PRESSURES ON USES IN THE SOUTH-EAST MARINE REGION

1.0 Introduction

Uses made of the South-east Marine Region (SEMR) apply pressures on the environment services from within the Region. These pressures occur as a result of human behaviour, which is driven by demographic change, economic forces and lifestyle decisions. While the impact of these uses are modified by dynamic events such as weather and other environmental feedback mechanisms, they are also altered by legislative behaviour rules and conventions applied at local, state, national and international levels.

This chapter presents a broad review of the environmental pressures within the SEMR according to each major use category (eg: fishing, shipping, conservation/heritage, …). This review is provided according to the factors driving the uses and according to the behaviour modifying rules and conventions. In providing this review, a limited, but by no means representative, number of examples from the SEMR are used to help explain the nature of the pressures reviewed.

2.0 Analysis by use

2.1 Fishing

The main Commonwealth commercial fisheries in the South-east Marin Region are the South East Fishery, the East Coast Tuna and Billfish Fishery, the Southern Shark Fishery and the Bass Strait Central Zone Scallop Fishery. The most valuable fisheries, the abalone and rock lobster fisheries, operate in most part in the coastal waters and are under state jurisdiction, while the Southern Bluefin Tuna (SBT) Fishery is no longer a major fishery in the Region, it could return as a major fishery to these waters (section 2.1.4).

Recreational fishing is under state jurisdiction and mostly occurs within state waters. However, increasing numbers of recreational fishing occurs along the edge of the continental shelf, where nutritional upswellings result in fish concentrations while tuna and billfish are important offshore gamefish species. In addition to this, some SEMR species, when spawning in coastal waters are taken by recreational fishers.

2.1.1 Economic and market pressures

World trade prices and export demand underlie the value of Australian fisheries. Within the domestic fresh-fish market, prices for the major fishery species in the SEMR vary by the condition

of the product, the time of year and the volume of landings. Prices for orange roughy (*Hoplostethus atlanticus*) and blue grenadier (*Macruronus novaezelandiae*), which are processed into fillets, depend on world prices (Smith, Griffiths and Ruello 1998). Population growth and increasing income and health concerns will over the long term increase the price of fish taken within the SEMR. The current downturn in the world economy, the decrease in tourism and travel resulting from recent events in the United States and the closure of Ansett will have, a short term negative effect on prices.

Most of Australia's fish exports go to the Asia Pacific Economic Cooperation (APEC) forum members (Gooday, Brown and Hardcastle 2001). Prices in this market have been affected by the fall in the Australian dollar, increasing per capita income and demographic changes such as population growth and changes in the population age mix, with fish consumption increasing with the age of the consumer. Changes in taste and preferences and changes in the relative price between fish and other meat products will bring about increased long term demand for fish (Smith, Dennis and Proctor 1996). Short to medium term factors, including recent slowdowns in the APEC economies and an expected improvement in the strength of the $A against the US$ and the ¥, will disrupt long term demand.

Barriers to trade

Any removal of barriers to trade within APEC will have minimal impact on Australian fish exports (Hartmann, Klijn and Cox 2000). Outside of the APEC forum, recent tariff reductions on Australian prawn and rock lobster into the Europe Economic Community have improved the access of these products into this market (Edwards 2001).

2.1.2 Lifestyle pressures

Lifestyle pressures have to do with individual preferences and the resource using choices made in regard to these preferences. While lifestyle has been important in making the choice to go commercial fishing, increasing commercial pressures make this a less important consideration. Such considerations are important when it comes to participating in recreational fishing. Recreational activities, including recreational fishing, are increasing in response to a range of economic, social and attitudinal factors (Stimson *et al* 1996).

The amount and nature of recreational fishing pressures have not been adequately identified As a result, many recreational fishing studies are poorly designed and are dependent on respondent recall

– which can be out by as much as a factor of two (Lyle 2000). It is therefore difficult to provide robust estimates of participation rates, fish catch and to estimate the possible impact of recreational fishing on fish populations. The soon to be completed National Recreational Fishing Survey will address many of the data shortcomings (see Lyle, Coleman, West, Campbell and Henry 2002).

Fewer than five per cent of Australians 18 years of age and over participated in recreational fishing – freshwater and marine, in 1997-98 (of a possible 26 activities, only aerobics/fitness, cycling, golf, swimming and tennis showed higher participation rates), although this rate varies between states, with 4.1 per cent in Victoria and 7.3 per cent in Tasmania (ABS 1998). However, these figures contrast with earlier studies in Tasmania by the Australian Bureau of Statistics (ABS 1984), a later study by Lyle (2000), and the nation wide review of studies carried out on recreational fishing by McIlgorm and Pepperell (1999), show participation rates in the Australian south-east of between 20 and 25 per cent.

Recreational and commercial fishers often compete for the same species of fish. While the overall level of direct competition in the waters of the SEMR is minimal, recreationalists do target offshore species along the coast and in coastal bays and inlets (eg school shark (*Galeorhinis galeus*), tiger flathead (*Neoplatcephalus richardsoni*) as immature or spawning fish. Direct competition occurs within the SEMR between commercial and recreational fishers for fish and fishing operational space at fish concentrations or ‘hot spots’ above the continental slope. Further, while only a small part of the total marine recreational catch, direct competition exists between recreational and commercial fishers in the taking of trophy sized tuna and billfish species. It is likely, though, that oceanographic events (section 2.1.3) rather than regional fishing pressures have greater influence on the recruitment of these species within the SEMR.

The competition by recreational fishers for resources and the need to protect other uses of marine areas (see section 2.6) has led to the closure of a number of bays and inlets to commercial fishing in Victoria and Tasmania, with similar consideration being given to some inshore areas in NSW. A consequence of this is the possible effect on the diversity of fish and the type of product that is available to fish consumers (Read, Sturgess and Associates 1997).

Lifestyle related pressures also occur due to pollution from recreational activities (see section 2.5).

2.1.3 Resource use pressures

Inadequate data

Sustainable management requires a high level of knowledge about the resource. However knowledge is normally limited and imperfect. Most stock assessments in the SEMR, together with the rest of Australia, rely heavily on commercial catch rate trends reported in logbooks, rather than fishery independent surveys to monitor trends in abundance. Many factors in addition to population abundance affect trends in commercial catch rates (Prince *et al.* 1998a). The lack of independent data can create considerable uncertainty in the scientific advice provided for setting total allowable catch (TAC) levels or modifying input controls.

