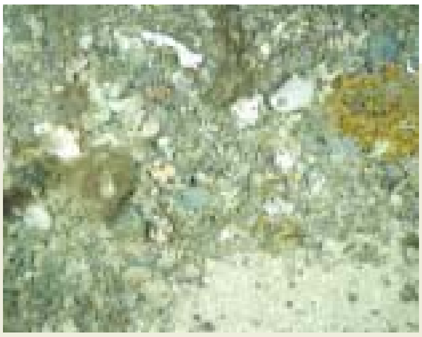
ASSESSMENT OF THE CONSERVATION VALUES OF THE BASS STRAIT SPONGE BEDS AREA

A component of the Commonwealth Marine Conservation Assessment Program 2002-2004



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Natural Heritage Trust
Helping Communities Helping Australia

Environment Australia
Department of the Environment

CSIRO
MARINE RESEARCH

Report to Environment Australia – December 2002

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TABLE OF CONTENTS

Summary

The Minister for the Environment and Heritage announced, on September 26, 2001, plans to assess the conservation values of 11 unique marine areas in Commonwealth waters. The assessment of the Bass Strait sponge beds area is the first of those. CSIRO was asked to provide a summary of relevant, available data, and expert opinions, to reach a balanced conclusion, including degree of confidence, regarding the question: “does the area possess biodiversity values worthy of protection?” The assessment of the conservation values was to be done in accordance with the identification criteria outlined in Guidelines for identification of MPAs detailed in the Strategic Plan of Action for the NRSMPA (see Appendix 1); and it was to report on the components specified in Appendix 2. The conservation values assessment was not intended to give recommendations as to what protection measures may be appropriate, provide information relevant to reserve design, or deal with reserve management issues; nor was it expected to provide a social and/or economic impact assessment.

The Bass Strait sponge beds area was identified as one of the 11 unique areas based on reports of large sponge catches in southern Bass Strait, taken on Museum Victoria research cruises conducted between 1979-1983 to assess the marine biodiversity of Bass Strait. These voyages made large collections of sponges (indicating the presence of sponge beds) around an arc at the 65-75 m contours in southern central Bass Strait (39°45.55’S, 145°33.82’E to 40°35.90’S, 147°5.11’E). However, there has been no subsequent work that could confirm the continued presence, or give an indication as to the size and distribution of those sponge beds.

‘Sponge bed’ is a collective term used for communities of sessile, filter feeding fauna generally containing habitat-forming organisms such as sponges, octocorals, bryozoans and ascidians. The filter-feeding fauna plays a significant part in the energy cycle of marine communities, efficiently concentrating the energy from small organic particles, bacteria and phytoplankton and passing it on to their predators. Furthermore, through their large and often complex structures they increase the complexity of the benthic habitat, hosting associated species such as small crustaceans, molluscs and worms not only amongst the sessile colonies, but even as symbionts within their colony structures. Thus, sponge beds, through the provision of shelter and/or food, may influence the presence and/or distribution of other, generally mobile seafloor fauna (O’Hara 2002), including commercial species. Preserving sponge beds not only preserves the species forming the community but also habitat complexity in the benthic marine environment, both factors that contribute to biodiversity — which in itself is a highly rated value in relation to conservation. In addition to their habitat forming function, sponges and other sessile fauna are sources of bioactive compounds potentially beneficial to human kind.

The South-east Marine Region in general is described as rich in diversity; central Bass Strait is classed by the IMCRA Technical group (1998) (based on geomorphology and fish distribution) as a demersal province within this region, defined by a few endemic species of limited range. At this stage we cannot confidently comment on the uniqueness of the sponge beds in southern Bass Strait. Data from other scientific work in the vicinity indicates that patches of sessile fauna occur throughout southeast Australia. However, it is possible that the species composition and/or diversity of the beds in Bass Strait differ from other areas, based on their position in a distinct demersal province. Neither the material collected in the initial surveys of Museum Victoria, nor specimens collected or observed on other surveys have been sorted and identified to date.

We conclude that the area may have biodiversity values that (compared with neighbouring areas) may be particularly worthy of protection from any processes that may disturb benthic assemblages. However, we are not able to specify the location or extent of these values with present information. Similarly, with present information, we cannot envisage an effective process leading to the selection and design of conservation measures to protect these values. We suggest that additional information, probably including data from new surveys, is needed to provide the data on which such decisions could be based.

Background

This report is the first of two conservation values assessments to be provided by CSIRO to Environment Australia during 2002. On 26 September 2001 the Minister for the Environment and Heritage announced plans to assess the conservation values of 11 unique marine areas in Commonwealth waters. The conservation values assessments are intended to provide information as to whether the Government should proceed with conservation measures for any of the areas, such as declaring new marine protected areas.

The 11 areas are divided into two groups:

- the Bass Strait sponge beds and blue whale aggregation site in the South East which are to be assessed within the framework of the South East Regional Marine Plan process. The conservation values assessments for these two areas are to be provided during 2002.
- nine areas to be assessed outside the SERMP framework - Eucla Canyon, Gulf of Carpentaria seagrass beds, Heywood Shoals, Naturaliste Plateau, Norfolk Seamounts, Pea Shoals, Sea Angel Bank, Swan Canyon and Wallaby Plateau.

This report concerns Area 1, referred to as the Bass Strait sponge beds.

Scope of the initial conservation values assessments

In summary, CSIRO was asked to provide a succinct summary of the relevant and available data and come to a balanced conclusion regarding the question “Does the area possess biodiversity values worthy of protection?” For example, does the site offer special/significant values in terms of, among other things, providing for:

- the special needs of rare, threatened or depleted species and threatened ecological communities;
- the conservation of special groups of organisms (eg species with complex habitat or migratory species, or species vulnerable to disturbance);
- centres of endemism, natural refugia for flora and fauna;
- recreational, aesthetic, educational or cultural needs; and
- a scientific reference site.

CSIRO was asked to include expression (with explanation) of degree of confidence in the conclusions, and necessity for any further information, and if appropriate to include conclusions about any specific sub-areas identified.

CSIRO was asked to identify and describe any areas of high conservation value in each of the areas and to provide an assessment of the conservation values of the areas in accordance with the identification criteria as outlined in *Guidelines for identification of MPAs* detailed in the *Strategic Plan of Action for the NRSMPA* (see Appendix 1) and to report on the components specified in Appendix 2, to the extent possible given available data. CSIRO was expected to consult with individuals and institutions with expertise and research interests in these areas and to make appropriate arrangements to access all available information and expertise; however, CSIRO was asked not to consult directly with stakeholders; this would be done by EA.

It is not the role of the initial conservation values assessment to recommend what protection measures may be appropriate, to provide information relevant to reserve design issues or to deal with reserve management issues. Similarly, while the assessment may provide information regarding current uses and threatening processes it does not aim to provide a Social and Economic Impact Assessment. Should the Minister decide to pursue conservation measures for the area (such as an MPA), then a detailed social and economic impact assessment will be developed at a subsequent stage of the process, in conjunction with an analysis of the conservation benefits, design and management of the proposed conservation measures.

The Bass Strait sponge beds — original outline

EA initially provided CSIRO with the following summary:

The deeper reef areas of Bass Strait (>20m) support a diverse range of sessile invertebrates such as sponges, bryozoans and gorgonians that flourish in low-light conditions. The extensive sponge beds are largely unexplored but are likely to be extremely species rich, high in endemism, and likely to include many species new to science.

The Museum Victoria (formerly the National Museum of Victoria) undertook a number of research cruises between 1979-1983 to assess the Strait's marine biodiversity. These voyages located sponge beds in the Strait located around an arc at the 65-75 m contours around southern Bass Strait (39°45.55'S, 145°33.82'E to 40°35.90'S, 147°5.11'E).

Since this research, the condition of the area is unknown but it is likely that the natural habitat cover has been modified in several areas from the effects of petroleum extraction, bottom trawling and scallop dredging.

An important component of the assessment is to assess the extent and condition of the sponge gardens, to the extent possible without further field surveys, and to advise on the outcome of that assessment and the level of uncertainty. While the habitat mapping commissioned by the

National Oceans Office does not cover this area, the South-east Regional Marine Plan assessment reports will provide an important knowledge base for developing a conservation values assessment for this area.

Methods

This report is the result of a desktop study, presenting data and information currently available that is relevant to the Bass Strait sponge beds. For the conservation values assessment we concentrated on the entire width of Bass Strait, from the shelf edge in the Gippsland Basin to the shelf edge west of King Island in the Otway basin, with an increased focus on the region identified in the original outline. Data collation involved literature searches and reviews as well as consultation with data holders. CSIRO was asked not to consult directly with stakeholders but the Stakeholder Reference Group (SRG) for the Commonwealth MPA process, established by EA, was informed on several occasions of the work of the CSIRO team and was invited to draw to our attention any information, whether quantitative data or anecdotal observations. Some provided us with publications and a number told us verbally about their experience in the area. Appendix 3 lists the membership of the SRG and the organisations and people we contacted directly in our search for data and expert opinions on issues related to the Bass Strait sponge beds. As part of the South-east Regional Marine Plan process, the NOO has released a series of reports in 2002 (NOO 2002a-f), and BRS compiled background information on the uses/users and presented it in a report to the NOO (Larcombe *et al.* 2002). As Bass Strait is contained in the South-east Marine Region and the present assessment is to be incorporated within the framework of the South-east Regional Marine Plan process, we were able to draw from the information presented there.

Data collated under projects for the NOO are, or will be, recorded in the Neptune metadatabase; records of CSIRO generated data are contained in CSIRO's Marlin metadatabase. Both these databases are compliant with the ANZLIC guidelines. Other data stems from publications that are referenced.

Findings

Physical environment

Bathymetry

The Bass Basin, a basin elongated from southeast to northwest in extension of the Tamar valley, formed by a sinking trough around 70-80 million years ago (Jennings 1974). As a result, central Bass Strait's seafloor is nowadays shaped like an irregular saucer (IMCRA Technical Group 1998) with a 90 m deep basin in the middle, and a broad ring of 80 m depth (Fig. 1). The eastern margin is bordered by the Furneaux Island Group along a ridge with maximum depths of 60 m. This ridge separates the Gippsland Basin, off southeast Australia, from the Bass Basin (*sensu* Jennings 1974). To the southwest, there is a relatively narrow, 60 m-deep channel between King Island and Tasmania. In the northeast, between King Island and Cape Otway, depths gradually increase from the 80 m saucer rim to the shelf-edge in the Otway basin.

Geomorphology

Jones and Davies (1983) described the superficial sediments of part of Bass Strait excluding, however, the central deep basin. A thorough description of the sedimentology and petrology of Bass Strait is given by Baillie *et al.* (1991).

The southern part of 'the saucer' is dominated by mud-sized sediments (grainsize $\leq$0.06 mm), in addition to some very fine sand (grainsize 0.1 mm). The northern part of central Bass Strait is dominated by coarse sand (grainsize 0.5 mm) with a large, very coarse patch in the centre between Wilsons Promontory and King Island. The sediments closer inshore, to the south and east are much coarser, in the range of gravel to boulder size (Fig. 2)

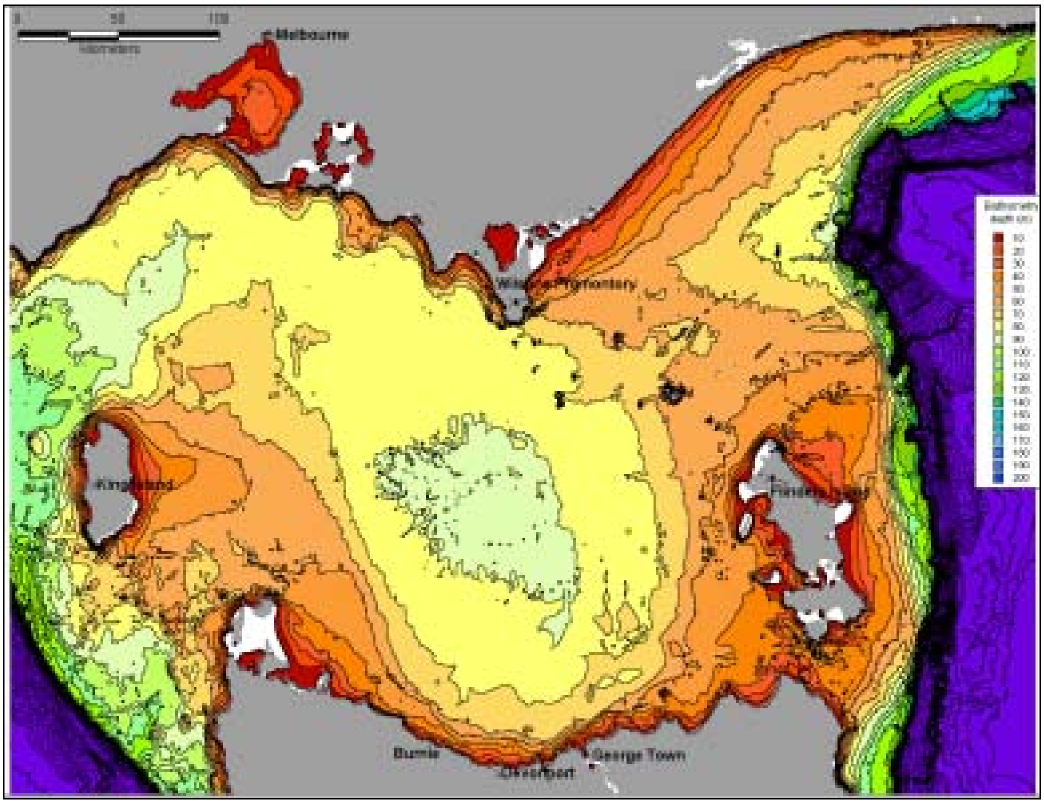


Fig. 1: Bathymetry of Bass Strait; depths off the continental shelf (>200m) dark purple. Data supplied by GA.

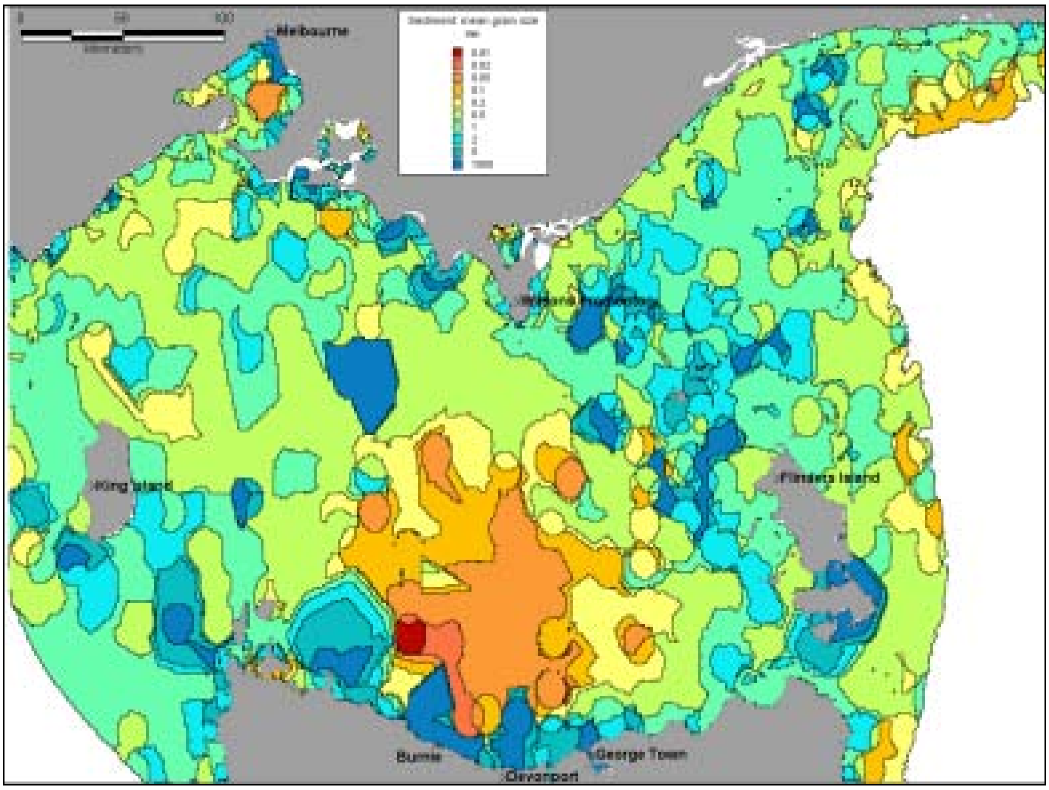


Fig. 2: Mean grain size distribution of Bass Strait. Data supplied by GA.

