment Report - Gunnedah Council - 1993
State of the Environment Report 1993 - City of Bankstown
State of the Rivers and Estuaries Report
Structures Impeding Tidal Flow
Study of Selected South West Wetlands
Subtidal Seaweed Communities of Bare Island, Botany Bay
Survey of Wetlands in the Bega Valley
Survey of Wetlands on the Lower Hunter Flood Plain
Swan River Algal Bloom Data 1994-1995
Sydney Olympic Park Ecosystem Distribution
Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005
Tasmania - CRA/RFA - Forests - National Estate - Fauna Key Habitats
Tasmanian Oil Spill Response Wetlands Susceptible to Marine Oiling
Tasmanian Waterline - 1:250 000 Digital Topographic Statewide Series
Tasmanian Wetland - 1:250 000 Digital Topographic Statewide Series
TASVEG, the Tasmanian Vegetation Map
Terrestrial vertebrates of Weipa, Cape York Peninsula
The Ecology and Management of Shorebirds in the Homebush Bay Wetlands
Threatened Ecological Communities
Threatened Ecological Communities, CALM, 2005.
Threatened Fauna, CALM 2005.
Threatened Flora, CALM 2005.
Tweed and Brunswick River Catchment Wetlands Inventory
Vegetation and Flora of Wetlands Near Busselton 1980
Vegetation Assessment - Lake Victoria
Vegetation of Driftway Reserve, Hawkesbury Campus, University of Western Sydney
Vegetation of Kooragang Island, NSW
Vegetation of Three Headlands of the Central Coast of NSW - Norah, Wamberal and Wybung Heads

Vegetation: Wetlands (below 1000m)

Vesicular-arbuscular mycorrhizal fungi in Natural Vegetation and Sand-Mined Dunes at Bridge Hill, NSW

VICTORIAN DRYLAND SALINITY ASSESSMENT 2000 - d01cac_ramsar_final.xls

VICTORIAN DRYLAND SALINITY ASSESSMENT 2000 - d05cac_wetland_final.xls

Victorian Wetland Environments and Extent - up to 1994 (WETLAND_1994/WET1994)

WAGIN LAKE WETLAND

Wastewater artificial wetlands listed as important wetlands in Australia - point locations

Water Quality and Wetland Evaluation - Final Report

Waterbird Counts in Nature Reserve Wetlands

Waterfowl counts

West Gippsland CMA: Mapped wetlands on river floodplains; IWC Condition assessments - generates wetland maps

Wetland Inventories - Statewide (Incomplete)

Wetland Inventory - Longneck Lagoon

Wetland Rehabilitation Project - Kooragang

Wetland Requirements and River Operations in the Murray Region

Wetland Vegetation

Wetlands

Wetlands - Boundaries

Wetlands - Murray River (Wetlands Atlas)

Wetlands - Murray river Thompson and Pressey

Wetlands and Recreation Corridor Study - Rockdale

Wetlands Coastal of South-eastern Queensland

Wetlands Database - Botany Bay Wetlands

Wetlands Database for WA

Wetlands Directory of Important

Wetlands Extent for Victoria Prior to European Settlement - Deduced (WETLAND_1788/WET1788)

Wetlands GIS of the Murray-Darling Basin Series 2.0

Wetlands in arid parts of the Northern Territory, listed in Duguid et al. (2002). This report includes methodology on ground surveys, aerial surveys, and remote sensing.

Wetlands in the Alligator Rivers Region were mapped by ERISS (Saynor et al. 2001)

Wetlands Inventory - Lake Macquarie

Wetlands of part of the Daly Catchment have been mapped, based on 1:50,000 topo maps, land unit maps and aerial photography (Begg et al. 2001)

Wetlands of South Australia

Wetlands of the Barwon-Darling River (Mungundi to Menindee)

Wetlands of the Gwydir Valley

Wetlands of the Jemalong and Wyldes Plains Irrigation District

Wetlands of the Lachlan Valley

Wetlands of the Lower Clarence Floodplain, Northern Coastal NSW

Wetlands of the Lower Darling River and Great Darling Anabranch

Wetlands of the Lower Macleay Floodplain Northern Coastal NSW

Wetlands of the Murrumbidgee Valley

Wetlands of the Namoi Valley

Wetlands of the Paroo River and Cuttaburra Creek

Wetlands of the Warrego River

Wetlands Report - Plumpton Park

Wetlands Species List - Botany

Wetlands Survey - Monaro - MDBVNRBG0020

Wheatbealt Wetland Mapping

Willandra Creek Wetlands Proposed Management Plan - Draft document for Public Comment (March 1994)

Wimmera CMA: - Groundwater modelling, Wetlands and wetland catchment mapping, DEM developed, Geomorphic classification developed – wetlands mapped according to geomorphic category

Woodada Gas Project 1981 Environmental Review and Management Programme, Vegetation

WWF Kimberley Wetlands Project

Yalgorup National Park Management Plan