The landings for many south-east fishery (SEF) quota species are not constrained by the TAC set under the individual transferable catch quota for that species. Consequently, the TAC and the use of quota are irrelevant to the management of the fishery (Australian National Audit Office 1996). As a result, fishers can be expected to behave the same to taking these species as they would in any other fishery where they share access to the resource. That is, fishers will compete to obtain the greatest share of the available catch as long as the expected average cost of taking that species is no more than the average return – rather than equating marginal costs and returns. This results in excess inputs to fishing (excess fishing effort) and poor quality of the landed catch. As observed for the southern bluefin tuna (Campbell, Battaglene and Brown 2000), if the TAC used in setting the individual quota were limiting, operators could be expected to maximise the profits from their quota by trading off minimum cost of catch with catch quality.

State of the environment

Environmental pressures on some commercial fisheries, particularly those with an inshore component, are derived through a number of sources including activities outside of the SEMR such as run off of onshore pollution (section 2.5), and uses within the SEMR such as oil and gas exploration and extraction (section 2.2), shipping (section 2.3), recreation (section 2.4) and recreational and commercial fishing activities.

Fishing pressures

Long-term over-exploitation of biological populations, as has occurred for school shark (*Galeorhinus galeus*) and eastern gemfish (*Rexea solandri*), results in declining recruitment levels and the long-term decline of populations towards localized extinction. In fact, 11 target species in Commonwealth fisheries in the SEMR have been assessed as being currently overfished

(BRS Fishery Status Report 2001). This results in a direct loss of production of these species and a decline in the value of the fishery due to reduced total landings and a reduction in the catch rate – with consequent higher unit costs. These considerations are important to the setting of TAC levels for quota-managed species.

Fishing activities within the SEMR have limited potential to impact regional abundance on the major east coast tuna species, particularly yellowfin and some billfish. Commercial fishing activities may affect regional abundance of the major species, resulting in localised depletion (Galeano *et al* 2000), and impacting recreational game and trophy fishing.

Ecosystem effects.

The productivity base for the fisheries resources of the SEMR is highly variable seasonally, inter-annually and over decades. Bio-productivity in the SEMR is driven by the mixing of nutrient rich sub-Antarctic mode water (SAmW), along the edge of the continental shelf and across the sub-tropical convergence, which lies adjacent to the SEMR. Variability in some south-east fish stocks is correlated with climatic variation in the local wind fields, sea surface temperatures and surface productivity. This variation of regional winds appears to be at least partly a function of the possible consequence of an apparent southward shift in the Australian sub-tropical ridge since the 1920s. While it is not possible to directly assess the impact of these changes on Antarctic derived nutrients, based on observations in the Artic, greenhouse induced warming is likely have a negative effect on the shunting of Antarctic SAmW to the Australian continental slope and the movement of the sub-tropical ridge (Anonymous 1997, Prince and Griffin 2001).

The geographic distribution of many fish species during their life cycle includes coastal bays and inlets, especially during spawning and the juvenile stages, and will depend on the nutrient levels of these waters (Prince 2001). Bio-productivity in coastal bays and inlets are directly affected by pressures generated by activities and uses within the jurisdiction of the adjoining states (section 2.5). As well as direct effects on SEMR species, trophic level changes, such as decreases in the abundance of prey, due to the loss of seagrass in Port Phillip Bay (Jenkins *et al* 1992), can have important impacts. Alternatively high catches and reduction in Jack Mackerel biomass is likely to impact major higher order species in the SEMR (Prince 2001).

In fisheries, such as the south-east trawl, which uses the relatively indiscriminate catching technique of demersal trawling on a multi-species assemblage, a large amount of unsaleable bycatch (up to

50%) is caught and discarded dead at sea (Knuckey 2000). This discarding has potential ecosystem effects by re-cycling nutrients away from the natural predators to scavenging species with, for instance, the possible build-up of ling numbers in the SEF. Demersal trawling techniques can also break down the softer structured reef and sponge habitats converting them into unstructured, unstable sediment and rubble.

2.1.4 Crosscutting pressures

A number of the generic crosscutting resource use pressures inherent in fishing are discussed in Fletcher, Chesson, Sainsbury and Fisher (2001).

Interactions with other uses

Oil platforms and pipelines do not appear to be a problem because they are shallower than the trawl grounds and while competing for space, do not interfere with the use of other static gear. The same is not true for the proposed power line between Victoria and Tasmania. Most carnivorous species in the SEF feed in the dark and consequently have well developed sensors for micro-electrical fields. It is expected that the power line being proposed between Tasmania and Victoria will have an impact on these species and on fishing in that area (Walker 2001).

Indigenous

An often-overlooked impact of commercial and recreational fishing is the impact on Indigenous activities and Indigenous sites (Campbell 1999, Smyth 2001) having totemic and archaeological significance. While mostly coastal, Aboriginal claims to seacountry, and areas of cultural significance, can extend ‘as far as the eye can see’ (Mary Yamirr v Commonwealth (Federal Court Croker Island decision) 1998).

Two upcoming court decisions that are likely to be important to Indigenous interests in sea-country include the *Miriuwung Gajerrong* case involving considerations regarding resource use and the *Yanner* v *Eaton* case indicates that Indigenous rights and interests do not give way to legislative *Acts* introduced to conserve fish stocks (Myers 2001). That native title rights and interests can exist jointly with non-Indigenous rights, in regard to cultural activities and subsistence hunting and fishing, was confirmed by the High Court in 2001 (Mary Yamirr v Commonwealth).

Aquaculture production

The expectancy, with the introduction of an individual transferable catch quota based management plan to the SBT fishery, was that fishing would return to the waters off southern New South Wales for the larger, higher sashimi quality and higher unit valued fish. While the schools of SBT have since increased in the waters off south-eastern Australia, this has not occurred as over 90 per cent of the available national quota is used to take SBT in the Great Australian Bight for growing out in sea cages off Port Lincoln (Campbell 2002). Current research in South Australia on induced spawning of SBT might impact on this outcome.