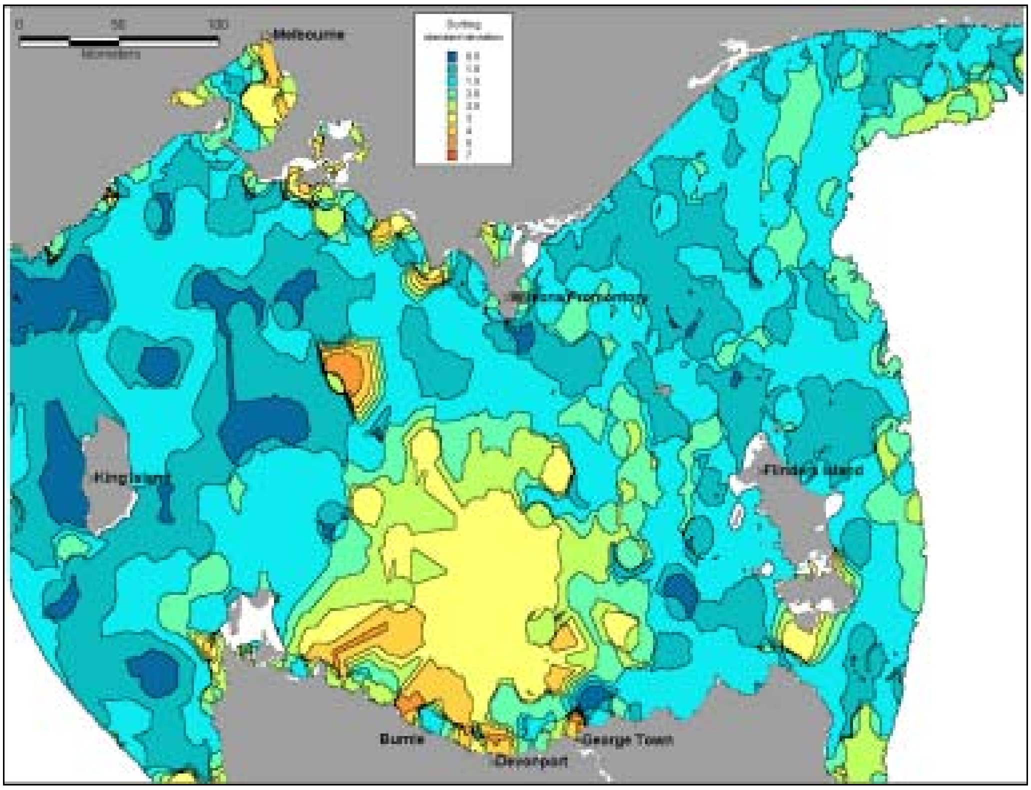


Fig. 3: Grain size sorting in Bass Strait. Data supplied by GA.

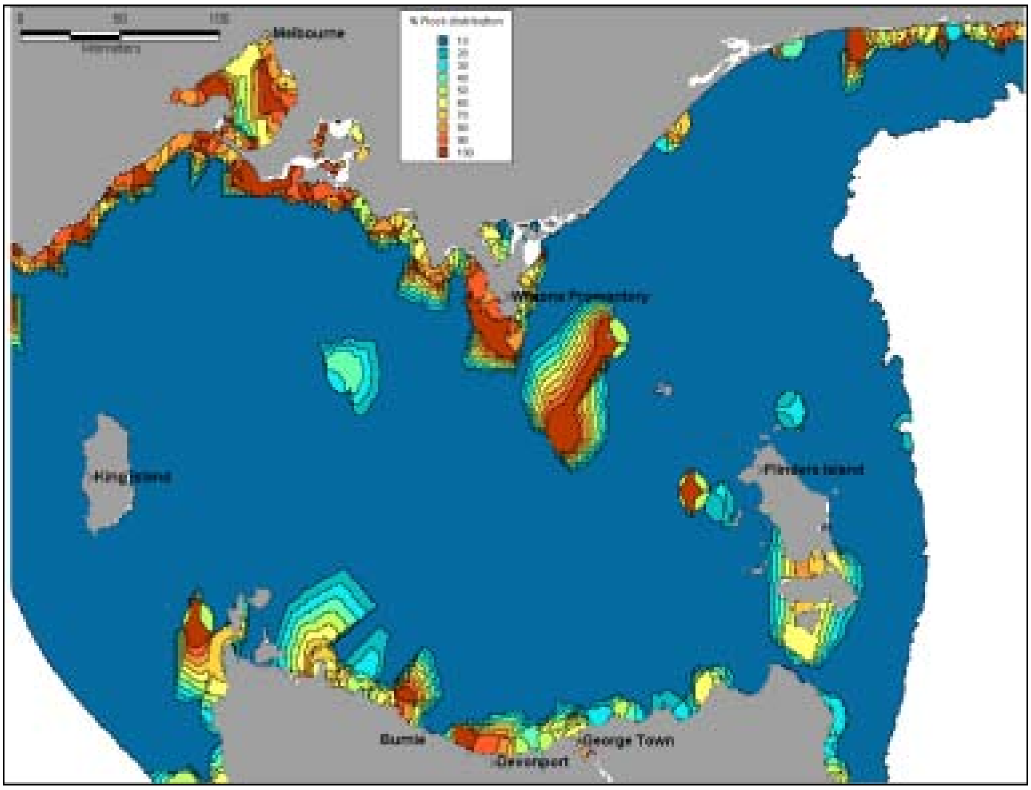


Fig. 4: Rock substrate distribution in Bass Strait. Data supplied by GA.

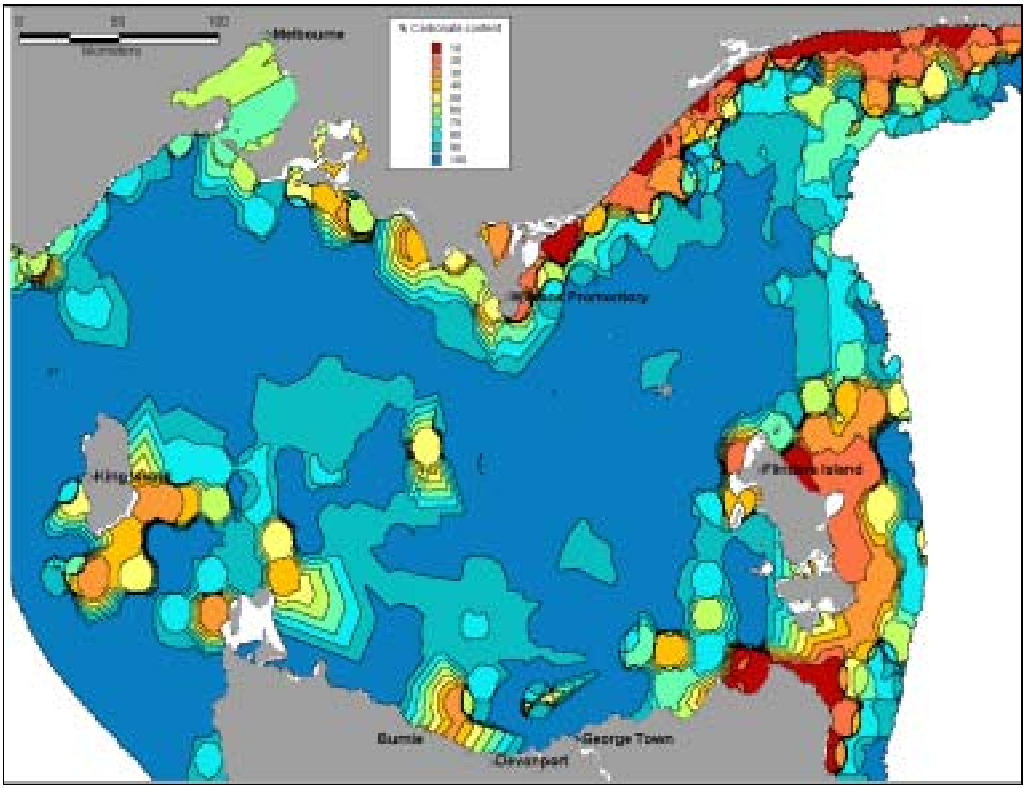


Fig. 5: Carbonate distribution in Bass Strait. Data supplied by GA

Geoscience Australia supplied information from its GEOMAP model on the mobility of sediments in this area.

To describe sediment transport, the distribution of each of the variables — Grainsize, Sorting, Rock, and Carbonate — should be used (Jenkins 2000). Grainsize may be used as an initial guide to sediment mobility, however, a more accurate guide to long-term stability is available using particle size ‘Grainsize + Sorting’. Rock depicts the distribution of hard grounds (rock outcrops, coral reef fronts, cementation of sediments) and Carbonate provides information on intragrain porosity and shape (carbonate materials have typically high internal porosity and irregularly shaped particles).

Figures 2 to 5 illustrate data for those variables. The GEOMAT model has the capacity to predict, from these data, the likelihood of mobilisation of sediments due to wave action and tidal currents.

Physical oceanography

Bass Strait has a unique geometry consisting of a broad shallow region, which descends abruptly to very deep water on each side. The flux of water through the strait and its variations are key components of many physical and biological processes in the region. The factors that are able to influence the currents in the central Bass Strait region are tidal forcing, wave set-up, locally wind-forced events and large-scale circulation mechanisms.

In general, the tidal currents in Bass Strait are dominated by the M_2 component (Fandry *et al.*1985, Black 1992). On approaching Bass Strait from the west, this component separates into two distinct streams. The first enters the strait directly through the western entrance and the second proceeds around southern Tasmania and enters from the east. Due to the interaction of the western component with the local topography, the two streams enter the strait almost simultaneously. The resulting interaction of the two tidal currents means that the net current in central Bass Strait is rather small. Thus, currents in Bass Strait may at times be ‘swirling’, possibly providing for an interesting distribution of filter feeders and for substantial retention of short-lived larvae in the system, contributing to population differentiation.

Observations of the flow through Bass Strait in autumn and winter indicate that the transport is from the west to the east with a mean flux of $0.49 \times 10^6\ m^3s^{-1}$ (Baines *et al*. 1991). The flow is highly correlated with the local wind stress. In fact, much of the flux was driven by storm surges with 2-3 day’s duration following the passage of atmospheric cold fronts across the region. No current meters were deployed in the central Bass Strait region in the Baines *et al*. (1991) experiment, but we may infer from their results that transient bottom currents of more than $0.2\ ms^{-1}$ may be experienced during the peak storm surges. Recent model results for the region confirm that the flow follows a meandering eastward path through the strait (Cirano and Middleton 2002). Both model and data show a mean current of about $0.05\ ms^{-1}$. We note that periodic cold fronts throughout the year dominate the weather patterns in the region. Summer frontal winds are generally similar to those in winter but less intense. Therefore, it is likely that the eastward flux events, with associated peak bottom currents, will be dominated by 2-3 day surges throughout the year but mean transport will be reduced in summer (Baines *et al*. 1991).

Distinct sub-regions within the assessment area

The assessment area includes the entire Bass Strait. There are three distinct sub-regions identified by the IMCRA Technical group (1998) — Otway to the west, Central Bass Strait in the centre, and Flinders to the east (see bioregionalisation below). Two coastal meso-scale regions — Central Victoria and Boags — were also identified, but are not relevant to this assessment. Within Central Bass Strait, 6 trawl stations (Fig. 6) of the Bass Strait Survey conducted by the Museum Victoria yielded substantial quantities of sponges. These stations form an arc along the 65-75 m contour in southern Bass Strait (O’Hara 2002).

Biological environment

Bioregionalisation

There are several bioregionalisations of this area. One of the earliest (Bennet and Pope 1953), is based on the distribution of intertidal and shallow sub-tidal organisms. Bass strait forms part of the Maugean Province that encloses Tasmania's coastline. The biota of the Maugean Province is described as cool temperate marine, with similarities to the cool temperate Chilean coast, the Namaqua of South Africa, and the shores of southern New Zealand (Bennett and Pope 1960). Dartnall (1974), as well as Thomas and Shepherd (1982), refer to this separation of southern Australian biota into the Flindersian (western and central Great Australian Bight) and Maugean Province. Based on macrophytes, Womersley (1984) describes the Bass Strait region as part of the Maugean sub-province, or 'eastern floral element' of the Flindersian province. The latter extends from Geralton WA to the NSW-Victoria border, while the Maugean sub-province includes the southeast Australian coast from Eyre Peninsula to the NSW-Victoria border, including Tasmania. The Interim Marine and Coastal Regionalisation for Australia (IMCRA) provided a new bioregionalisation based on fish distribution and sea floor topography, derived from expert field ecological knowledge and interpretation of existing regionalisations. IMCRA has a nested structure with meso-scale regions contained in demersal provinces, which in turn coincide with, or are part of, pelagic provinces (IMCRA Technical Group 1998). Six meso-scale regions are identified in the area of Bass Strait: Central Bass Strait, defining, as the name suggests, the central area; Flinders, an area surrounding the Furneaux group that flanks Bass Strait to the east; the southern extension of Otway, forming the western flank of Bass Strait (Fig. 7); and 3 coastal regions (Victorian Embayments, Central Victoria and Boags) mentioned only for completeness. Central Bass strait together with the coastal meso-scale regions is identified as a demersal province (Bassian Province). Flinders is part of the South Eastern Biotone — a zone of faunal overlap of 4 provinces — but its fauna is dominated by Bassian Province species. Otway is part of the Western Bassian Biotone — a zone of faunal overlap of elements derived mainly from the Tasmanian and Bassian Province to the east, as well as a small suite of extralimital species from the Central Eastern Province. Table 1 details IMCRA Technical Group's (1998) description of Central Bass Strait and the Bassian Province only, since these form the focal point of the present assessment.

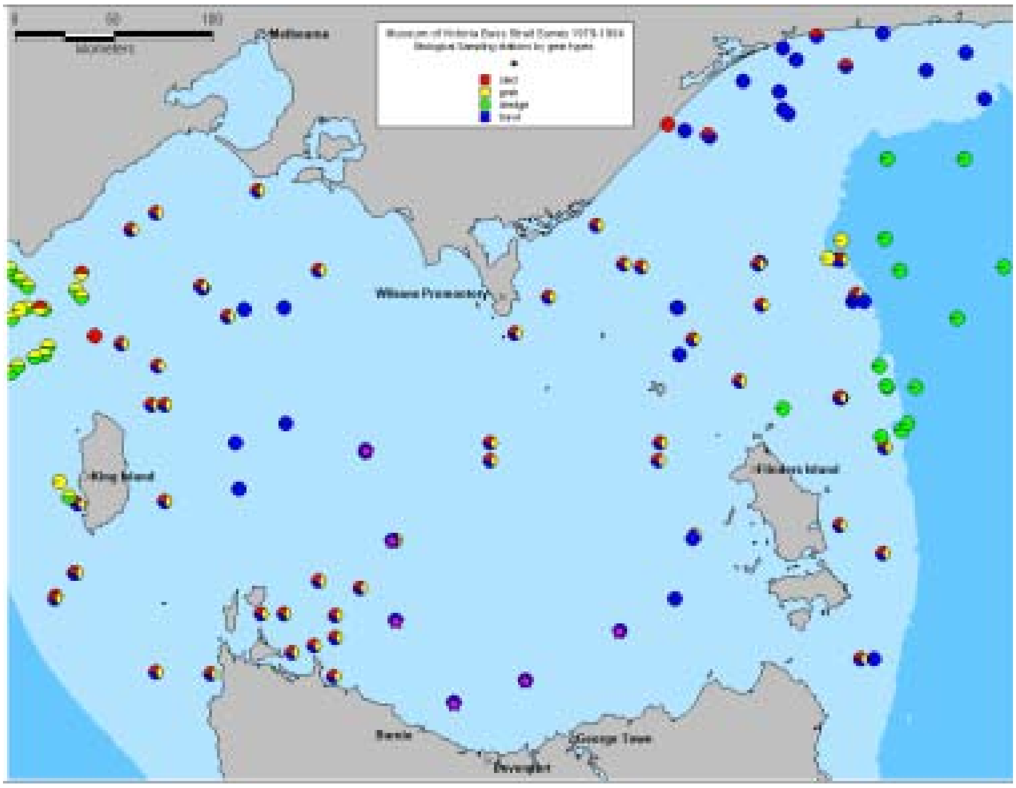


Fig. 6: Stations of the Bass Strait Survey 1979-1984 conducted by Museum Victoria, indicating the gear used for biological sampling in each. Pink stars indicate the 6 stations where large sponge catches were noted. Data supplied by Museum Victoria.

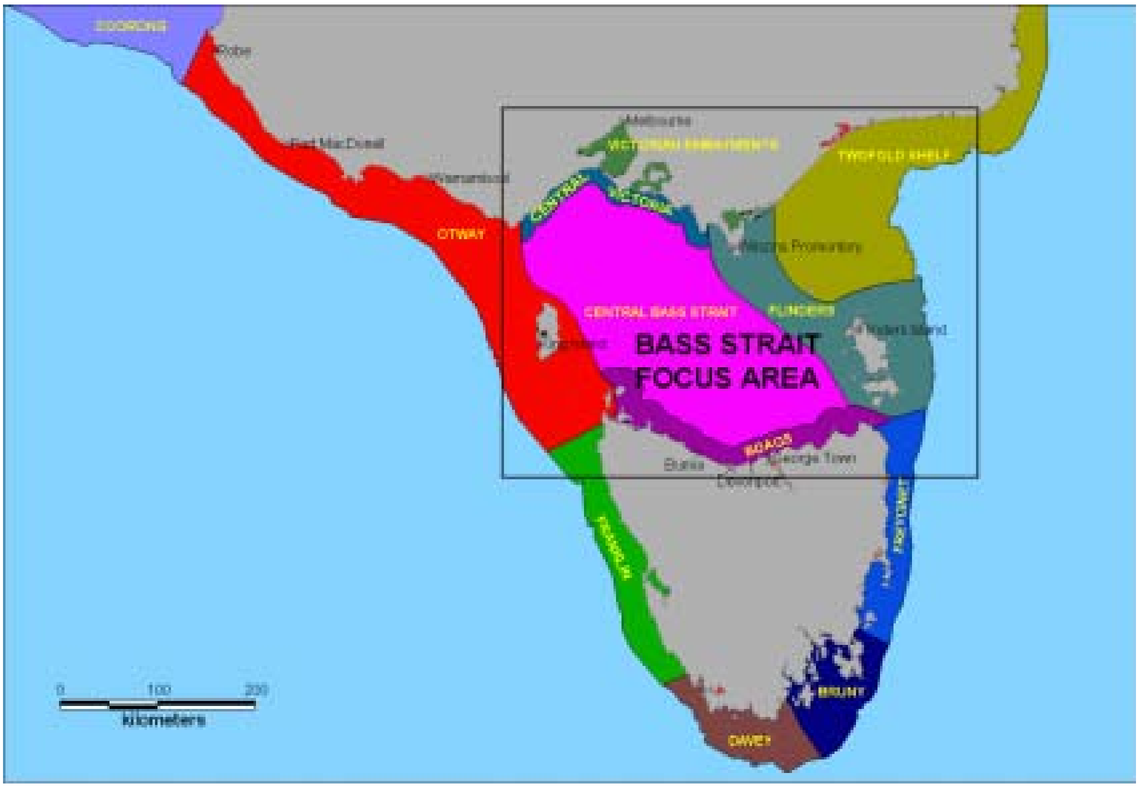


Fig. 7: Map of the Meso-scale regions in Bass Strait, as defined by IMCRA Technical group (1998).

Table 1: Bioregionalisation classification of Bass Strait, including its eastern and western flanking, according to IMCRA Technical group (1998). Sequence of the bioregions is from east to west.

Classification	Name	Description
Meso-scale Region	Central Bass Strait	The region is about 60,000 sq. km in size and lies in the central area of Bass Strait. The sea floor is shaped like an irregular saucer with water depth varying from about 80 m at its centre to 50 m around the margins. The substrate of the central area is mainly mud. Tidal velocities vary from <$0.05 ms^{-1}$ in the central area to as high as $0.5\ ms^{-1}$ at the margins where the islands and promontories form the western and eastern entrances to Bass Strait. Water mass characteristics are complex and vary seasonally, representing the mixing of the different water masses present on western and eastern sides of Bass Strait (detailed description Climate, Oceanography, Geology/geomorphology, Biota on pg 79 in IMCRA report) — there the Biota is described as diverse infaunal biota, consisting predominantly of crustaceans, polychaetes and molluscs.
Demersal Province	Bass Province	A weak province defined by a small suite of narrow ranging endemic species confined to Bass Strait and adjacent biotones, superimposed on a strong biotone where warm-temperate elements from the Central Eastern Province and South Western Province, cool-temperate elements from the Tasmanian Province, and widespread southern temperate-species mix. The region is recognised on the basis of its small but unique indicator group that is important from a biodiversity conservation perspective.
Pelagic	Southern Pelagic Province	Largely comprised of Flindersian cool-temperate species. The endpoint disjunctions also represent southern limits of warm-temperate species in the Eastern and Western Pelagic Biotones. Intra-provincial disjunctions occur at Esperance and east of Point Dempster near the western edge of the Baxter Cliffs. In the east, disjunctions occur just east of Kangaroo Island and at Wilsons Promontory.

List of taxa

Species diversity appears to be particularly high in Australia's southeast marine region (Womersley 1984, Wilson and Allen 1987; Kott 1997). Wilson and Allen (1987) note that species endemicity, in almost every group of marine animals in southern and in particular in southeastern Australia, is very high (usually over 90%). Southern Australia has a long east-west coastline with a long geological period of isolation from other similar environments. Table 2 lists a brief description of, and references to, the main biological taxa occurring in Bass Strait.

Table 2: A brief description of and references to the main biological taxa occurring in Bass Strait.

Broad Category	General description and/or species	References
Marine mammals	In the Australian action plan for cetaceans, Bannister *et al.* (1996) list 23 cetacean species whose distribution includes southern Australia	Bannister et al. (1996)
	All true and eared seals are listed under the *Environment Protection and Biodiversity Conservation* (*EPBC*) *Act*. They are detailed in Appendix 4.	*EPBC Act* (1999)
Marine Birds	All marine birds are listed under the *EPBC Act*. They are detailed in Appendix 4.	*EPBC Act* (1999)
Macrophytes	SE Australia has one of the richest macrophyte floras in the world (409 genera with 1,124 species) with a high percentage of endemism.	Womersley (1984, 1990)
Fish	Gomon et al. describe the nearly 200 cool-temperate fish species occurring in the southern part of the Flindersian Province, i.e. from Recherche Archipelago to Wilsons Promontory, excluding Tasmania.	Gomon et al. (1994)
Crustacea	There are no recent crustacean guides for southern Australian fauna. However, Jones and Morgan (2002) compiled a field guide to the crustaceans of Australia. A new, comprehensive guide to crustaceans in Australia is going to be released by ABRS shortly. It will be accessible through ABRS' website.	Jones and Morgan (2002); ABIF (2002)
Sponges	Sponges in this area are probably highly diverse (see text for details), however the sponge fauna requires a great deal of taxonomic study.	Wiedenmayer (1989); Hooper and Wiedenmayer (1994)
Invertebrates (general)	Detailed descriptions of marine invertebrates of southern Australia are given in a 3 part series of books edited by Shepherd and Thomas (1982, 1989) – Parts and II, and Shepherd and Davies (1997) – Part III. Groups covered are: cnidarians, worms, sipunculans, echiurans, bryozoans, echinoderms (Part I), mollusks (Part II), nemerteans, nodding heads, phoronids, brachiopods, acorn worm sea spiders, littoral insects and tunicates (Part III).	Shepherd and Thomas (1982, 1989); Shepherd and Davies (1997)
Benthic invertebrates (general)	Bass Strait is species rich - 554 benthic invertebrate species were identified from the Bass Strait Surveys conducted by the Museum Victoria, not including sponges, ascidians, bryozoans, hydroids, small crustaceans (eg amphipods, cumaceans), bivalves and the majority of polychaetes.	O'Hara (2002)

Key species

The key species for the present assessment are clearly the sessile filter-feeders — sponges and associated habitat-forming organisms such as octocorals, bryozoans and ascidians — that define ‘sponge beds’ (Gili and Coma 1998). However, other species occurring in the region are mentioned here, in particular threatened and listed marine species, as well as the main commercial species.

Large quantities of sponges were collected during the Bass Strait Survey conducted by the Museum Victoria between 1979 and 1984 (O’Hara 2002). However, they remain largely unsorted and unidentified (Hooper and Wiedenmayer 1994). Similarly, much of the early material from the Bass Strait region collected by Carter and Dendy and housed in the Museum Victoria also remains unsorted and unregistered (Hooper and Wiedenmayer 1994). Wiedenmayer (1989) published a taxonomic work on Demospongiae from diving depths of the Victorian coastline. He states: “A modern and thorough reappraisal, in publications, of the sponge fauna of the Maugean province, even without the well known Calcarea (about 90 species recorded), would involve, in my estimate, at least 20 years of fulltime work by a qualified taxonomist, under the best circumstances. On the basis of extrapolation from the number of new species and new records in this report I estimate that the number of demosponges inhabiting the Maugean province is about 500.” Furthermore, J. Hooper (pers. comm.) commented that Bass Strait is the meeting place of two provinces — Flindersian and Peronian (Wilson and Allen 1987) — therefore it is likely that this is an area of very high diversity. This prediction is based on a similar area of meeting of two provinces in NSW — Peronian and Solandrian (Wilson and Allen 1987) — described in Hooper *et al.* (2002), which supports a highly diverse sponge fauna. However, Hooper stressed that it is necessary to work up the material already held in museums but not yet examined, to confirm or deny this expectation.

Similarly, the octocorals and bryozoans from Bass Strait in particular, and from the southeast Australian region in general, are relatively poorly known and many are undescribed (K. Gowlett-Holmes pers. comm.). Grasshoff (1982) comments on the lack of knowledge of the southern Australian species of sea fans. Bock (1982) notes that the bryozoan fauna of southern Australia is in need of revision.

There are 210 ascidian species recorded from southern Australia, and many new species are still being collected from these waters, suggesting that knowledge of the southern Australian ascidian fauna is still sketchy. The temporal element includes 79 indigenous species from the central to eastern part of southern Australia, and 35 Flindersian species, with another 49 temperate species that have a wider distribution (Kott 1997).

Eighty-one species occurring in the area are covered by one or more provisions of the *Environment Protection and Biodiversity Conservation* (*EPBC*) *Act* (*EPBC Act* 1999). Of these 7 species (3 whales, 3 sharks and 1bony fish) are not listed marine species but they are listed threatened species under the *EPBC Act*. Bass Strait harbours, in total, 25 listed threatened species: one shark is listed as critically endangered; 4birds and 2 whales are listed as endangered; and 14 birds, 2 sharks, 1 whale and 1 bony fish are listed as vulnerable. The listed marine migratory species include 18 birds, 1 shark and 3 whales (EA 2000). Non-marine birds that overfly the region are not included. Appendix 4 summarises the listed threatened, listed marine migratory, and listed marine species occurring in the Bass Strait region. While Appendix 4 includes an indication of the type of presence of each species in the area, it is beyond the scope of this report to give details on habitat range, habitat restrictions and seasonality of habitat usage by each of the 78 species.

Ten species of fish and 4 species of invertebrates are consistently targeted by a variety of fisheries in Bass Strait (Appendix 5) (Larcombe *et al.* 2002).

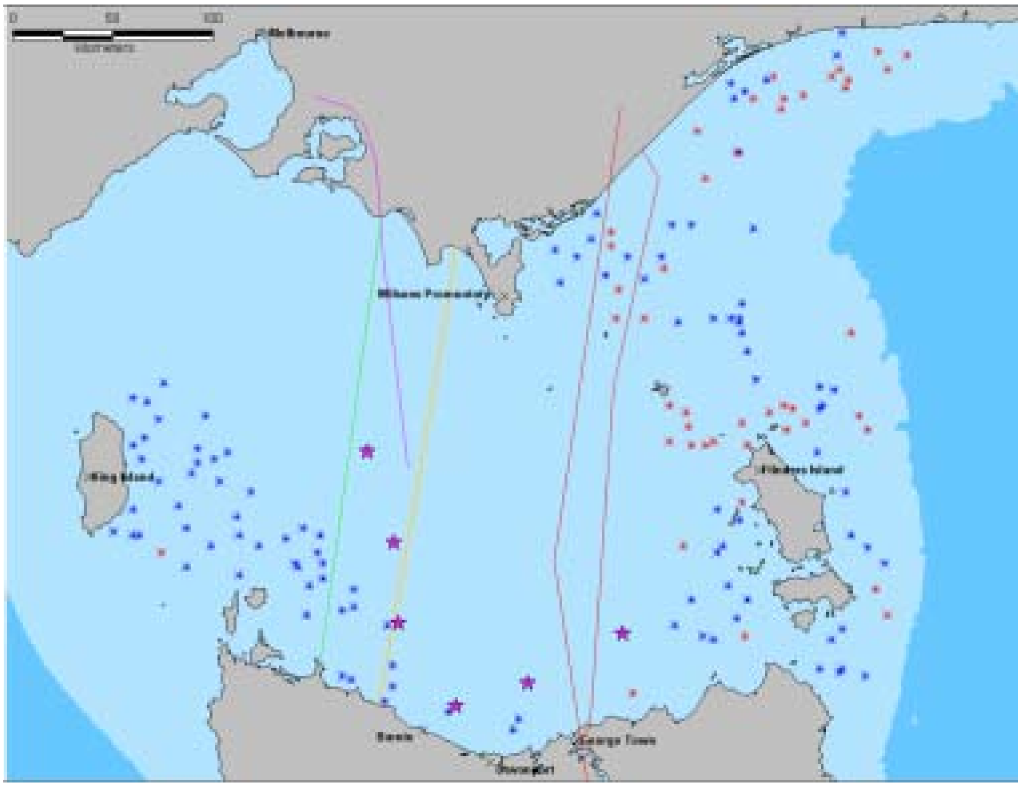
Abundance and distribution

As mentioned above, this assessment was initially focussed on the region of the 6 trawl stations (Fig. 6) of the Bass Strait Survey conducted by Museum Victoria that yielded substantial quantities of sponges (Plates 1 and 2). These stations form an arc along the 65-75 m contour in southern Bass Strait (O'Hara 2002). However, O'Hara (2002) notes that smaller amounts of sponges were also collected throughout Bass Strait, particularly south of Cape Otway and on the Gippsland shelf. In the latter area, scallop-dredging stations of the 1988 survey conducted by CSIRO also noted patches of sponges (unpublished data from scallop surveys 1988, Fig. 8). Furthermore, Williams *et al.* 2000 observed patches of sponges in the Gippsland Basin. However, the sheer volume of sponges collected in the 6 stations in southern Bass Strait distinguished that area during the Museum Victoria survey (T. O'Hara pers. comm.). It can only be assumed from the general associations of octocorals, bryozoans and ascidians with sponges, that these three taxa are also abundant in the stations dominated by sponges.

Plate 1: Sponge catch from the Museum Victoria surveys 1979-1984 (picture curtesy T O'Hara, MV)

Plate 2: Sorting the sponge catch from the Museum Victoria surveys 1979-1984 (picture curtesy T O'Hara, MV)

The above evidence suggests that there are sponge patches throughout Bass Strait but perhaps particularly dense beds in the region of the six Museum Victoria stations south of Bass Lake. This evidence, however, is not sufficient to establish the distribution and abundance of the sponge beds with any confidence. For example, sponge beds are frequently patchy in occurrence and a trawl taken through a series of small but dense beds would produce the same large catch of sponges as another trawl taken through a more even, but sparser, stand of sponges extending over a wider area. These different possibilities cannot be resolved with the Museum Victoria data alone, but would require additional surveys involving very frequent bottom sampling or, ideally, video transects of the sea floor.



/ Scallop Survey stations with/without sponges noted in the dredge
—— location of proposed Duke Energy Pipeline surveyed by CSIRO in 2000
—— approximate location of a proposed pipeline track surveyed by Consulting Environmental Engineers in 2002 for Origin Energy
—— existing communications cable (BS1) surveyed by Hydro Tasmania in 2002 for Telstra
—— no anchor boundary of BS1
—— proposed cable track (BS2) surveyed by Hydro Tasmania in 2002 for Telstra
★ Museum Victoria survey, sponge dominated trawl stations.

Fig. 8: Map of station locations for the Bass Strait Scallop Survey conducted by CSIRO, 1988 as well as the approximate routes of recent video surveys conducted as part of environmental assessments of proposed cable/pipeline tracks.

A small section of the southeast Bass Strait – following the proposed track of a gas pipeline (Fig 8) – was recently surveyed with drop cameras by CSIRO, commissioned by Hydro Tasmania for Duke Energy. No significant biological communities or species that might indicate immediate rejection and repositioning of the proposed pipeline route were found (Karen Gowlett-Holmes and Bruce Barker, pers. comm.). Specifically, no sponge beds were observed.

Consulting Environmental Engineers have recently (August 2002) conducted a video survey commissioned by Origin Energy in that area (S. Chidgey pers. comm.). Dr Chidgey reports: "We video surveyed over 20 sites from Kilcunda to the proposed Yolla development in central Bass Strait approximately 140 km offshore from Victoria (Fig. 8). Most of the seabed was bare sand to sandy silt with sediment waves or ripples and occasionally shell (doughboy scallops and other bivalves). We saw no sponge 'gardens' at any site. One of the sites was the same as a site surveyed by the museum in the 1980's (navigation is much more accurate now with GPS than it was when the museum surveys were done). Epibiota on the soft seabed was very sparsely distributed. Sponges were very sparsely distributed over the seabed as individuals (such as pumpkin sponges) or in sparsely distributed small clumps of mixed sponges and bryozoans (clumps less than 1 m across)."

Hydro Tasmania also recently conducted a survey along the proposed route of a second Telstra communications cable (BS2) from Inverloch (Vic) to Stanley (Tas) (Fig. 8). This survey included video footage of a number of quadrats along the cable route of BS2 in mid Bass Strait, as well as some footage along the existing Telstra cable (BS1) that had been laid in 1995 (Fig. 8) (P Greilach pers. comm.). P. Greilach reports that only sporadic colonies of sponges were noted at depths greater than 40 m. The only extended patch was a thin line of sponges, running north-south along the route of BS1 in water depths of 40-75 m. He suggested that these organisms used the cable or some hard substrate exposed in the laying of the cable as a substrate for attachment (P. Greilach pers. comm.). Along the 40 m depth contour off Stanley, an area last fished for scallops in 1991, some sponge patches were seen. These were approximately 1 m across and 5 m apart (P. Greilach pers. comm.).

We interpret the available data and other circumstantial evidence as best we can in this assessment, but it must be stated here that the abundance and distribution of sponge beds in Bass Strait is not known with sufficient clarity to permit design of effective conservation measures. It is clear from the recent surveys, coupled with the results from the 1988 scallop surveys shown in Figure 8, that there are *not* sponge beds densely, extensively and uniformly distributed over central Bass Strait. This view is confirmed by the comments of fishers with whom we spoke; they consider the central Bass Strait area something of a "desert" and no-one has reported to us observations of dense sponge beds, or high catches of sponges in fishing gear. It is easier to report what there is *not*, than to be confident of what *is* present, especially in the southern part of central Bass Strait, since neither of the surveys reported above completely overlaps the arc of the original museum findings (see Fig 8); clearly we still have great uncertainty concerning the abundance and spatial distribution of sponge beds in that area.