In the waters south of Hobart, 10,907 tonnes of Atlantic salmon, valued at $84.8 million, was produced in 1999-2000 (ABARE 2000). As much of this product is a direct substitute for imported salmon – which would substitute for SEMR catch, it constitutes an indirect substitute for higher valued SEMR catch. Otherwise, there is little aquaculture product from the south-east ($18 million of aquaculture was produced in Victoria in 1999-2000, of which only $2m was marine based) (ABARE 2000). Aquaculture is an expanding industry with possible new developments in rock lobster, abalone, seahorses and higher valued scalefish. Institutional constraints and access to adequate coastal sites appears to be limiting development at this time (see section 2.6.4).

Technology

The growth in fishing power is directly related to improving technology and to a possible decrease in the cost per unit of catch. Whether this will lead to a decrease in total operator costs and total fishery costs will depend on the fisheries management structure. Technology can be expected to continue improving the effectiveness of both commercial and recreational sectors, as occurred with the introduction of GIS technology and net monitoring equipment over the past decade. At the same time, technology can work to mitigate or remove pressures, such as by assisting better targeting of fish by species and age classes and environmental friendly catch methodologies and trawl gear (Brewer *et al* 1997).

2.1.5 Institutional pressures

Institutions are the rules in which activities in the SEMR are carried out and occur as a result of formal arrangements such as constitutional, statutory and judicial rulings or as part of an organised system of laws and informal conventions and custom including Indigenous laws and customs. The effectiveness of institutional rules depends on whether: a) they are appropriate to the recognised performance objectives within the SEMR; b) compliance with the rules, which depends on

acceptance of the rules (Sutinen 1996); and c) on the level of control and enforcement. Compliance can be considered from the perspective of the owner or principle (eg: government as representatives of the public), the agency acting on behalf of the principal and the client, customer or reciprocant of the services delivered by the agency on behalf of the principal (Campbell, Stokes and Brown 1996). Control and enforcement depends on the use of performance indicators (eg: Chesson and Clayton 1998). Institutional rules are important tools for the managers of the SEMR to ensure players or participants in activities applying pressures on the Region do internalise and account for the costs of their actions (see section 2.5).

The pressures provided by institutional rules and structures will tend to be static in nature. However, any change in these rules will provide new pressures on current and possible new uses and are dynamic in nature.

Formal institutional structures occur at the level of:

- The fishery (eg, SEF and southern shark fishery management plans). This may involve a number of elements, including possible controls on how, when and where fishing may occur, controls on the gear that may be used and controls on the amount of catch that can be taken. Questions exist according to the appropriateness of the tools used to manage the resource – input controls and/or output controls, and whether the scale of management is appropriate to the species dynamics (Prince 2001, Prince *et al*.1998b) or the economic dynamics (Gordon 1954).

- The fishery management authorities and ministers' departments (eg AFMA, AFFA). The way an agency, such as AFMA, carries out its agency responsibilities will pressure uses. For instance, the effectiveness of individual transferable catch quota in the SEF requires the total allowable catch, according to which the quota is set, to meet a number of criteria, but primarily to be constraining within an optimal catch level. Failure to do this can lead to stock depletion, the overuse of scarce resources and the undermining of the management system.

  Alternatively, an agency might ignore the legislatively required performance objectives. A case in point is AFMA's earlier failure to meet its economic efficiency requirements (Australian National Audit Office 1996, House of Representatives Standing Committee on Primary Industries, Resources and Rural and Regional Affairs 1997).

- The jurisdiction level. The Federal Cabinet, involves all of the ministerial departments with interests in the SEMR. Depending on the particular issue under discussion, can include Agriculture, Forests and Fisheries Australia, Environment Australia and the Department of Transport and Regional Services and could involve legislation such as the *Environment Protection and Biodiversity Conservation Act 1999* and policy documents such as the *National Competition Principles Agreement* and the *Ecologically Sustainable Development Working Groups Reports*.
    - The state jurisdictions of Victoria, Tasmania, South Australia and New South Wales are an important component at this level. While the Commonwealth's constitutional responsibilities start from the mean high water mark, they are generally administrated, on the basis of the *Offshore Constitutional Settlement*, out to three nautical miles from the mean high-water mark. There are also strong overlapping interests by the States in uses of the SEMR, while state based uses and legislation have important influences on pressures within the SEMR.

- The international level. This is defined by a range of environmental conventions, such as the UN Law of the Sea conventions (Bergin and Haward 1995), and may be translated into domestic legislation, such as the *Wildlife Protection and Conservation Act 1982*[1] (Maynes 1995). Australia participates in a number of international commissions concerned with fish harvesting, including the Commission for the Conservation of Southern Bluefin Tuna and the Commission for the Conservation of Living Marine Resources.

2.2 Oil, gas and mineral resources

Bass Strait oil and gas deposits are an important source of oil and gas reserves. While the Gippsland Basin reserves of oil and gas in Bass Strait are decreasing, the recent and substantial Thylacine and Geographe gas field discoveries (over a trillion cubic feet) in the Otway Basin, off western Victoria (*Australian Financial Review*, 19 September 2001, p.22), and the relatively unexplored Sorell and Bass Basins indicate further exploration and development in the region.

2.2.1 Economic and market pressures

Domestic gas and oil prices follow the world oil prices, which have ranged between less than US$10 to over US$30 a barrel in the last three years. With substantive world reserves, world oil prices depend on the ability of the Organisation of Petroleum Export Countries (OPEC) to control the supply of oil onto the world market. Increasing production from non-OPEC members, such as

[1] Now replaced by the EPBC Act 1999.

Russia (currently the world's second largest supplier of oil), Angola and Kazakhstan, will put pressure on OPEC to place further control world oil prices. Important in the determination of domestic price is the exchange rate between the US$ and the $A, with the $A falling against the US$ during the period in which world prices have increased.

With the future of the Kyoto agreement and the direction that will be taken to control and mitigate the impact of greenhouse gases uncertain, globally tradeable quota continues to be an expected component of any future greenhouse control measures. In which case, greenhouse controls rather than OPEC controls could be expected to limit the rate of world oil use in the longer term. In a free market in tradable greenhouse gas units, oil prices would be expected to fall to around the marginal cost of supply, with the quasi rent, from the artificial under supply of oil, going to the limiting factor – tradeable greenhouse units.