Life history and behaviour

Sponges (Phylum Porifera)

The ecology and life history of sponges are described by Bergquist (1978), and Bergquist and Skinner (1982); we make only brief remarks here.

Commonly described as the simplest multicellular animals, sponges are, nevertheless, very complex sedentary filter-feeding organisms. They stand in organisation between protozoa, where individuals are independent cells, and the higher metazoa, which have cells arranged in tissues and organs specialised for particular functions. Although their shape is most often massive (i.e. an irregular lumpy shape without a regular outline), they can be massive with a predictable, species-specific shape (branched, encrusting, or in many cases variable within the one species) depending on the conditions under which the specimen is living. This variety in form and shape is clearly illustrated in Shepherd and Thomas (1982) and Edgar (1997). The rate of growth and longevity varies enormously in this Phylum; some species reproduce and die within less than a year, others live for decades or more than a century. Like many modular organisms, most sponges show more or less indeterminate growth rather than the steady growth to a predictable upper size that is typical of unitary organisms (eg people). Some may stay at almost the same size for a period, until disturbance clears neighbouring space, when they may then grow very rapidly (Ayling 1983). Reproduction of sponges can be sexual with the production of free-swimming larvae, or asexual through fragmentation (a piece simply breaks off and continues to grow as an individual), budding (formation of special buds that are then released), or through the production of complex gemmules. This variety in reproductive techniques results in sponges being efficient colonisers of marine hard surfaces although they will not typically colonise a newly cleared surface as rapidly as some other groups (eg bryozoans) (Butler 1986, 1991). Once established, sponges are effective competitors in retaining living space (Kay and Keough 1981, Keough 1984a, Keough 1984b, Butler 1991) through asexual reproduction and by using chemicals to deter competitors and predators (Paul 1992, Davis *et al*. 1991, Butler *et al*. 1996). Some sponges have symbiotic, phototrophic organisms associated with them, which contribute to their nutrition (Cheshire *et al*. 1995).

Sponges are sessile filter feeders; they flourish in waters where the water movement is strong. However, they pump water actively, thus they are not reliant on strong currents in the way that passive filter feeders such as gorgonians are. Nevertheless, they have important and complex relationships with ambient currents and can be described as combined passive-active suspension-feeders. The forms of sponges typically found in areas such as the Bass Strait sponge-beds area depend strongly on their colony form, to augment the flow of water through the filtering chambers of the animal. So the relationships between the sponge community and ambient water movement are important, and likely to vary throughout the area in quite subtle ways (Wildish and Kristmanson 1997). Details of the patterns of water movement are also likely to be important in the dispersal of sponges, particularly if their distribution on the sea floor in Bass Strait is patchy (McEdwards 1995, Wildish and Kristmanson 1997). Most species need some hard substrate for attachment, although some sponges grow on soft bottoms by welding shell fragments into a base. Large sponges are host to a myriad of commensal invertebrates, including crustaceans, molluscs, worms and echinoderms, as well as microorganisms. However, only few specialised species feed on sponges, due to their often highly developed chemical defence (Paul 1992, Bergquist 1978). For fish, they are in general unpalatable, but they may present shelter, and food, in form of their associated species.

Octocorals (Sub-class Octocorallia, Phylum Cnidaria)

All Australian Octocorals are colonial; colonies are formed through asexual budding and branching of the original primary polyp — the sessile life stage of cnidarians, that is formed from the sexually produced, free-living planula larva. Octocorals are sessile in the adult form, in general attached to a hard surface, although some species can anchor themselves in sand or mud. Octocorals are passive filter feeders, sometimes having a colony form that aids their capture of particles from water moving past the colony; this is particularly spectacular in seafans (order Gorgonacea), and well illustrated in Edgar (1997). Many seafans, in particular, harbour polychaetes or crustaceans, which create larger or smaller galls in the colony, making their home in the tissues or coelenteron of the host. Crinoids and ophiuroids often attach themselves to the colony to gain better access to water currents for feeding (Grasshoff and Verseveldt 1982). There is evidence that octocorals are chemically defended (Paul 1992).

Bryozoans (Phylum Bryozoa)

Bryozoans are colonial, mostly marine, and in general sessile filter feeders. The great variation in shape and colour of colonies is widely illustrated (eg Coleman 1981, Edgar 1997, Furlani 1996). Sexual reproduction results in free-living larvae, which form colonies through asexual reproduction after settlement. In general, growth rates and longevity have not been determined for local species, although some work has been done on shallow-water species (Kay and Butler 1983, Klemke 1993, Webb 2001). Depth and current strength are considered significant factors of the environment for these animals; there have been studies of the complex relationships between bryozoans and water movement elsewhere (Okinawa 1984, 1985, 1988, 1992) but no detailed local studies (Bock 1982). Many bryozoans use chemicals as well as spines, etc, as a predator deterrent (eg Paul 1992) and thus they have only relatively few, specialised predators.

Ascidians (Class Ascidiacea, Phylum Tunicata)

Ascidian life history and ecology are described by Kott (1997); here we paraphrase and summarise her descriptions. Ascidians are sessile, active filter-feeding organisms that include both solitary and colonial species, as illustrated in Edgar (1997) and Furlani (1996). Colony structures of various complexities are known within this group, but colony shape, size and pattern of growth are species specific. They reflect the type of substrate and properties of the water currents to which a species is adapted. Reproduction in ascidians includes both asexual budding and sexual reproduction with a free-living larval stage.

Ascidians are one of the most important components of the filter feeding fauna in most benthic habitats (Kott 1997, Keough and Butler 1995, Sebens 1985). Only limited information on predators is available, but they include some fish, molluscs and seastars. While some species are known to contain toxins, which deter predators, and settling larvae (Paul 1992, Davis *et al.* 1991), most solitary species have tough tests and colonial species a great ability to rapidly repair any damage through vegetative growth. The internal morphology of solitary ascidians, with large open spaces, provides habitat for many commensal species, such as small crustaceans. Ascidians contribute substantially to habitat complexity in the epibenthos.

Key processes

The filter feeding fauna plays a significant part in the energy cycle of marine communities, efficiently concentrating the energy from small organic particles, bacteria and phytoplankton and passing it on to their predators (Kott 1997, Gili and Coma 1998). As mentioned above, sponges, and to some extent bryozoans, have only a limited number of specialised predators, thus limiting the energy flow described. However, the large and often complex structures of the four principal taxa forming ‘sponge beds’ increase the complexity of the benthic habitat and thus influence the presence and/or distribution of other seafloor fauna (O’Hara 2002), including commercial species.

No studies have been conducted in this area to measure functional role, but in other areas (e.g. Lemmens *et al*. 1996, Hewitt *et al*. 1999, Davenport *et al*. 2000, Lehane and Davenport 2002) studies show that filter-feeders can have substantial connections with other parts of the ecosystem.

Discrete biological units within assessment area

It is currently unknown if there are distinguishable biological units within the assessment area. At present, we know that large catches of sponges have been taken at certain sites, but these were few, and widely spaced. We have no way of knowing whether these catches represent a uniform cover of sessile fauna on the seafloor, or a series of discrete, small patches "lumped" by the trawl. So, the spatial distribution and pattern of the sponge beds is unknown, and most of the species remain unidentified; clearly, there is no basis for the identification of discrete assemblages. New surveys would be needed to establish the spatial patterns of the assemblages whilst taxonomic work is essential to establish their faunal compositions.

Special locations

It is currently unknown if there are special locations within the assessment area. The above comments apply here.

MPA identification criteria

Representativeness

This area is considered special, rather than representative in the sense used by the ANZECC TFMPA (1999) in discussing the establishment of a Comprehensive, Adequate and Representative (CAR) system of MPAs for Australia. It was initially selected as an "iconic" area, because it was believed to be an area of extensive sponge beds. Although not selected as part of the CAR system, the Central Bass Strait meso-scale region is not represented in any MPA, so any creation of an MPA in this area would increase the representativeness of the system.

Comprehensiveness

This criterion is not applicable for the present assessment.

Ecological importance

Large sessile invertebrates such as sponges, bryozoans and gorgonians, are habitat forming biota, supporting epizoic fauna, providing shelter for mobile, demersal fauna and contributing to trophic dynamics, as described in the life history and behaviour section. They are also an important determinant of fish habitats, and/or feeding grounds (van Dolah *et al.* 1987, Sainsbury *et al.* 1997, Öhman and Rajasuriya 1998, Williams *et al*. 2000, Williams *et al*. in prep).

International / national importance

The preservation of sponge beds is in the national/international interest in relation to conserving biodiversity. In addition to this, future research into bioactive compounds may identify beneficial products from sponges or other sessile fauna endemic to this region, but as yet unidentified.

Uniqueness

At this stage we cannot confidently comment on the uniqueness of the sponge beds in southern central Bass Strait. 'Beds' of sessile fauna occur throughout southern Australia and, as mentioned previously, patches of sponges and associated fauna have been observed throughout Bass Strait and in particular in the area of the Gippsland Basin (unpublished data from scallop surveys 1988, Kloser *et al*. 2001, Williams *et al*. in prep.). However, neither the collections of the Museum Victoria surveys, nor the ones from Kloser *et al*. (2001) have been examined by experts in a way that would allow a direct comparison. Nevertheless, expert opinion suggests that the central Bass Strait fauna may be expected to be especially rich (i.e. there are many different species; this does not specify their densities or spatial distribution) for several reasons. Firstly, it is likely to be a meeting or overlap zone between two biogeographic provinces (J. Hooper pers comm.). Secondly, the diversity of other groups, which have been studied in more detail, is high in this area and that suggests the same would be true throughout the fauna (e.g. Womersley 1984, Kott 1997, O'Hara 2002). In particular, the pycnogonids and certain gastropods are associated with sessile fauna and so the exceptional diversity of the former supports at least high abundance and complexity, and probably high diversity, of the latter (O'Hara 2002). Thirdly, the southern central Bass Strait is likely to have been relatively little impacted by the effects of human activities.

Productivity

With the present limited knowledge of the species involved, of the extent of any sponge beds in central Bass Strait, or of any details about ecosystem function in the area and the functional roles of sessile filter-feeders, we cannot comment on the productivity of the area.

It is, however, not considered by fishers to be a highly 'productive' area in a fisheries sense.

Vulnerability

The Bass Strait sponge beds may be vulnerable to natural processes such as extreme storm events that may result in dislodgement or smothering of some of the organisms. However, this is very unlikely to occur. Vulnerability of the assessment area and the sponge beds to anthropogenic processes is discussed below.

Biogeographic importance

Central Bass Strait was identified by IMCRA Technical Group (1998) (Fig. 7) as a meso-scale region in the demersal Province of Bass. Bass was recognised as a province rather than a biotone, indicating that its fauna is distinct from other provinces. As described in Table 1, however, the Bass province is weak, defined by only a few, endemic species with narrow ranges. This classification is principally based on demersal fish, which are highly mobile in comparison to sessile epibenthos; it is thus feasible that the Bass province is more clearly distinct from its neighbouring regions in regard to large sessile epibenthic species. As noted above, the best judgements that several experts could make (given that the sponge samples from this area have not yet been studied in detail) suggest that the fauna is likely to be not only distinct, but also exceptionally diverse.

Naturalness

Bass Strait has been fished since the arrival of Europeans in the area. In the late 18th and early 19th centuries, sealing and then whaling were practiced extensively in the region; once these industries became unviable, trawl and then Danish seine fisheries developed (Gilmore 1974). Nowadays, Bass Strait is a multiple-use area supporting several fisheries, containing current offshore petroleum leases, and being traversed by a multitude of shipping routes, as well as by a few sub-marine cables and pipelines (refer to next section).

Current and potential uses and existing management regimes

Fisheries

Many freight and fishing ports are situated in Bass Strait (Fig. 9). The main fishing methods used in central Bass Strait are gillnetting, scallop dredging and lobster trapping, as well as some squid jigging (Figs. 10 to 14); where the data was available to us, we mapped fishing effort rather than catch rate since this is a better indicator of the potential impact of a fishery on benthic fauna. In Appendix 5 we list the main species caught by the various fisheries. Despite the variety of fishing methods, the southern central part of Bass Strait is virtually untouched by commercial fishing. State and Commonwealth Fisheries effort in Bass Strait, from 1995 onward, are concentrated mostly close to the coast (depths <60 m), and between King Island and Cape Otway. Thus, the muddy central basin (Figs. 1 and 2) remained virtually unfished (Figs. 10 to 16). Of particular interest in the present conservation values assessment are bottom impact fishing gears, such as scallop dredge, bottom trawl and Danish seine. The mapped distribution of fishing, for the Scallop Fishery (Fig. 12), seems to apply also to the years between 1979 (first year of the Museum surveys) and 1994: McLaughlin *et al.* (1988) and Martin *et al.* (1989) report that prior to their studies virtually all scallop fishing in Bass Strait had been restricted to areas around the periphery of the region in water depths of 20 to 60 m; furthermore, unpublished data collated by AFMA, including the years between 1989 and 1995, also supports this distribution of fishing. Both the Trawl and Danish seine Fisheries concentrate their effort outside of central Bass Strait (Figs. 15 and 16).

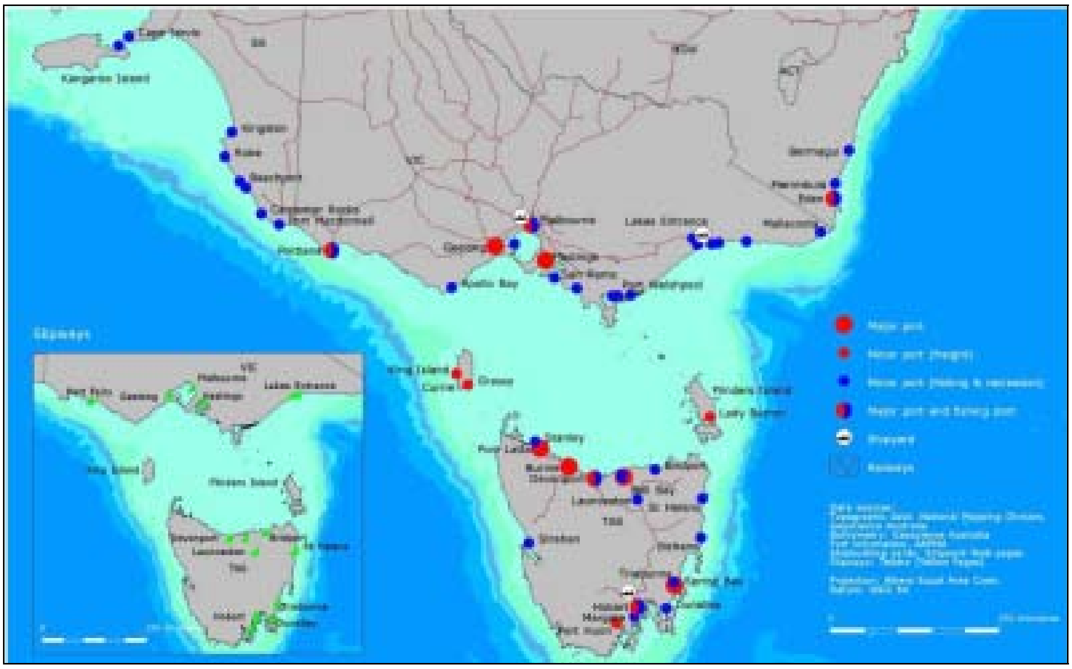


Fig. 9: Major and minor ports, slipways and shipyards in the South-east Marine Region. Reproduction of Map 71 from Larcombe *et al.* (2002).

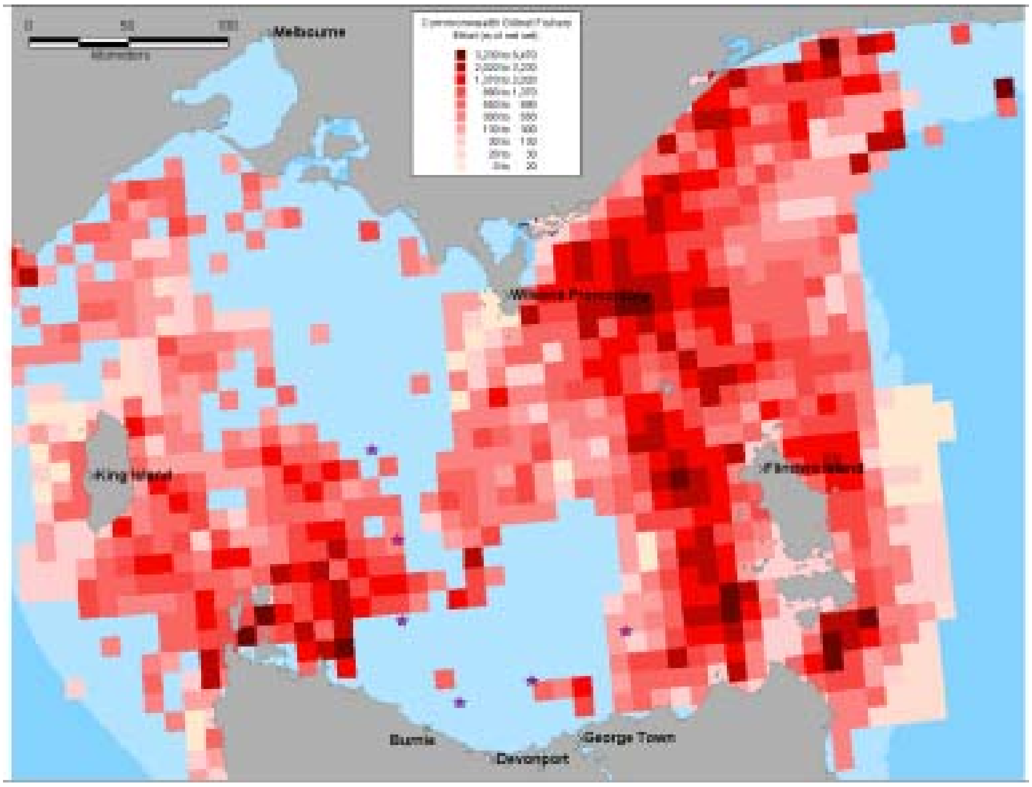


Fig. 10: Fishing effort (m of net set) of the Commonwealth Gillnet Fishery in Bass Strait, 1997-1999. Pink stars: Sponge dominated trawl stations of the Museum Victoria surveys. Cell size 10 km, cells with less than 5 boats excluded. AFMA data, BRS supplied

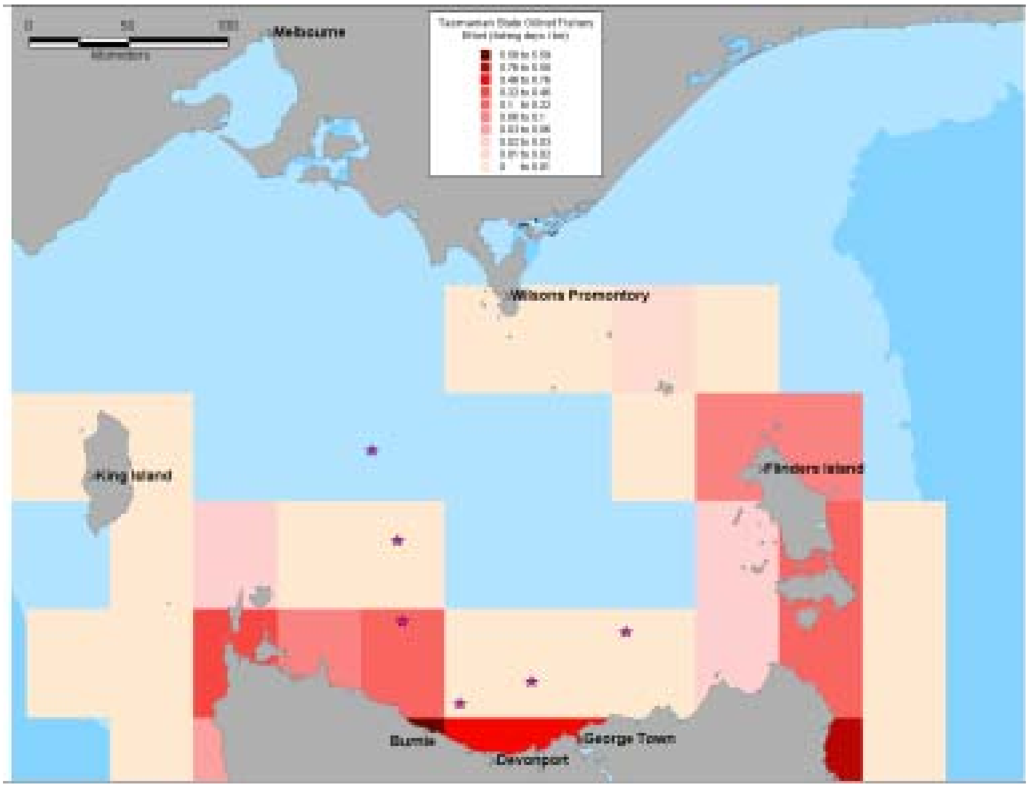


Fig. 11: Fishing effort (fishing days /km) of the Tasmanian State Gillnet Fishery in Bass Strait, 1995-1999. Pink stars: Sponge dominated trawl stations of the Museum Victoria surveys. Cell size 1°. Tasmanian Fisheries data, BRS supplied.

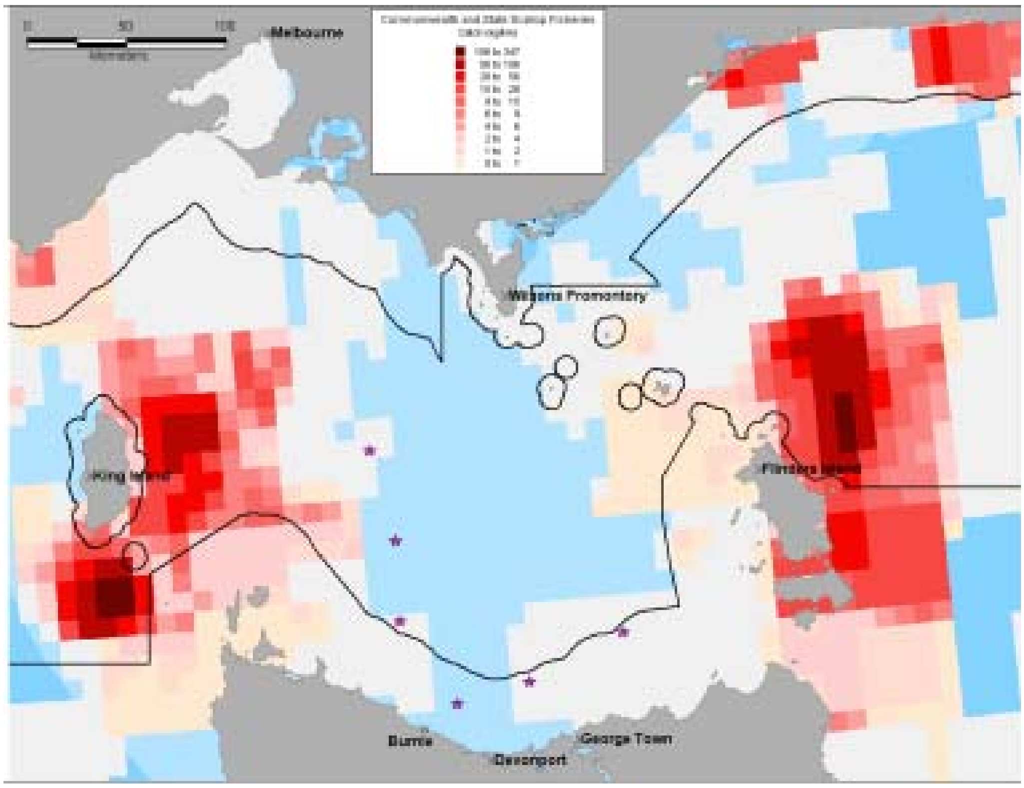


Fig. 12: Catch rate (kg/km) of the Commonwealth and State Scallop Fisheries in Bass Strait, 1995-1999. Black outline: the border of the Central Zone Scallop Fishery (Commonwealth). Pink stars: Sponge dominated trawl stations of the Museum Victoria surveys. Cell size 10 km, cells with less than 5 boats masked (light grey). AFMA and the respective State Fisheries data supplied by BRS.

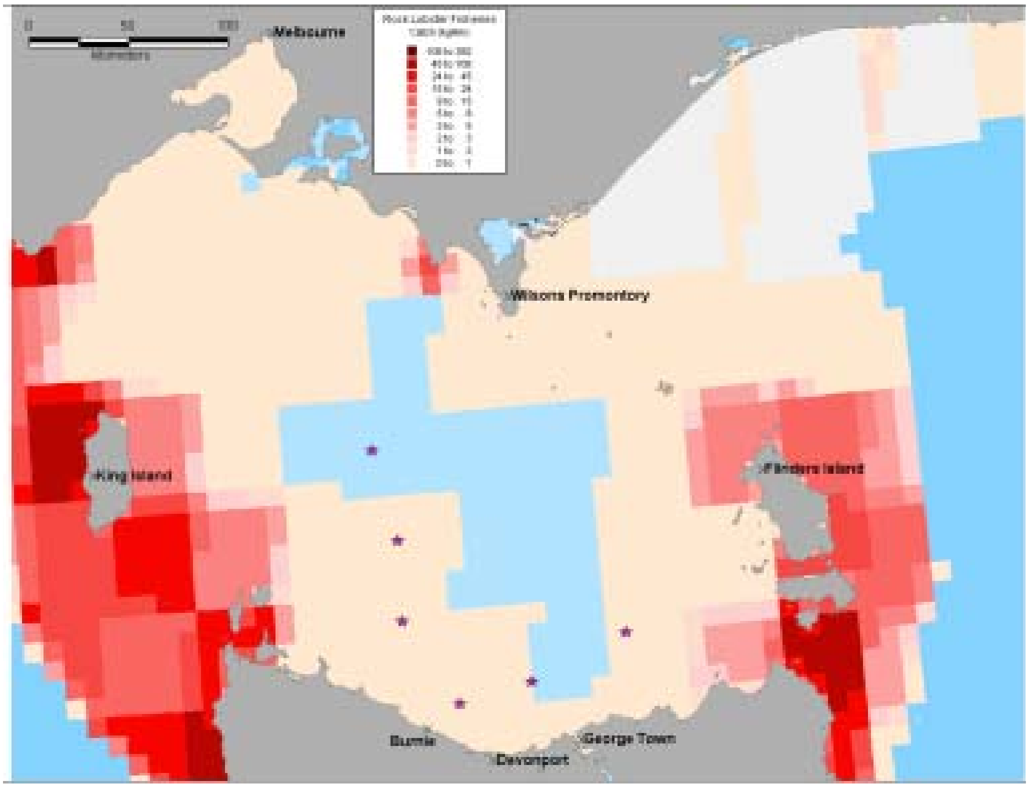


Fig. 13: Catch rate (kg/km) of the combined State Rock Lobster Fisheries in Bass Strait, 1995-1999. Pink stars: Sponge dominated trawl stations of the Museum Victoria surveys. Cell sizes of reporting: Vic: 10', Tas and NSW: 1°; cells with less than 5 boats from Vic and NSW were masked (light grey). Respective State Fisheries data, BRS supplied.

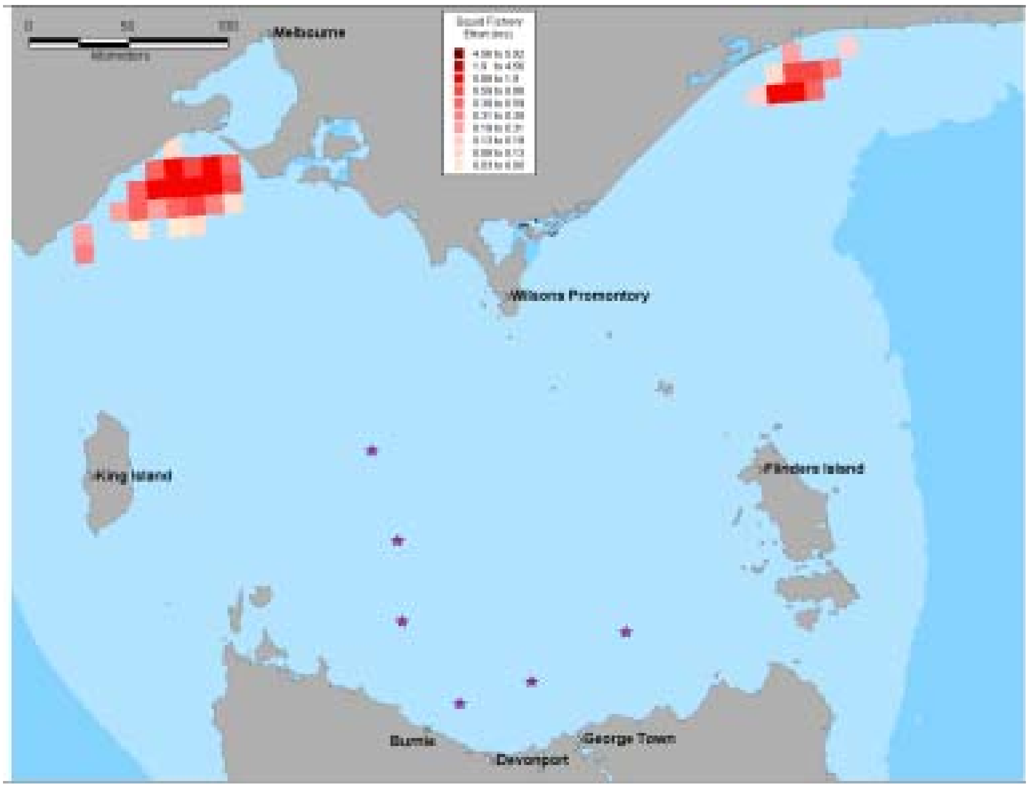


Fig. 14: Effort of the Commonwealth Squid jig Fishery in Bass Strait, 1995-1999. Pink stars: Sponge dominated trawl stations of the Museum Victoria surveys. Cell size 10 km, cells with less than 5 boats excluded. AFMA data, BRS supplied

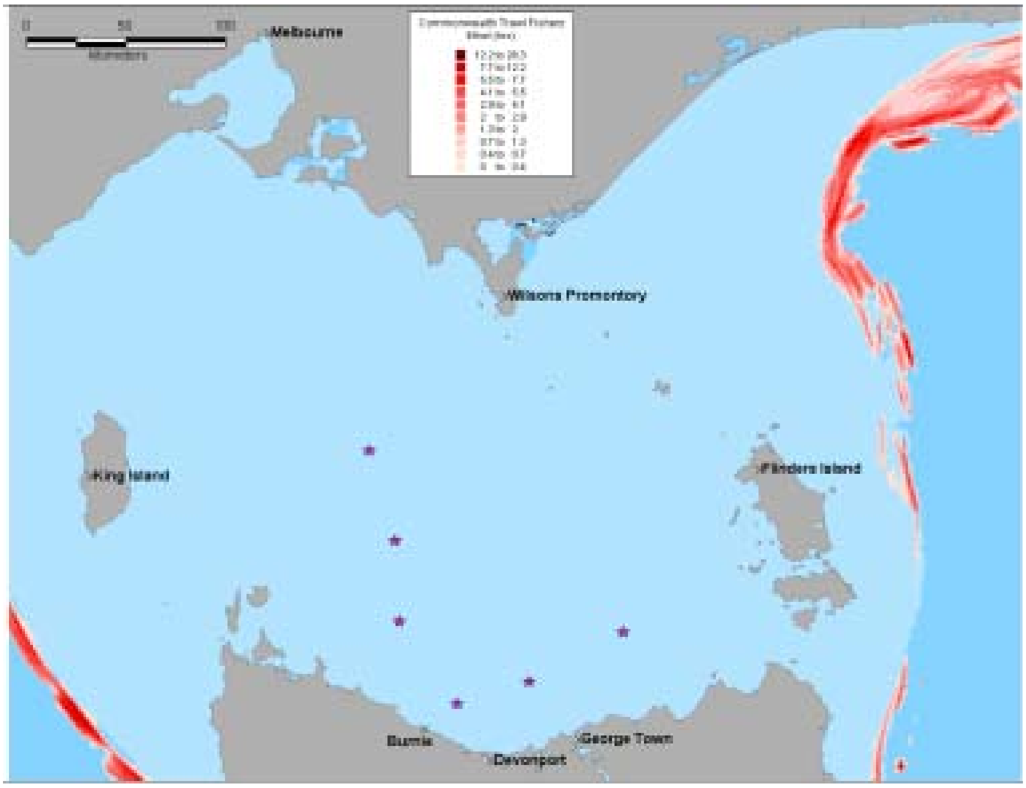


Fig. 15: Fishing effort (hrs) of the South-east Trawl Fishery in Bass Strait, 1995-1999. Pink stars: Sponge dominated trawl stations of the Museum Victoria surveys. Cell size 1 km, cells with less than 5 boats excluded. AFMA data, BRS supplied.

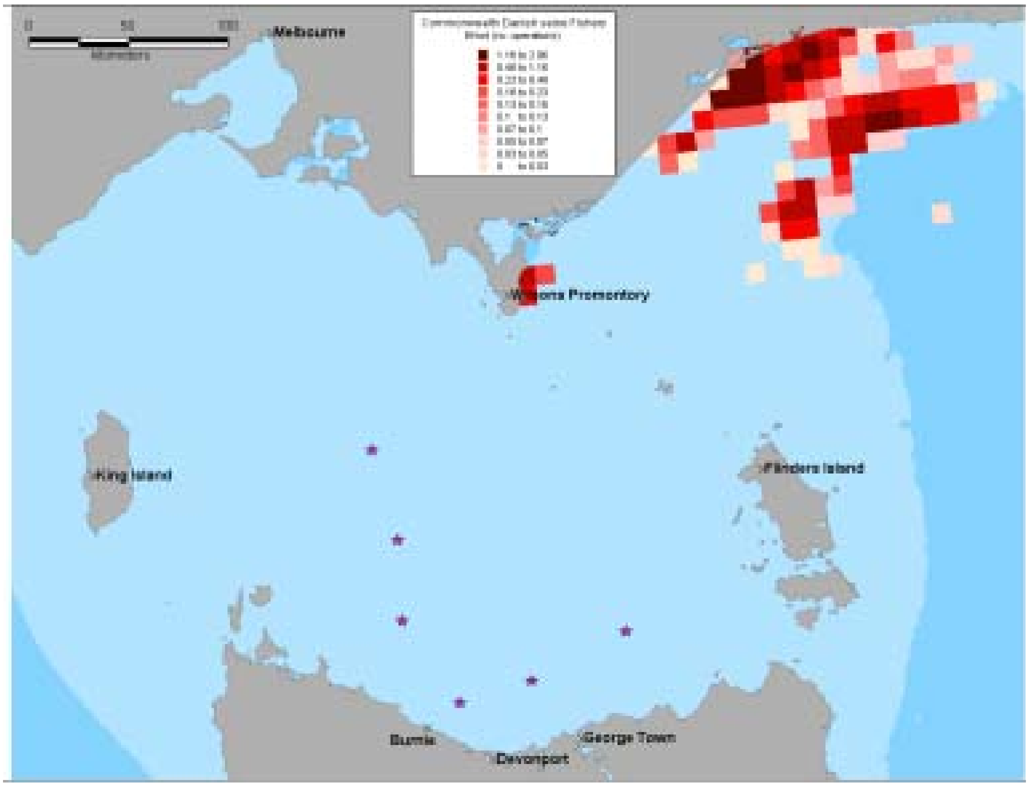


Fig. 16: Fishing effort (no. operations) of the Commonwealth Danish Seine Fishery in Bass Strait, 1995-1999. Pink stars: Sponge dominated trawl stations of the Museum Victoria surveys. Cell size 10km, 5 boats excluded. AFMA data, BRS supplied.