Current high prices are likely to bring forward the completion of the Gippsland Basin oil reserves and the exploration and development of the recent Otway basin discoveries. In addition, the need to provide back-up supplies for the Melbourne and the Adelaide markets, as well as local markets in the Victorian south-west and South Australian south-east will encourage this development.

2.2.2 Lifestyle pressures

Increasing recreational boating (for fishing or otherwise) places a pressure to monitor and control such activities during seismic surveys and during the development and extraction of gas and oil reserves (section 2.4). Conversely, oil exploration and extractive activities and structures are likely to interfere with recreational boating activities if close to large population centres or popular recreational areas.

Increasing expectancy and relative affordability to be able to control household temperatures creates an increasing demand for energy. Increased car ownership, including greater multiple car ownership within a single family, and increased willingness to travel adds to fuel demand.

2.2.3 Resource use pressures

Seismic Surveys

The use of high intensity, low frequency acoustic surveys can impact on fish swim bladders, causing disorientation and/or permanent damage, which is particularly important to juveniles in the shallower waters of Bass Strait. Seismic surveys can also disrupt fish congregations, resulting in

reduced survival and recruitment. While the impact on highly fecund animals such as fish might be small (McCauley 1994), this would depend on the current status of the fish stocks and whether they are already under pressure. Some commercial fishers report that regional catches are depressed in the SEMR for a number of seasons following each seismic survey. Whether this is due to a temporary movement of fish or due to the loss of fish is uncertain. Seismic surveys are likely to have substantive pressures if carried out proximate to sources of nutrient enrichment or 'hot spots', and in bays and inlets. In the case of marine mammals, whale pods have been reported as demonstrating avoidance responses at up to 7 to 12 km from a seismic source (URS 2001).

Oil and gas production

The production of oil and gas within the SEMR involves possible causes of chronic pollution. These range from the use of seawater containing non-toxic additives as a lubricant and to maintain hydrostatic pressure during drilling (URS 2001) and the use of 'displacement' water in on-platform oil storage tanks and as ballast in oiltanker tanks. Such tanks are usually segregated tanks so as to separate the seawater from the oil. Water contained in reservoir formation rocks is co-produced with hydrocarbons as a normal part of petroleum production activities. This, produced formation water (PFW), naturally contains a wide variety of compounds and elements occurring within the producing formation. A variety of chemicals are added to the raw hydrocarbon/PFW to facilitate separation of the hydrocarbons from the PFW and to prevent deterioration of production facilities. PFW water may be either released into the environment, forming a plume several kilometres down from the well, or re-injected into the well. PFW released back into the sea from the Bass Strait Kingfish well, for instance, was found to include a number of naturally occurring nitrates (Burns, *et al* 1997).

Minerals

In addition to channel construction, there has been some quarrying of sand, gravel and stone from the sea floor within coastal regions. This will result in the direct localised removal of habitat and impact on adjoining areas due to the disturbance of sediment (see section 2.5.3). Aside from such coastal activities, there has been, as yet, little or no extraction of mineral resources within the SEMR.

2.2.4 Crosscutting pressures

While there have been no calamitous instance of oil pollution involving oil exploration in the SEMR (this does not hold for transportation), this risk remains. One source of risk is shipping while another is recreational and fishing boats. Commercial vessels not providing services to an oil platform are

routed outside of the range of the oil or gas platforms. Recreational and fishing boats are required to maintain a minimal distance of at least 500 metres from oil rigs and activities.

2.2.5 Institutional pressures

In addition to enclosed bays and inlets, State and Territory jurisdiction extend seawards three nautical miles from the marine base-line. Australian assertion to the waters beyond these boundaries is established under the UN *Law of the Sea Convention 1982*.

Current assessment and approval process for the oil industry include:

- Assessment and approval of petroleum exploration and appraisal activities in Commonwealth waters is currently undertaken in accordance with the provisions of the *Petroleum (Submerged Lands) Act 1967,* the *Petroleum (Submerged Lands) Acts Schedule of Specific Requirements as to Offshore Petroleum Exploration and Production 1999* and the *Petroleum (Submerged Lands) (Management of Environment) Regulations 1999.* The administration of this legislation is delegated under the *Petroleum (Submerged Lands) Act 1967* to State/Territory Designated Authorities.

- Since July 16, 2000, the *Environment Protection and Biodiversity Conservation Act 1999* is also applicable to offshore petroleum exploration and appraisal activities.

- Greenhouse Policy Documents. Greenhouse 21C – Plan of Action for a Sustainable Future (Commonwealth Government 1995) and the international agreement on the Convention on Civil Liability for Oil Pollution Damage.

2.3 Shipping – commercial and defence

The SEMR is a very important area for shipping in Australia, both for its shipping lanes and port infrastructure. Ports in both Victoria and Tasmania host many of the estimated 11,000 international vessels that visit Australia each year, including military craft. In addition, the same sea-lanes and ports play host many domestic or coastal vessels. Reflecting Australia's relative geographic isolation, 98 per cent of our trade is transported on ships compared to only 80 per cent internationally. For the SEMR this relative importance of shipping is expanded as the bulk of Australia's population is located in the south-east corner of the country.

While surveillance activities are minor in this area, defence enforces Australian sovereignty throughout the SEMR. As in other regions of Australia, its functions in the SEMR include the provision of surveillance and response, enforcement of fisheries and environmental law, search and rescue, hydrographic surveys and operational exercises. The SEMR is an important transit route between the eastern and western fleet bases and is in close steaming distance of the eastern fleet base and the ports of Sydney and Adelaide.

2.3.1 Economic and market pressures

The demand for shipping through and within the SEMR is derived from overseas demand for Australian product and Australian demand for imports and the cost of delivering shipping services. The depreciation of the Australian dollar has been a major factor in the increasing demand for Australian product, while the negative impact of a falling dollar has to a large extent been offset by a relatively buoyant Australian economy. The cost of shipping service delivery has been helped by the low level of world interest rates keeping the cost of capital down, the holding down of labour costs and the shift to containerisation and bulk handling. However, the recent increases in fuel costs has increased the cost of shipping.

Economic conditions will continue to exert strong pressure on global and domestic demand, industry cost structures and industrial relations. Nevertheless, it is anticipated that international trade will continue its long-term trend increase, notwithstanding the current and subsequent downturns due to periodic regional and/or global recessions. Shipping will become increasingly more important to the southeast region of Australia and, in a similar fashion, an even more important use within the SEMR.