Minerals and petroleum

The Gippsland Basin at the eastern edge of Bass Strait is being heavily exploited: out of the 701 wells, 554 are producing and an additional 35 are potentially producing. Most discoveries are oil (454), and oil and gas wells (80). Currently 17 platforms (8 oil, and 9 oil and gas) are under operation in that region (Fig. 17). Furthermore, increasing demand, together with deregulation and recent reform of the upstream and downstream gas industry, has provided the impetus for renewed exploration activities in the area. This has resulted in an increase in exploration activities in the Gippsland Basin and the discovery of oil at East Pilchard, south of the Kipper Field, in 2001. As a consequence, three new areas are currently open for bids (GA 2002a).

The centre of the Bass Basin is under acreage release (Fig. 17) and much of Bass Strait has been surveyed using 2D seismic techniques (Fig. 18). The Bass Basin has been only lightly explored and, although encouraging indications of hydrocarbons have at times been encountered and tested, none of the discoveries has led to commercial development (Baillie *et al.* 1991). Unpublished data from Geoscience Australia indicates that, in the Bass Basin 35 exploration wells had been drilled, but there are only 7 potential producers. Summarised by hydrocarbons discovered in these, there are: 10 gas, 5 minor gas, 2 oil and gas, and 18 dry wells (Fig. 17). In recent news, Yolla gas and liquids project plans to produce 20 PJ of gas per annum, representing ~10% of Victoria's current consumption; as well as 13.5 mmbbl condensate and 1,000 kilotonnes of LPG over the Elgas contract period (4/02 - news.ogtoday.com – GA 2002b). Currently, two areas in western Bass Strait, north of Tasmania and east of King Island (75 m depth), are open for bids, closing in April 2003 (GA 2002b).

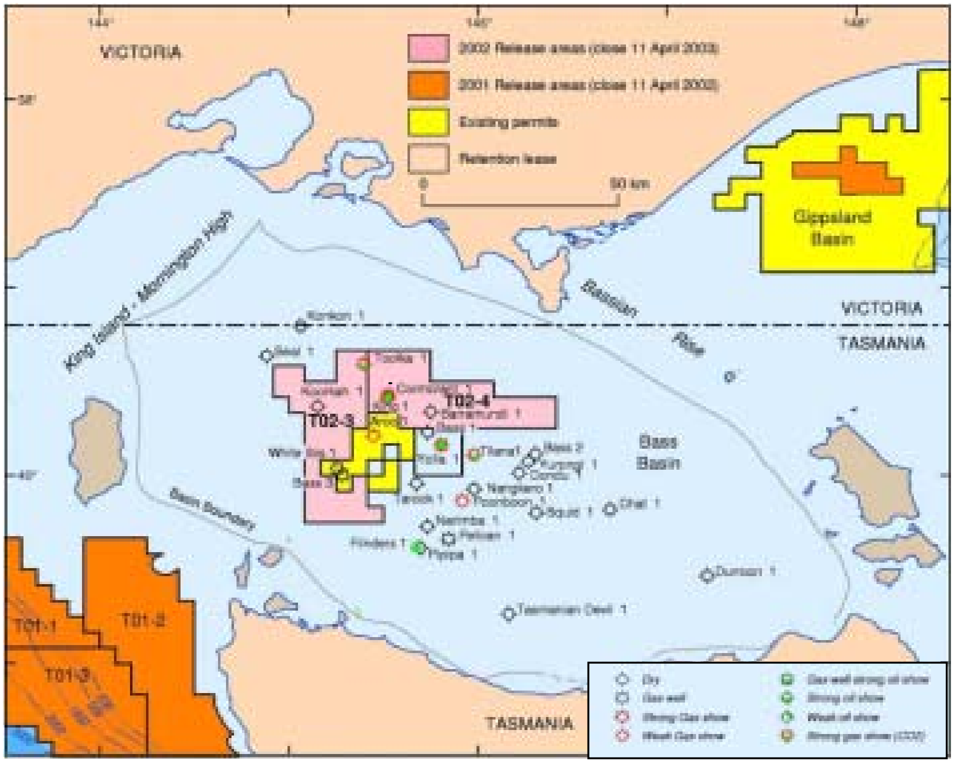


Fig 17 Exploration wells in the Bass Strait identifying the 2002 release areas T02-3 and 4. Reproduction of Figure 2 from 'Bass Basin release area T02-3 and 4' in Department of Industry Science and Resources (2002).

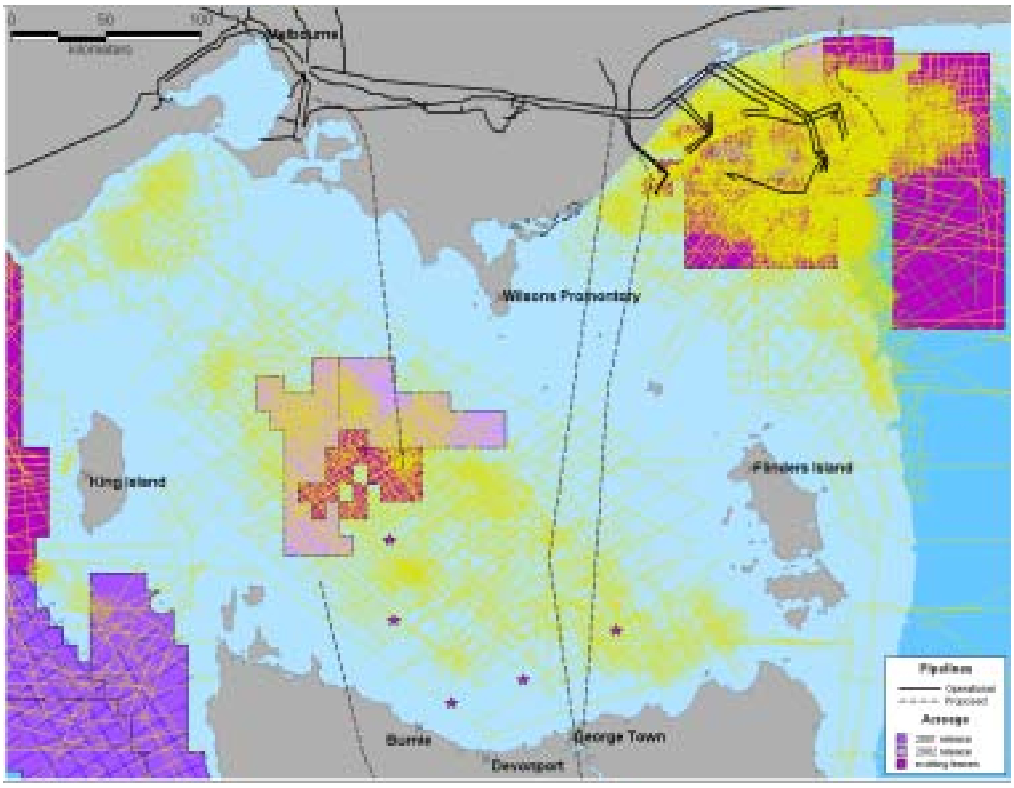


Fig. 18: Seismic surveys that have been conducted in Bass Strait (yellow: 2D, blue and green 3D), overlaying the pipeline tracks (proposed and existing) and acreage releases. Pink stars: sponge dominated trawl stations of the Museum Victoria surveys. Data supplied by GA

Sub-marine cables and pipelines

There are a total of six routes of submarine cables in Bass Strait (Fig. 19). Four of these cross our focus area: the route of cables laid between 1869 and 1909, a currently operational communications cable operated by Telstra, and the proposed routes of 'Basslink' and a second Telstra operated communications cable. While there is an exclusion zone around the operating communications cable, it is planned to bury the proposed second cable deep enough such that no exclusion zone is needed (B. Free pers. comm.).

In addition to the cables Duke Energy is currently laying a gas pipeline across Bass Strait from Seaspray to Low Head, and there are 2 further proposed pipelines connecting wells with the Victorian and Tasmanian coast respectively (Fig. 18). Exclusion zones will be necessary around any gas/oil pipelines.

Environmental impact surveys were conducted for the existing Telstra cable (BS1), as well as for the proposed cables and pipelines. While only geological and sediment data was collected during the surveys of the offshore regions of BS1 and the Basslink cables, for the Duke Energy pipeline, 2002 surveys of the proposed pipeline from the Victorian shore to the centre of Bass Strait and of the routes of both Telstra cables (BS1 and BS2), video footage was collected. As described previously, none of this footage has shown any extensive sponge beds.

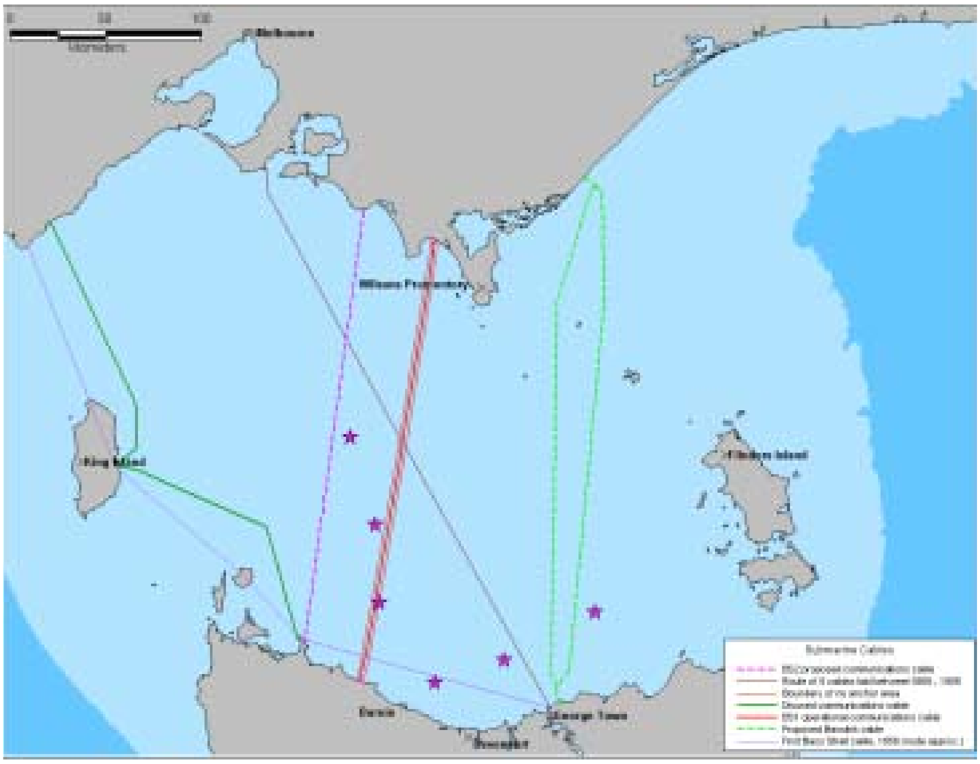


Fig. 19: Submarine cables in Bass Strait, data supplied by BRS. Pink stars: Sponge dominated trawl stations of the Museum Victoria surveys.

Tourism and recreation

On the Victorian coast, most charter boat operators are situated on the shores of Port Phillip Bay and Western Port Bay, with another concentration of operators near Port Albert. Only a few charter boats operate out of the northern Tasmanian ports and one from Lady Barron (Larcombe *et al.* 2002).

In Australia's southeast, there are typically 12 offshore yacht races held each summer, about half of which cross Bass Strait (Larcombe *et al.* 2002).

Maritime transport

Bass Strait is an intensely used area for passenger traffic, as well as freight movements, between mainland Australia and Tasmania. Furthermore, it is also a transit route for shipping traffic connecting the eastern and western ports of Australia (Larcombe *et al.* 2002). Figure 20 summarises the volumes of shipping traffic passing through Bass Strait between 1999 and 2000. The passenger service in Bass Strait is under three operators, TT-Line, Southern Shipping Service and Holyman Shipping. TT-Line has been operating the Spirit of Tasmania between Devonport and Melbourne, and the highspeed catamaran Devil Cat between George Town and Melbourne. The Spirit operated all year round, crossing in each direction on 4 days per week, while the Devil Cat operated in the summer months (December to early April) to cope with the excess capacity required. In 1999-2000 TT-Line carried some 330,000 passengers and 122,000 passenger vehicles (Government of Tasmania 2002, Larcombe *et al.* 2002). In spring 2002, two superfast monohull ferries, crossing daily in either direction, will replace the Spirit of Tasmania and the Devil Cat. Southern Shipping Service operates the Matthew Flinders between Bridport (Tasmania) and Port Welshpool (Victoria) via Lady Barron (Flinders Island) and Deal Island. This service caters to a small but steady sea passenger traffic. In 1999-2000 it carried less than 100 passengers and 30 passenger vehicles. Finally, Holyman Shipping (now Patrick) transports vehicles and freight between Melbourne and Devonport (with a once a week diversion to King Island on the way to Melbourne). No berths are provided for passengers; they must travel by air. It carries ~200 vehicles per year to and from King Island (Government of Tasmania 2002).

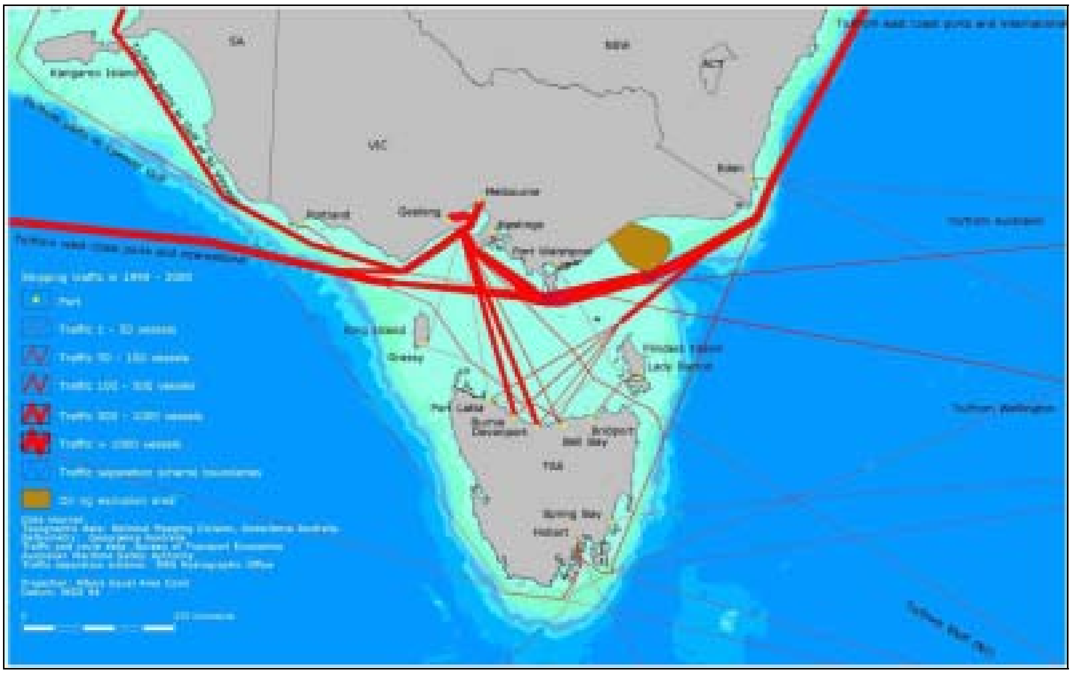


Fig. 20: Shipping routes and traffic volumes (1999-2000) in the South-east Marine Region. Reproduction of Map 69 from Larcombe *et al.* (2002)

Indigenous interests / values

No current or past indigenous "uses", in a narrow sense, have been identified for the seafloor in the relatively deep waters (> 50 m) covered by this report, except that indigenous people already take part in some of the uses noted above (especially fishing).

In a broader sense, however, indigenous people have a stake in the area. Indigenous people have been engaged in the development of the South-east Regional Marine Plan (NOO 2002c). During those discussions, they have made it clear that indigenous people make no distinction between land and sea; they see themselves as having responsibilities and rights across the land and sea boundaries; and they still relate to land that was inundated by sea during the last ice age and regard it as their own. They wish to be recognised as the continued unbroken custodians of the land and seas, with particular rights arising from that custodian status (NOO 2002c, p. 11). In the South-east Marine Region, there were of course many Aboriginal uses (mostly nearshore, rather than in the deep waters where the sponge beds have been reported). These are described in NOO (2002c), which also refers to earlier reports. Aboriginal culture has, in many aspects, a very strong emphasis on sustainability; the indigenous people are therefore concerned about environmental degradation through pollution and over-exploitation of coastal and marine resources and for that reason they want to be involved in marine planning and management.

The area considered in this report was land during low sea-level stands – it was last inundated about 6,000 years ago. The sites where the Museum Victoria survey took large sponge catches are around the southern shores of a lake that occupied the centre of Bass Strait (the depression at 80-90 m depth shown in Figure 1); the sites where other researchers noted abundant sponges are further east, along the ridge running through the Furneaux Group to Gippsland. It is likely that Aboriginal people have lived in Tasmania since at least 22,500 years ago, so people would have moved through the area of Bass Strait many times during low sealevel stands. We found no specific references to stories associated with this area in NOO (2002c); activities that occurred 6,000 years ago are no doubt less important for discussion in the context of the SE RMP than those that were still occurring less than 200 years ago and up until the present. However, the Bass Strait area no doubt did give rise to stories and was, and is, clearly part of the country identified by the aborigines of the area. We would surmise that, as a corridor for travel so very long ago, this area had significance to many (or all) groups of people on both sides of the Strait, not just to the groups whose territories happened to abut the Strait only 200 years ago (from NOO 2002c, Map 1, these were the language groups named Gadubanud, Wathaurong, Boonwurrung, Kurnai, Peerapper, Pyemmairrener, Tyerrernotepanner and Tommeginne).

The region from west of Wilsons Promontory to east of Lakes Entrance is a registered native title (Larcombe *et al.* 2002).

Legislation / management arrangements

The Commonwealth legislation that affects how we use and protect our oceans in the South-east Marine Region is described in NOO (2002f). The management framework of our oceans has arisen historically from sectorial planning and is thus characterised by a multiplicity of legislation — more than 100 pieces of Commonwealth legislation apply to ocean use and ecosystem health (NOO 2002f). In their report the NOO (2002f) have subdivided the sectors into 8 chapters titled: overarching legislative framework of marine regulation in Australia; shipping and related activities; indigenous interests; maritime security; environment protection; living marine resources; seabed and subsoil activities; and tourism and recreation.

The focal point for the present assessment is the chapter on legislation regarding environmental protection, in particular, legislation aimed at biodiversity issues. In Commonwealth waters, these are addressed in the *Environment Protection and Biodiversity Conservation Act* 1999 (*EPBC Act* 1999). It makes provisions for environmental impact assessment and strategic environmental assessment. In relation to biodiversity conservation, it provides protection for nationally threatened native species, internationally protected migratory species, cetaceans and other marine species and protected areas. Thus, proposed actions that are likely to have a significant impact upon listed threatened native species or ecological communities are subject to environmental impact assessment and approval processes (NOO 2002f). Although not a legislative instrument, *The Commonwealth Guidelines for the Ecological Sustainable Management of Fisheries* (EA 2001) play an important role in the assessment of fisheries under the *EPBC Act*— for example, the Bass Strait Scallop Fishery has already undergone such an assessment. None of the organisms that identify sponge beds are currently listed as endangered or of national environmental significance; neither are sponge beds in general classified as threatened ecological communities (EA 1999).

Pollution control — including dumping of waste at sea, and shipping and oil related pollution — does not fall under the *EPBC Act* but is regulated under various part of the *Protection of the Sea Acts 1981 and 1983* (NOO 2002f).

Detailed legislative provisions related to petroleum exploration activities and fisheries are described in the NOO (2002f) report, under the titles ‘seabed and subsoil activities’ and ‘living marine resources’, respectively.

Fisheries management is divided between the Commonwealth and the States, although some fisheries are managed under joint authority arrangements (NOO 2002f). The management of Commonwealth fisheries is administered by the Australian Fisheries Management Authority (AFMA). The Fisheries branch of AFMA is responsible for the Bass Strait Central Zone Scallop; Southern Squid jig, South-east Trawl; Southern Shark and South East Non-Trawl Fisheries, and others not relevant here. The respective state fisheries of Tasmania and Victoria administer state Scallop, Rock Lobster and Gillnet fisheries.

Scientific / educational value

Sessile animals, such as those that constitute sponge beds, have already proved highly useful in increasing our understanding of the diversity of ecological communities and the relationships amongst species in natural communities. There have been studies of the ecology of sessile animals done in southern Australian waters, which have already proven fertile grounds for scientific understanding of the ecology of these kinds of communities (Russ 1980, Kay and Keough 1981, Russ 1982, Fletcher and Day 1983, Kay and Butler 1983, Keough 1983, Keough 1984a, Keough 1984b, Butler 1986, Davis 1987, Davis 1989, Butler 1991, Keough and Butler 1995), and there have been similar studies elsewhere, e.g. Sebens (1985). Most such work, however, has been done in depths readily accessible to divers, and it is likely that the high diversity of the relatively unstudied sessile communities in deeper waters in Bass Strait will lead to further insights.

Current and potential impacts on natural values

The NOO report titled 'Impacts – identifying disturbances' (NOO 2002e) identifies broad categories of disturbance used to define impacts, as well as broad categories of sources of disturbance to the South-east Marine Region. The entire list of disturbance categories from the NOO (2002e) is relevant to the inner and mid-shelf flora and fauna (NOO 2002e). However, we identified more concrete categories of disturbance, which may affect epibenthic communities: bottom impact activities, pollution, biodiscovery, changes in current regimes (mechanical), climate change, and introduced marine species. Despite the potential occurrence of interactions, some are known not to occur currently in Bass Strait Bottom impact activities

Many recent reviews and studies highlight the generally adverse effects of trawl fishing on benthic habitats, particularly on large sessile epibenthic organisms (van Dolah *et al.* 1987, Kaiser *et al.* 1998, Engel and Kvitek 1998, Moran and Stephenson 2000, Pitcher *et al.* 2000). Auster *et al.* (1996), Collie *et al.* 1997 and Collie *et al.* (2000) expanded their research to include other bottom impact gears such as scallop dredges. Auster *et al.* (1996) provide a good summary of the general findings of all these studies: "… mobile fishing altered the physical structure (= complexity) of benthic habitats. Complexity was reduced by direct removal of biogenic (e.g. sponges, hydrozoans, bryozoans, amphipod tubes, holothurians, shell aggregates) and sedimentary (e.g. sand waves, depressions) structures.

Although gillnets, in particular if set in contact with the seafloor, and lobster traps are not categorised as 'mobile fishing gear', they can be snagged on large, sessile epibenthos which may be damaged when the gear is retrieved. The gillnet fishery in southeast Australia mainly sets nets in contact with the seabed (Larcombe *et al.* 2002).

Physical smothering or burial of benthos and alteration of substrate characteristics are usually the main observable effects of drilling discharges on the marine environment; knowledge of plume behaviour and sedimentation rates can be applied to the fate of offshore drilling wastes, provided that sufficient information on the composition of the wastes is available (Hindwood *et al.* 1994).

The initial laying of pipe-lines/cables may result in the removal of epibenthos, however, the presence of established pipes or cables may provide additional attachment points for organisms.

As mentioned above, recent video footage revealed a thin north-south running extended patch of sponges along the cable route of the existing Telstra cable (BS1) (P. Greilach pers. comm.).

Pollution

Terrens and Tait (1994) concluded that produced formation water discharges from offshore development in Bass Strait (Gippsland Basin) create very low environmental risk to marine organisms due to the low toxicity and high dilution rates. Furthermore, they state that 'sediments are unlikely to be a source of hydrocarbons because of the low hydrocarbon concentrations and the buoyant plumes'. Black *et al.* (1994) reach similar conclusions for the environmental impacts of production activities in general. However, it should be noted that both Terrens and Tait (1994) and Black *et al.* (1994) focussed on the existing offshore developments in the Gippsland Basin. Central Bass Strait has a very different current regime to that area.

Oil spills, for example from rigs, shipping activities or pipe-line leakage, can have lethal, as well as sub-lethal, effects such as reduced filter feeding rates, survival and fecundity, on marine benthic communities (Volkman *et al.* 1994). The Bureau of Transport and Communications Economics (BTCE) estimated the probability of a major spill (>1,370 t) occurring in Australia in 1991 to be 49% in the next 5 years, 84% in the next 20 years. The bureau identified the region between Brisbane and Adelaide as generally high risk, with Bass Strait and the Great Barrier Reef being areas of particular concern (Bannister *et al.* 1996).

Discarded fishing gear, and other marine debris, has the potential to become snagged on large sessile epibenthos, damaging the organisms or reducing water flow to their feeding structures.

Biodiscovery

As mentioned above, sponges and bryozoans produce chemicals that deter predation and have antifouling and other ecological benefits to the sessile organism. These natural products can often have pharmaceutical or other values to humans and increasing interest in, and screening for, bioactive compounds may lead to future harvesting of certain species (Paul 1992, Gribble 1994, Kjelleberg and Steinberg 1994, Baker *et al*. 1995). However, the development of new techniques in biodiscovery has greatly reduced the quantities required for initial discovery of bioactive compounds (Hooper *et al.* 1998; Munroe *et al.* 1999; Quinn *et al* 2002). Furthermore, where bioactive compounds are isolated, bulk supply may be achieved by harvesting from natural origins, by aquaculture/fermentation, or by synthesis (Munroe *et al.* 1999); of these methods harvesting of wild populations is generally no longer considered a viable option (J. Hooper pers. comm.).

Changes in current regimes (mechanical)

Current regimes may be changed as a result of the presence of large constructions (including pipe-lines). Organisms defining 'sponge beds' are mostly active filter-feeders (Poore 1990) but drastic changes in the current regime in Bass Strait may still be detrimental to these organisms, due to decreased volumes of food being swept past them, or due to increased deposition of silt smothering these organisms.

To understand current changes around large constructions, they would have to be modelled on a case-by-case basis. Climate change is covered under a separate heading below.

Climate change

Climate change may cause increased temperatures, as well as changes in current regime. Global warming is a result of increasing levels of greenhouse gases (CO_2, CH_4, and N_2O) in the atmosphere. This increase is attributed largely to human activities such as use of fossil fuels, land-use changes, and agriculture (Houghton *et al.* 1995). Temperature changes affect marine biota directly and indirectly (Denman *et al.* 1995). Bass Strait temperatures currently support a temperate biota; increases in temperature may result in the invasion of more tropical species or in the local extinction of the temperate species.

It is beyond the resources of this project to predict current changes due to climate change, particularly since some aspects of the current pattern in Bass Strait are driven by very large-scale events. However, we note that predicted changes to wind patters in this area with a doubling of atmospheric CO_2 are relatively minor and that the strength of winds, and its variance, might decrease slightly (K. McInnes, CSIRO Atmospheric Research, pers. comm.). Thus, locally driven currents may not change greatly.

Introduced marine species

Successful invaders are often able to exploit resources in novel ways, and free of their natural predators, competitors and parasites (Mack *et al*. 2000, Bax *et al.* 2001). Thus, they can direct more resources to growth and reproduction and thereby reduce or eliminate populations of native species through predation, competition or other means (Vitousek *et al.* 1997, Bax *et al.* 2001) Marine species can be introduced through ballast water (Carlton 1999) and hull fouling of ships (Cohen and Carlton 1997), or through natural dispersal from other point of introduction (Hutchings *et al.* 1986, Geller 1994).

Summary

To summarise, there are many activities that pose a threat to sponge beds; the most direct being bottom impact activities. To the best of our knowledge, the area of the stations where the Museum took high sponge catches has been minimally impacted by these activities, and is not recognised to be a target area for such activities in the foreseeable future. However, due to the lack of recent specific information on sponge-bed distribution and abundance within Bass Strait, it is uncertain whether this area is, in fact, significant, and whether there may be other significant areas of sponge-beds within Bass Strait.

Discussion

The spatial distributions of sessile faunal assemblages (including whether or not they occur in dense aggregations that would merit the colloquial term “sponge beds”) are unknown. The early evidence does suggest the occurrence of dense “sponge beds” but this is based on a small number of widely-separated sampling points and needs to be confirmed by surveys with a design that permits assessment of spatial distributions in much more detail. As reported above, neither the limited amount of subsequent work in this area, done for other purposes, nor the just completed video surveys of Consulting Environmental Engineers has rediscovered the sponge beds or clarified their distribution.

To the best of our knowledge, effects of bottom-contact human activities on this Bass Strait area have probably been small compared with other areas of the continental shelf, and other disturbances appear to have been minimal; therefore it is possible that any sponge beds remain in good condition. However, the information available about bottom-contact activities is likely to be incomplete, so we have little confidence in this extremely indirect way of assessing the condition of the seafloor biota. Only if we had recent, direct observations could we be confident that the beds (if there were in fact dense “sponge beds” present in the 1980s) are still present and in good condition. We are not aware, however, of any observations made since the Museum Victoria surveys in the early 1980’s that could confirm or deny this. Again, we advocate surveys to confirm the condition of the beds.

The term “Conservation Values”, of course, implies a value judgement which should not be attempted by us alone; it is for the whole community to decide what is to be valued. However, as scientists, we can comment on the biology, geology, and oceanography of the area and on aspects we think might reasonably be considered valuable.

Functional relationships can be speculated about on the basis of work in other systems and, although they remain unstudied here, are likely substantial – it is reasonable to assume that these, when we do understand them, will prove to be a substantial part of the "ecosystem services" for which biodiversity is increasingly valued in all sorts of ecological systems. For example, on land, bacteria in the soil are now recognised as an important part of the biodiversity because of the ecosystem services they provide (as well as for their intrinsic interest); we are not yet able to make such assessments for the sea, but it is likely that dense stands of filter-feeders will be shown to have a significant role. One value of this area, *if* it is in good condition, will be that it is an excellent area in which to study those processes.

Diversity itself is of conservation value; this is part of life on earth as it has evolved to this point, it is part of our history, and something that many people value and wish to know more about, quite apart from functional values such as those mentioned above. It appears highly likely that the area being assessed here is special in this regard; the whole of southern Australian waters display exceptional species diversity and high endemicity (Kott 1997), and this particular area is clearly as diverse as the rest of the southern Australian shelf, and may be more so because of its local hydrology.

There is no reason to suggest that this area is "unique" – there are areas like it throughout southern Australia. Nor should anyone assume that it has been isolated for a long time and therefore evolved to be extremely different from other such areas – it has not; Bass Strait has been periodically exposed subaerially, the last time about 6,000 years ago, and the seafloor has been recolonised by marine organisms. Nevertheless, it is likely that the area now harbours a particularly fine example of the biological diversity of southern Australian shelf seafloors, and that it is somewhat special because of its hydrology

From the information presented above, if there are sponge beds, then they must be patchy or restricted in distribution. In order to discover the beds (if substantial beds exist) and to map their distribution, we suggest that a survey is needed using an optimised sampling approach. In addition, the museum catches should be sorted and identified to provide a baseline of the biodiversity that was, and possibly still is, present. An optimised sampling approach would employ multibeam sonar (or another broad-swath acoustic technique such as side-scan sonar) with on-board data processing to guide optimally-positioned sampling with a stereo video camera, drop camera, and ground truthing with tools such as a benthic sled or rock dredge (Kloser *et al*. 2000, 2001), all accurately geolocated. We suggest that such a survey should be concentrated around the locations of the original 6 museum sites which gave high sponge catches (the stars in Figs. 6, 8, 10-18). It is possible that industry groups (especially the fishing industry but also petroleum companies and their consultants) may have additional information that was not made available to us in the short time of this study. Such information may indicate where any significant sponge beds are or are not likely to be located; and this information should be taken into account in designing any further surveys.

Conclusion

The main question of the present assessment is: “Do the Bass Strait sponge beds possess biodiversity values worthy of protection?” Based on the currently available data we do not know the location, distribution and dispersion, or species composition of the epibenthic fauna in Bass Strait. Museum Victoria surveys in the early 1980s led to the inference that there were dense sponge beds, particularly along an arc in southern central Bass Strait. Such beds may still be present, since officially-recorded bottom impact activities have been minimal in the vicinity of the ‘sponge stations’, but in fact the beds have not been observed since. Patches of filter-feeding communities have been observed throughout the edges of Bass Strait and it is considered unlikely that the species in central Bass Strait are unique. However, since this area is a region of convergence between two provinces, it is likely that the community is highly diverse. Furthermore, filter-feeding communities provide habitat and to some extent food for a myriad of marine invertebrates and fish, thus adding to the overall biodiversity through their presence. Unfortunately the collections of sponges from the Museum Victoria surveys and from other surveys in Bass Strait have not been sorted and identified to date.

We conclude from the above that the area may have biodiversity values that (compared with neighbouring areas) may be particularly worthy of protection from any processes that may disturb benthic assemblages. However, we are not able to specify the location or extent of these values with present information. Similarly, with present information, we cannot envisage an effective process leading to the selection and design of conservation measures to protect these values. We suggest that new surveys are needed to provide the data on which such decisions could be based.

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Appendix 1

FROM: *Guidelines for establishing the National Representative System of Marine Protected Areas.* (ANZECC TFMPA 1998). Criteria to be used as a basis for the identification and selection of MPAs

IDENTIFICATION

Representativeness

Will the area:

- represent one or more ecosystems within an IMCRA bioregion, and to what degree;
- add to the representativeness of the NRSMPA, and to what degree.

Comprehensiveness

Does the area:

- add to the coverage of the full range of ecosystems recognised at an appropriate scale and within and across each bioregion;
- add to the comprehensiveness of the NRSMPA.