Alternative uses or modes of transport are not considered to be a major competitor of shipping. Only with respect to relative high value product is airfreight a viable alternative means of transport, such as, for example, farmed salmon from Tasmania, or other high value and/or perishable product (eg live lobsters). However, for passenger movement air, rail and road alternatives will remain the major modes of transport to and from the region although some holiday/cruise shipping will doubtless continue to operate, as will the ferry services between Tasmania and the mainland.

Economic conditions have only a small bearing on military shipping in the region, although some actions will be the result of the response of others to economic incentives, such as with the encroachment and poaching of fish by foreign-based fishers in Australian waters.

2.3.3 Resource use pressures

Pollution

The range of pollutants associated with shipping operations includes oil, noxious liquid substances, sewerage, garbage, solid substances carried in bulk, air pollutants, anti-fouling paints, alien organisms and noise. Accidental pollutants include: oil, noxious liquid substances, packaged harmful substances (marine pollutants) and solid bulk substances. Physical damage includes: mechanical destruction of habitat and smothering of habitats (Australian and New Zealand Environment and Conservation Council 1995) (see section 2.5).

A number of exotic species, including the Japanese giant kelp (*Undaria pinnatifida*) and the northern Pacific seastar (*Asterias amurensis*), have been accidentally introduced via ship's ballast water. Such species predate on native species or competes with them for space.

2.3.4 Crosscutting pressures

Weather and climate

Weather and climate will continue to have a large constraining influence on shipping of all types and can result in delays to and loss of ships, personnel and cargo. To the extent that weather patterns will change due to the predicted greenhouse effects, the shipping industry has little influence or control. This leads to the need for improved weather forecasting and the training to use this information, together with better safety and route planning.

Interaction with other uses

There is a high level of interaction between shipping, both commercial and military, and other uses in the SEMR. For example, shipping lanes cross both fishing grounds and submarine communication lines with sometimes-costly interactions. Collisions between freighters and fishing boats and between freighters and yachts are not uncommon. The competition for port berths and associated port facilities and infrastructure can be expected to increase over time unless accompanied by proper planning.

Technological progress

Technological developments such as on-board navigation equipment, shore and satellite based navigational aids, weather and ocean current forecasting capacity, and the ability for ships to monitor and react to safety factors can be expected to contribute to a more efficient, effective and

safer shipping industry operating in the region. Commercial and military shipping alike will benefit from these improvements.

While shipping, ports and stevedoring will continue to enjoy much the same benefits from the application of broader technological developments there are a number of resulting pressures. As ships have got bigger, there is an increasing need to accommodate larger vessels, such as the need to increase the depth of water leading into Port Phillip Bay, and to enlarge channel depth and width to accommodate increasing boat size. These same factors, and changes in onboard cargo handling configuration has also required changes to port infrastructure (Maunsell, McIntyre 2000).

2.3.2 Lifestyle pressures

An emerging aspect of commercial shipping in the SEMR is that of cruise ships (Australian and foreign) visiting the Region and using the region as a gateway to the Antarctic. As part of the tourism industry, cruise ship operators cater to lifestyle/leisure factors and as such are competing for the consumer dollar alongside all other tourist or holiday industry operators. Growth in disposable incomes and the growing interest in the Antarctic as a tourist destination are driving this activity. General economic conditions have been, and will continue to be, a major determinant in cruise ships using, or at least transiting, the SEMR (see section 2.4). For example one of the world's largest cruise shipping companies, Renaissance Cruises, which had boats calling into Melbourne and Hobart, recently ceased operations due to the world economic slowdown.

3.3.5 Institutional pressures

Most of the pressures or forces exerted on shipping described above meet or interplay within the institutional frameworks as established by governments through their regulatory agencies. While operating essentially in what must be described as a free or market economy, many operational aspects of shipping, such as the implementation of environmental standards, safety standards, and operational procedures are matters very largely predetermined for ship operators. By way of example, Commonwealth agencies determine and enforce ship safety standards (both for ship and crew), environmental standards to control the disposal of waste at sea, and ballast water management procedures, although such requirements are generally based on international agreements and conventions. Such International protocols include the *International Convention for the Prevention of Pollution from Ships*, which, among other factors, relates to questions of environmental protection in regard to ship's routing and related measures and procedures, including the protection of particularly sensitive marine areas (Australian and New Zealand Environment and Conservation Council 1995).

It was only in mid-2001 that mandatory ballast water management requirements were introduced for all international ships entering Australian waters so as to help prevent the unwanted introduction of harmful marine pests and pathogens (Johns 2001). It is now planned to introduce similarly tight controls for ballast water management on all coastal shipping, as it is to introduce measures to control vessel bio-fouling to prevent the introduction and translocation of similar pests. Commonwealth regulatory measures are by and large implemented through legislation, including the *Environmental Protection and Biodiversity Conservation Act 1999.*

As in the rest of Australia, shipping in the SEMR is also regulated through State laws when ships are in state waters or ports. Ships are subject to state environmental standards such as those regarding oil spills and other waste discharges, including bilge water disposal.

The laws and regulations applying to shipping do not apply to matters of defence in instances relating to national security. In all other instances, state and Commonwealth Acts and regulations apply to Defence as a Commonwealth agency. This includes matters dealing with ballast water, marine pests, and anti-fouling paint management. As well as complying with the *Environmental Protection and Biodiversity Conservation Act 1999*, Defence also has an enforcement role.

2.4 Tourism and recreational boating

Marine based tourism range from the enjoyment of environmental amenity services, such as viewing the seascape and going on cruise ships to physical activities such as: swimming, fishing, boating/kayaking, sailing, scuba diving, surf sports and water skiing/power boating.

The greatest direct involvement of recreationalists with the SEMR is likely to come from ocean boating including ocean fishing. For instance, in June 2000, 13,890 recreational vessels, including 4264 sailing vessels, were registered in Victoria. Most boats would have been operated in fresh waters or close to the coast (Victorian Marine Board). Other than for the occasional ocean race, such as the Sydney-Hobart, and interstate boat delivery, most boats remain close to the coast. Exceptions also include group tours, such as that organised by the Ocean Racing Club of Victoria from Melbourne to Burnie in early 2001, or the occasional crossing of Bass Strait organised by the members of the Victorian or the New South Wales sea kayaking clubs.