Ecological importance

Does the area:

- contribute to the maintenance of essential ecological processes of life-support systems;
- contain habitat for rare or endangered species;
- preserve genetic diversity, i.e. is diverse or abundant in species;
- contain areas on which species or other systems are dependent, e.g. contain nursery or juvenile areas or feeding, breeding or resting areas for migratory species;
- contain one or more areas which are a biologically functional, self-sustaining ecological unit.

International or national importance

- is the area rated, or have the potential to be listed, on the world or a national heritage list or declared as a Biosphere Reserve or subject to an international or national conservation agreement.

Uniqueness

Does the area:

- contain unique species, populations, communities or ecosystems;
- contain unusual or unique geographical features.

Productivity

- Do the species, populations, or communities of the area have a natural biological productivity.

Vulnerability assessment

- Are the ecosystems and/or communities vulnerable to natural processes.

Biogeographic importance

- Does the area capture important biogeographic qualities.

Naturalness

- How much has the area been protected from, or not been subjected to, human induced change.

Appendix 2

Information to be compiled for each area.

Note, all of this information is to be assembled / interpreted ***to the extent possible***. In some cases, there may be no relevant information.

1. A Description of the Physical Environment

a. Bathymetry – To a resolution required to identify biophysical values

b. Geomorphology

c. Oceanography

d. Distinct sub-regions within the assessment area

2. A Description of the Biological Environment

a. Comprehensive list of taxa to lowest practical taxonomic rank.

b. Full list of species that are of known ecological, commercial, cultural or recreational importance (to be referred to below as key species, where the term key simply means species of interest or special concern).

c. Abundances and distributions of key species

d. Behaviour and life history of known key species, e.g. breeding, feeding, migratory paths, etc. as they relate to the area.

e. Key processes such as trophic relationships and species interdependence including any known functional linkage with other communities/systems or areas outside the assessment area

f. Definition of discrete biological units (ecosystems / habitats / communities / assemblages / systems) within assessment area

g. If specific locations are found within the general area studied for the conservation values assessment as having particularly high biophysical values or other features of specific interest these locations should be identified and described.

3. **Address to the extent possible each MPA Identification Criterion** (see Appendix 1)

a. Representativeness

b. Comprehensiveness

c. Uniqueness;

d. Naturalness;

e. Ecological importance;

f. Biogeographic importance;

g. International or national importance;

h. Productivity; and

i. Vulnerability.

4. Current and Potential Uses and Existing Management Regimes

Provide information, to the extent possible, on the following

a. Fisheries – Complete information on commercial, charter, amateur and traditional fisheries including:
    - catch composition and distribution of fisheries
    - catch quantities including bycatch of non-commercial species;
    - main fishing methods and boat types;
    - number of non-commercial and commercial operators using the area;

b. Minerals and petroleum –exploitable minerals present, potential petroleum and mineral reserves, any exploration leases granted, seismic activity, location of any wells etc

c. Tourism and recreation (non fishing) - types of use/activity, visitation rates, seasonal use patterns, number of commercial operators

d. Maritime transport – locations of shipping lanes and volumes of traffic

e. Indigenous interests/values.

f. Describe the legislation and management arrangements (both domestic and international) relevant to each of the uses above and or to the assessment area generally.

g. Scientific and education values – such as ongoing projects, exploration, and relevance for future local and regional users.

5. Current and Potential Impacts on Natural Values

The report should identify natural processes and anthropogenic *processes* that may impact on the biophysical values of the assessment area. For example, the report should identify/list any existing and potential pressures from human impacts such as physical, chemical and or biological processes that impact on biophysical values such as the disturbance of seagrass habitat, heavy metal contamination and predation by introduced pests. Similarly the risk and associated impact of storm events, global warming and natural predators, etc., should be described.

Appendix 3

Sources for data and/or expert opinions

A Stakeholder Reference Group (SRG) has been established by EA for the Commonwealth MPA process. The CSIRO team made presentations to this group, and specifically invited provision of data, anecdotal information and comments. The membership of the SRG is listed in Table A3.1. For this particular assessment area, few SRG members offered data or publications, but a number offered observations based on their experience. CSIRO specifically contacted the organisations and individuals listed in Table A3.2

Table A3.1 Membership of the Commonwealth MPAs Stakeholder Reference Group

Organisation	Contact Name
Aboriginal & Torres Strait Islander Commission	Rodney Dillon
Aboriginal & Torres Strait Islander Commission	Wieslaw Lichacz
Association of Australian Ports & Marine Authorities Inc.	Jane Reynolds
Association of Australian Ports & Marine Authorities Inc.	John Hirst
Austral Fisheries	Martin Exel
Australian Fisheries Management Authority	Joanna Fisher
Australian Fisheries Management Authority	Paul Murphy
Australian Marine Conservation Society	Kate Davey
Australian Maritime Safety Authority	Annaliese Caston
Australian Maritime Safety Authority	John Gillies
Australian Petroleum Production & Exploration Association Limited	Mark McCallum
Australian Seafood Industry Council	Russ Neal
Australian Seafood Industry Council	Terry Moran
Australian Shipowners Association	Jennifer Taylor
CSIRO	Alan Butler
Department of Defence	Lauren Gray
Department of Defence	Colin Trinder
Dept of Agriculture -- Fisheries and Forestry - Australia	Matt Gleeson
Dept of Agriculture -- Fisheries and Forestry - Australia	Louise Galli
Dept of Agriculture -- Fisheries and Forestry - Australia	Glenn Hurry
Dept of Education -- Science & Training	Philip Diprose
Dept of Education -- Science & Training	Patrick Davoren
Dept of Industry -- Tourism & Resources	Chris Lloyd
Dept of Transport and Regional Services	Katrina Preski
Dept of Transport & Regional Services	Karenn Singer
Marine & Coastal Community Network	Tim Allen
Marine & Coastal Community Network	Di Tarte
Minerals Council of Australia	Michael Bissell
National Oceans Advisory Group	Russell Reichelt
National Oceans Office	David Johnson
National Oceans Office	Bernadette O'Neil
Recfish Australia	Graeme Creed
Recfish Australia	Ross Monash
SERMP Steering Committee	Diane James
Tourism Task Force	Stephen Albin
Whale & Dolphin Conservation Society	Margi Prideaux
Woodside Petroleum	Greg Oliver
World Wide Fund for Nature Australia	Margaret Moore

Table A3.2 Organisations/people contacted for data and/or expert opinions

Organisation	Contact Name	Reason for contacting
NOO - National Oceans Office	Meredith Hall	BRS Marine matters report and other SE MRP data
GA - Geoscience Australia	P. Harris / R. Smith	Geomorphology maps
AFMA - Australian Fisheries Management Authority	M. Clarke / T. Skousen	Scallop fishery (Bass Strait)
Tasmanian Scallop Fishery	H. Revill	Scallop fishery (Bass Strait)
Queensland Museum	J. Hooper	Expert opinion on sponge diversity/abundance
Museum Victoria	T. O'Hara / G. Poore	Museum Surveys; expert opinion on sponge and other invertebrate abundance/distribution
Department of Industry, Tourism and Resources	C. Locke	Seismic surveys/ drilling permits etc
AES – Applied Ecology Solutions Pty. Ltd. (Consultant for ESSO)	S. Mustoe	Recent surveys Bass Strait
Woodside Energy	D. Gordon	Surveys/studies on exploration activities
BHP Billiton	E. Pinceratto	Surveys/studies on exploration activities
Consulting Environmental Engineers	S. Chidgey	Surveys in Bass Strait (benthic?)
Maunsell Australia Pty Ltd	B. Ridgway	Surveys in Bass Strait (benthic?)
Basslink	S. Hargreaves (enquiry line)	Survey reports
EA – Environment Australia	J. Tranter	Threatened and listed species
Telstra	B. Free / J. Hogart	Communications cable surveys
Hydro Tasmania	P. Greilach	Communications cable surveys for Telstra
CSIRO (NOO Data management/spatial analysis)	V. Lyne and M. Martin	SE RMP data
CSIRO (Oceanography)	K. Ridgway / S. Condie	Oceanographic data
CSIRO (Climate Program)	D. Griffin	SST and SeaWifs images
CSIRO (invertebrate collection)	K. Gowlett-Holmes	Expert opinion on invertebrate distribution / Duke Energy pipeline survey
Ex-CSIRO (Scallop Surveys)	P. C. Young	Scallop fishery (Bass Strait); video & dredge surveys
Ex-CSIRO	R. Martin	Scallop fishery (Bass Strait); video & dredge surveys

Appendix 4

Marine species occurring in Bass Strait that are listed under the *EPBC Act* (L: listed), also including species listed as threatened, and their status. CR: critically endangered, EN: endangered, VU: vulnerable; N/a not on threatened list. 'Presence code' refers to the type of presence in the area: 1 Species or species habitat likely to occur within area; 2 Foraging recorded within area; 3 Breeding recorded within area; -a Derived from a general distribution map > 1 degree

Class	Scientific Name	Common Name	Listed threatened species status	Listed marine migratory species	Listed marine species	Presence code
Aves	*Arenaria interpres*	Ruddy Turnstone	N/a	N/a	Listed	1
Aves	*Calidris acuminata*	Sharp-tailed Sandpiper	N/a	N/a	Listed	1
Aves	*Calidris alba*	Sanderling	N/a	N/a	Listed	1
Aves	*Catharacta skua*	Great Skua	N/a	N/a	Listed	1-a
Aves	*Diomedea amsterdamensis*	Amsterdam Albatross	EN	Listed	Listed	1-a
Aves	*Diomedea antipodensis*	Antipodean Albatross	VU	Listed	Listed	1-a
Aves	*Diomedea dabbenena*	Tristan Albatross	EN	Listed	Listed	2-a
Aves	*Diomedea epomophora*	Southern Royal Albatross	VU	Listed	Listed	1-a
Aves	*Diomedea exulans*	Wandering Albatross	VU	Listed	Listed	1-a
Aves	*Diomedea gibsoni*	Gibson's Albatross	VU	Listed	Listed	1-a
Aves	*Diomedea sanfordi*	Northern Royal Albatross	EN	Listed	Listed	1-a
Aves	*Eudyptula minor*	Little Penguin	N/a	N/a	Listed	3
Aves	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	N/a	N/a	Listed	1
Aves	*Halobaena caerulea*	Blue Petrel	VU	N/a	Listed	1-a
Aves	*Larus dominicanus*	Kelp Gull	N/a	N/a	Listed	3
Aves	*Larus novaehollandiae*	Silver Gull	N/a	N/a	Listed	3
Aves	*Larus pacificus*	Pacific Gull	N/a	N/a	Listed	3
Aves	*Limosa lapponica*	Bar-tailed Godwit	N/a	N/a	Listed	1
Aves	*Macronectes giganteus*	Southern Giant-Petrel	EN	Listed	Listed	1-a
Aves	*Macronectes halli*	Northern Giant-Petrel	VU	Listed	Listed	1-a
Aves	*Morus capensis*	Cape Gannet	N/a	N/a	Listed	3
Aves	*Morus serrator*	Australasian Gannet	N/a	N/a	Listed	3
Aves	*Numenius madagascariensis*	Eastern Curlew	N/a	N/a	Listed	1
Aves	*Pelagodroma marina*	White-faced Storm-Petrel	N/a	N/a	Listed	3
Aves	*Pelecanoides urinatrix*	Common Diving-Petrel	N/a	N/a	Listed	3

Class	Scientific Name	Common Name	Listed threatened species status	Listed marine migratory species	Listed marine species	Presence code
Aves	*Phalacrocorax fuscescens*	Black-faced Cormorant	N/a	N/a	Listed	3
Aves	*Phoebetria fusca*	Sooty Albatross	VU	Listed	Listed	1-a
Aves	*Pluvialis fulva*	Pacific Golden Plover	N/a	N/a	Listed	1
Aves	*Pterodroma mollis*	Soft-plumaged Petrel	VU	N/a	Listed	1-a
Aves	*Puffinus tenuirostris*	Short-tailed Shearwater	N/a	Listed	Listed	3
Aves	*Sterna bergii*	Crested Tern	N/a	N/a	Listed	3
Aves	*Sterna caspia*	Caspian Tern	N/a	Listed	Listed	3
Aves	*Sterna striata*	White-fronted Tern	N/a	N/a	Listed	3
Aves	*Thalassarche bulleri*	Buller's Albatross	VU	Listed	Listed	1-a
Aves	*Thalassarche cauta*	Shy Albatross	VU	Listed	Listed	1-a
Aves	*Thalassarche chlororhynchos*	Yellow-nosed Albatross	N/a	N/a	Listed	1-a
Aves	*Thalassarche chrysostoma*	Grey-headed Albatross	VU	Listed	Listed	1-a
Aves	*Thalassarche impavida*	Campbell Albatross	VU	Listed	Listed	1-a
Aves	*Thalassarche melanophris*	Black-browed Albatross	N/a	Listed	Listed	1-a
Aves	*Thalassarche salvini*	Salvin's Albatross	VU	Listed	Listed	1-a
Aves	*Thalassarche steadi*	White-capped Albatross	VU	N/a	Listed	1-a
Chondrichthyes	*Rhincodon typus*	Whale Shark	VU	Listed	N/a	1-a
Chondrichthyes	*Carcharias taurus (east coast population)*	Grey Nurse Shark (east coast population)	CE	N/a	N/a	1-a
Chondrichthyes	*Carcharodon carcharias*	Great White Shark	VU	N/a	N/a	1-a
Mammalia	*Arctocephalus pusillus*	Australian Fur-seal	N/a	N/a	Listed	3
Mammalia	*Balaenoptera musculus*	Blue Whale	EN	Listed	N/a	1-a
Mammalia	*Eubalaena australis*	Southern Right Whale	EN	Listed	N/a	1-a
Mammalia	*Megaptera novaeangliae*	Humpback Whale	VU	Listed	N/a	1-a
Osteichthyes	*Heraldia nocturna*	Upside-down Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Hippocampus abdominalis*	Eastern Potbelly Seahorse	N/a	N/a	Listed	1-a
Osteichthyes	*Hippocampus breviceps*	Short-head Seahorse	N/a	N/a	Listed	1-a
Osteichthyes	*Hippocampus minotaur*	Bullneck Seahorse	N/a	N/a	Listed	1-a
Osteichthyes	*Hippocampus whitei*	White's Seahorse	N/a	N/a	Listed	1-a
Osteichthyes	*Histiogamphelus briggsii*	Briggs' Crested Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Histiogamphelus cristatus*	Rhino Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Hypselognathus rostratus*	Knife-snouted Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Kaupus costatus*	Deep-bodied Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Kimblaeus bassensis*	Trawl Pipefish	N/a	N/a	Listed	1-a

Class	Scientific Name	Common Name	Listed threatened species status	Listed marine migratory species	Listed marine species	Presence code
Osteichthyes	*Leptoichthys fistularius*	Brushtail Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Lissocampus caudalis*	Australian Smooth Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Lissocampus runa*	Javelin Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Maroubra perserrata*	Sawtooth Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Mitotichthys mollisoni*	Mollison's Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Mitotichthys semistriatus*	Half-banded Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Mitotichthys tuckeri*	Tucker's Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Notiocampus ruber*	Red Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Phycodurus eques*	Leafy Seadragon	N/a	N/a	Listed	1-a
Osteichthyes	*Phyllopteryx taeniolatus*	Weedy Seadragon	N/a	N/a	Listed	1-a
Osteichthyes	*Prototroctes maraena*	Australian Grayling	VU	N/a	N/a	1
Osteichthyes	*Pugnaso curtirostris*	Pug-nosed Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Solegnathus robustus*	Robust Spiny Pipehorse	N/a	N/a	Listed	1-a
Osteichthyes	*Solegnathus spinosissimus*	Spiny Pipehorse	N/a	N/a	Listed	1-a
Osteichthyes	*Stigmatopora argus*	Spotted Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Stigmatopora nigra*	Wide-bodied Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Stipecampus cristatus*	Ring-backed Pipefish	N/a	N/a	Listed	1-a
Osteichthyes	*Syngnathoides biaculeatus*	Double-ended Pipehorse	N/a	N/a	Listed	1-a

Appendix 5

Commercially fished species taken with gears used in Bass Strait (Larcombe *et al.* 2002)

Common Name	Scientific Name	Fishery/ies
Eastern school whiting	*Sillago flindersi*	Danish seine
Flathead	*Neoplatycephalus spp. & Platycephalus spp.*	Danish seine
Jackass morwong	*Nemadactylus marcopterus*	Trawl (low numbers)
Ling	*Genypterus blacodes*	Gillnet, trawl, dropline & bottom longline (low numbers)
Spotted warehou	*Seriolella puncata*	Gillnet & trawl
Gummy shark	*Mustelus antarcticus*	Gillnet, dropline & bottom longline
School shark	*Galeorhinus galeus*	Gillnet, dropline & bottom longline
Elephant fish	*Callorhinchus milii*	Gillnet & trawl
Saw shark	*Pristiophorus spp.*	Gillnet & trawl
Whiskery shark	*Furgalaeus macki*	Gillnet
Southern rocklobster	*Jasus edwardsii*	Rock lobster (SE states)
Eastern rocklobster	*Jasus verreauxi*	Rock lobster (SE states)
Blacklip abalone	*Haliotis rubra*	Abalone (SE states)
Greenlip abalone	*Haliotis laevigata*	Abalone (SE states)
Southern scallop	*Pecten fumatus*	Scallop (SE states & Commonwealth)