Charter vessels are an increasing component of recreational boating. In June 2000, the Victorian Fishing Charter Association had 35 members, of an estimated 58 boats registered in that state, or, 60 per cent of the number of commercial charter recreational fishing charter vessels (pers. comm. John Joubert, Victorian Fishing Charter Association Sept. 2001). In addition to recreational fishing charter vessels, a number of registered commercial charter vessels are used for whale spotting and general sightseeing (eg coastal features, seal and bird colonies).

2.4.1 Economic and market pressures

While most tourists are domestic, the greatest growth in tourist activities has been from international tourists. While events surrounding the destruction of the World Trade Centre in New York have caused a substantial fall off in international tourists, the underlying long term demand by northern hemisphere tourists for Australia remains.

The overall growth in tourism has been put down to increased wealth and disposable income, increased leisure time, car ownership, and improvements in travel technology, especially air travel where more people can travel further, faster and at a lower cost. This has been accompanied by increased urbanisation and a shift from a work ethic to a leisure ethic (Stimson *et al* 1996). As an escape to the sun, sand and sea is a major attraction to tourists, this places increasing pressure on these natural resources. Increasing activities such as whale watching, recreational fishing, and boating are serviced by charter boat operations.

The coming retirement of the ‘baby boomers’ and the general higher income and health of this group, when compared to earlier retirees, is likely to result in an increase in the demand for recreational and leisure services. Increases in tourist coastal facilities and activities are likely to add to the disruption of the coastal ecology and to the level of coastal pollution.

2.4.2 Lifestyle pressures

The changes in attitude and resulting behaviour (section 2.4.1), are lifestyle driven, with increasing wealth making these recreational choices available. People retiring at an earlier age along with improving life expectancy and better health allows people to increase their life style choices. These choices include making the decision to move to and live along the coast. Among younger people, there appears to be greater interest to participate in ‘risk’ sports such as sea kayaking and diving, while increasing personal income has allowed people of all age groups to obtain larger and faster boats.

2.4.3 Resource use pressures

Boaters are a source of waste and pollution, including fuel and oil, litter and damage to the benthos from anchors and drags and the scraping of boat bottoms. The collection from the beach and from off rocks of bait and of trip souvenirs by recreationalists can impact on species composition and biodiversity and of fish recruitment. In addition, the increasing proportion of the population moving to coastal locations has increased use and pollution pressures (section 2.5).

Coastal constructions such as breakwaters, groins, boat harbours and beachfront housing can impact the movement of coastal seas and tides and the movement of sand and the release of toxins, metals and chemicals that may be held in coastal sediments. This can impact on marine species and coastal benthic characteristics including the loss of seagrass, the blocking of spaces and crevices in coastal reefs and a loss of habitat.

2.4.4 Crosscutting pressures

Interaction with other uses

The ubiquitous nature of recreationalists is such that they can have a high level of interaction with those involved in other uses. This can be with commercial fishers, in competing for catch and space, to interfering with commercial fishing gear and with aquacultural operations in coastal bays and inlets. Because many recreationalists are new to an area, information on requirements, and commitment to local norms are unlikely to be as well developed as it is for people who are local to an area. Activities by recreationalists may also impact Indigenous traditional and cultural concerns.

An important element of recreationalists is that they may not have the knowledge, skills and understanding appropriate to an activity and may place themselves and others at risk. Such instances are more prevalent and have a greater overall impact than the occasional high profile racing tragedies. For instance, in Victoria, in the past twelve months up to the middle of the year, there were 10 fatalities involving recreational boating accidents, or 120 fatalities over the past 11 years (Victorian Marine Board data). Meeting the needs for emergencies, such as sea rescues by other vessels, interferes with their normal procedures. Increased offshore activities will require greater rescue and safety support. Recreational boating can interact with other forms of boating/shipping and marine oil and gas exploration and development.

Weather/climate

Weather and climate are important considerations in sea and coastal recreational activities and in the infrastructure accompanying such activities. The 1999 Sydney-Hobart yacht race emphasised the importance of weather and the impact it can have on recreational activities. This instance also emphasises the importance that environmental information is presented in a form that occasional users of the information can interpret.

2.4.5 Institutional pressures

Recreational boaters are required to meet many of the same Commonwealth and state boating requirements as other vessel operators. While some of these requirements have been less demanding, this is changing, with, for instance, Victoria introducing, in line with the other states, licensing requirements for powered recreational boats in February 2001.

Judicial decisions, regarding duty of care requirements, are impacting how recreational organizations operate. As a result, many organizations are introducing gear, training and safety requirements for their members and activity coordinators. These requirements are greater for charter boat operators supplying services to recreationalists.

2.5 Waste disposal

The pollution of marine and coastal waters occurs in the form of organic material, oil, grease and fats, chemical pollutants including greenhouse gases, minerals and soil and rock spoil and other solid material. It was reported at the Third International Conference of Marine Debris (in United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution 1994), that most marine debris and marine pollution is from land-based sources; fishing and boating is also likely to be an important source of marine waste in Australia (Jones 1994).

2.5.1 Economic and market pressures

Waste is a by-product of production. Just like weeds are grasses growing in the wrong place, pollution is waste, when deposited in the wrong place; which is an indication of inappropriate behavioural incentives.

Increasing wealth and increasing population size will increase pressures on the generation of waste. Added to this is increased trade and the accompanying shipping waste (2.3.3). However, within this, increasing tertiary production and consumption, means that increases in the level of economic

activity need not result in a proportional increase in waste – while technology and institutional changes provide the opportunity to decrease the per capita and possibly the total level of pollution.

The Commonwealth, through the Urban Storm Water Program of the Clean Seas Programme, is providing funding to support programmes directed at limiting and controlling waste into the sea (Environment Australia 2000). At the state level, as in Victoria, this will go to improving the environmental management of 'urban stormwater' ... through ... 'a shift in management culture' and funding assistance of $22.5 million over three years (EPA Victoria 2000).

2.5.2 Lifestyle pressures

Increasing wealth has allowed people greater lifestyle choices. Lifestyle impacts have come about due to increased coastal recreation and the movement of populations to the coast, bringing with them increased waste from commercial and human activities, trafficking and coastal construction. Increased recreational activities, such as boating, leads to increased pollution from fuel, litter, human excreta and coastal disruption by boat harbours and marinas.

2.5.3 Resource use pressures

Most of the pressure from pollution is likely to be in near-shore areas including estuaries and bays, which have the least capacity to handle pollutants. While immature fish are more susceptible to chemical and physical stress, inshore areas provide important spawning grounds for several offshore species. In addition chemical and heavy metal accumulation can impact spawning by mature fish (Sinderman 1996). Pollutants can increase the level of heavy metals, pathogens and sea born toxins and are a health risk (eg, Stanber *et al* 1996, discuss the impact of copper and other pollutants from the Mt Lyle mine in Macquarie Harbour). Dispersed oil can have particular short and long term effects on mangrove flora and fauna, leading to the degradation of coastal areas.

Boating and other sources of waste can have a direct physical impact on marine species. These include entanglement in discarded or lost nets and pots, nylon rope and polypropylene strapping bands by fish, sea mammals and birds; the ingestion of plastic and other debris by marine mammals and birds; the smothering of bottom fauna and beach infauna and the use of floating debris as a source of transfer of exotic organisms.

Increased activity on, or in the seabed, is likely to increase pollution levels. This includes the laying of electricity lines and gas pipelines across Bass Strait and the increase in oil and gas exploration off

western Victoria and south-east South Australia (see section 2.2.3). In addition, the use of the foreshore and ocean waters as a cheap depository for sand, rock and other material can lead to the loss of sea grass beds that are important to the recruitment of juveniles (eg see Jordan *et al* 1998, in regard to research carried out in Tasmania).

Because the productivity of the SEMR is derived from oceanic sources it is relatively robust to human impact and strongly influenced by climatic/oceanographic factors. However nutrients are concentrated at the shelf edge and by implication the shallow coastal environment is naturally relatively oligotrophic (low nutrients) and are particularly susceptible to degradation due to run-off from agricultural and urban areas.

2.5.4 Crosscutting pressures

Climate

The climatic changes due to greenhouse effects are expected to raise water temperatures, which may result in a change in marine species composition, while increased UV-B will have a negative impact on marine micro-organisms (Everett 1997). Such micro-organisms are important to marine bio-productivity and to the taking up of carbon dioxides from the atmosphere – marine carbon sequestration. Climatic changes will also result in greater extremes in weather and in sea levels. Over an extended period of time this will impact existing infrastructure, shipping, recreational activities and foreshore construction (see section 2.2.1).

However, the models used to make predictions about rises of atmospheric CO_2 assume no solution of carbonate material in surface waters of the earth's oceans. 'Under such an assumption, the capacity of the surface ocean to remove and store CO_2 from the atmosphere becomes more limited as atmospheric CO_2 rises'. However, '[t]he solution of carbonate rocks on continental shelves around the world would cause atmosphere CO_2 to rise more slowly than is currently predicted' (Barnes, Cuff and Lough 2001).

Interaction with other uses

In addition to onshore sources, marine waste and pollution is likely to both originate from and impact most other uses of the marine environment.

2.5.5 Institutional pressures

As indicated (section 2.5.1) institutional rules can affect behaviour and pollution, with most polluting activities within the control of state jurisdictions. Recent legislative requirements for secondary treatment, requiring physical and biological treatment, to reduce organic matter, suspended solids, pathogens and toxicity prevention in raw sewerage is mitigating one source of pollution and waste.

There are a number of international agreements affecting the creation of marine wastes and pollution such as Agenda 21 at the 1992 United Nations Conference on Environment and Development in Rio (see Section 2.4.5) and the International Convention for the Prevention of Pollution from Ships 1973/78 (MARPOL73/78). MARPOL was established in response to growth in the maritime transport of oil, the increasing size of tankers and the increase in the amount of chemicals carried by sea. The Convention is administrated in Australia by the Australian Maritime Safety Authority. Nationally, the major sources of pollution are under the administrative control of the states, although the *Environment Protection and Biodiversity Conservation Act 1999* is an important element.

2.6 Conservation/heritage

Marine cultural heritage is the result of human marine activities with most identifiable and readily accessible instances proximate to rather than within the SEMR. However, aboriginal occupation existed across Bass Strait in addition to coastal sites while cultural attachment may exist for coastal/offshore species including sea mammals. Conservation and natural heritage sites are under increasing pressure from increasing urbanisation and commercial recreational use of coastal areas and the use of fish and other marine resources.

There is a range of activities outside of the SEMR impacting conservation values within the Region. For example, there is continuing uncertainty over the status of SBT stocks, and whether current catch rates are sustainable. The introduction of marketing controls in Japan might mitigate the catch and marketing of SBT outside of the control of the Commission for the Conservation of Southern Bluefin Tuna. Climate change, though, is a particular example, affecting the southward shift of the Australian tropical ridge and is impacting polar melting, which is important to the continental upswelling of nutrient rich SAmW. The recent withdrawal of the United States from the Kyoto agreement places increased pressure on where control over greenhouse gases might go.

2.6.1 Economic and market pressures

While conservation and heritage values are rarely expressed in market prices, the value placed on these resources is directly expressed in the effort and the costs incurred to observe and enjoy these benefits, and indirectly, in the attention provided through comment, publications and the desire to pass this heritage on to future generations.

With Indigenous sites, the value of the site occurs in two ways. First, is the traditional value of an area or feature that occur as a result of the cultural norms or as a result of an Indigenous community's attachment to a location (Campbell 2000). Secondly, is the cultural value placed by the community as a whole as a result of the community's recognition of prior settlement. There is a risk that the European appreciation of Indigenous heritage may take precedence over the value Indigenous people place on their culture and their heritage. This is analogous to the conflict between the community's conservation values in national parks and ongoing traditional Indigenous uses in national parks.

Non-indigenous heritage values relating to marine uses in the South-east Marine Region are observable along the coast. This most strongly relates to shipping, and exists in the form of inshore and coastal wrecks, lighthouses, old shipping wharves and restored vessels. These resources face the pressures of trafficking, souveniring, and competition for what may be highly valued sites.

Both Indigenous and European values recognise natural heritage as well as their cultural heritage, which may be referred to as conservation values. From an economic perspective, conservation is a question of 'optimal use in time'. Cultural and heritage values will increase with increasing wealth and increasing population size. They will also increase with increasing knowledge and understanding of these values. The importance given to amenity values, such as scenery, will also vary according to changing social attitudes.

2.6.2 Lifestyle pressures

Lifestyle pressures (see section 2.5.4) will increase the value placed by the public on conservation and heritage values as people place increasing demands on amenity uses. Lifestyle changes, in part due to increasing incomes – allowing individuals to purchase the special equipment and obtain necessary training, sees greater access to shipwrecks and underwater natural heritage areas, including cold water corals and kelp forests. At the same time, and consistent with the increasing

value placed on coastal amenity uses, there is increasing travel to and increasing use of highly valued coastal features.

2.6.3 Resource use pressures

A range of impacts or pressures acting on these uses including greenhouse effects (although the oceans provide an important modifier of these effects), marine pollution and the destruction of benthic habitat. Marine preserves are used to moderate these pressures. Increased ultraviolet light (section 2.5.4) has a negative effect on marine microflora. Depending on the action of feedback mechanisms, this will have a negative effect on the marine biomass and on marine carbon sequestration.

Conservation

The hotspots of marine productivity and fishing activity in the South East Marine Region will also be hotspots of marine biodiversity. Careful mapping of competing uses, and consideration of including extractive uses compatible with the preservation of marine bio-diversity, inside some marine conservation areas will go towards minimising conflict.

Marine protected areas

The Commonwealth government has established a marine protected areas over 15 of 70 Tasmanian seamounts located 170 kilometres south of Hobart (Environment Australia 2001), and Macquarie Island, 1500 kilometres south-east of Tasmania. These waters are noted for the Patagonian tooth fish, which are fished commercially under strict monitoring and control. This species is noted for instances of poaching by foreign based vessels. The states adjoining the SEMR are, in conjunction with Environment Australia, in the process of establishing Marine Protected Areas, with 12 previously proposed for Victoria, six for Tasmania, and a number under consideration by the SA Cabinet (the number due to be publicly available by 15 November). Commonwealth and state marine protected areas are in addition to those areas closed off to commercial fishing as a means of protecting recreational uses.

2.6.4 Crosscutting pressures

Impact on other uses

Marine protected areas can impact on environmental uses, commercial and recreational fishing and other uses. What the net impacts will be depends on how and where they are established, how they are managed and compliance with the rules under which the area is established. While

environmental uses are enhanced, the impact on commercial and recreational fisheries is not clear-cut, as access to fish within the protected area is likely to be diminished, the recruitment of fish outside of the protected area might increase.

The Victorian Land Conservation Council assessed the possible annual revenue losses for a number of proposed marine parks ands sanctuary zones in Victorian for 1966. While the estimated direct and indirect job losses from the proposed marine parks ands sanctuary zones was, respectively 17 and 42[2], the estimated direct increase in employment from tourism and recreation was 20-200. The annual value for lost fisheries production for all of the proposed closures was estimated at $450 000. The estimated annual return from the closure of the proposed sites was $300 000 per year. This makes no allowance for the estimated increase in returns from aquaculture production of $1m (Victorian Land Conservation Council 1996).

Institutional

State and Commonwealth fisheries legislation have a high conservation component and legislation dealing with heritage values including Indigenous heritage values, such as the Commonwealth government's *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* and the *Environmental Protection and Biodiversity Conservation Act 1999*. Internationally, the *United Nations Conventions on the Law of the Sea*, and the *International Convention for the Regulation of Whaling* are important examples.

3.0. Discussion & Conclusion

Uses made of the South-east Marine Region provide a number of pressures on the environment services provided within the Region. While the source and nature of these pressures are reviewed, it is only possible to provide the briefest of assessments and a limited range of examples. However, the pressures on uses within the SEMR are shown to be extensive and interlocking with uses and pressures initiated or derived from activities within or beyond the Region (table 1). The nature and extent of these pressures has been indicated to be the result of human behaviour driven by demographic change, economic forces and lifestyle decisions. While the impact of these pressures are modified by dynamic events such as weather and other environmental feedback mechanisms, the impacts are also altered and controlled through the use of legislated behaviour rules and conventions.

While pressures within the SEMR are the result of human behaviour, it is not always possible to control or modify these pressures within the Region. For example, commercial fishing applies direct pressure on school shark stocks, while recruitment of yellowfin tuna depends on activities outside of or exogenous to the SEMR and outside of the Australian fishing zone. Such exogenous pressures include the impact of climatic warming on sea temperatures, tidal movements including the Deep Antarctic Circumpolar Current, and coastal pollution on inshore spawning grounds.

Table 1: **Sources of Pressures in the SEMR According to Levels of Control**

	Examples of Pressures According to Levels of Control[a]	
	Minimal or no control of pressure	Full or some control[b] of pressure
Exogenous pressures (Occurring outside of the SEMR)	• Greenhouse pressures (sections: 2.5.4, 2.6.3) • World economy (sections: 2.1.1, 2.2.1, 2.3.1)	• Coastal runoff (section: 2.1.3) • Activities in coastal bays and inlets (sections: 2.1.3, 2.5.3)
Endogenous pressures (Occurring within the SEMR)	• Life style (sections:2.1.2, 2.4.2)	• Boating activities: commercial[c] (section 2.2) Recreational (section: 2.4) • Fishing activities (section 2.1)

a. It will be noted that the examples provided include driving factors, such as life style, as well as actual pressures.
b. Control of a pressure may be complete, so there is no observable presence or impact of the pressure, or incomplete, so that there is an observable impact.
c. There need not be a clear delineation between exogenous and endogenous pressures as controls on commercial shipping, for example, depends on international agreements as well as local enforcement.

[2] This implies a surprisingly large multiplier.

References

ABARE 2000, *Australian Fisheries Statistics 2000*, ABARE, Canberra.

ABS 1984, *Household Fish Consumption and Non-Commercial Fishing Activities, Tasmania*, Australian Bureau of Statistics, Report non. 7601.6, AGPS, Canberra.

------ 1998, *Participation in Sport and Physical Activities, Australia*, ABS catalogue no. 4177.0, Canberra.

Anonymous 1997 'Climate and fisheries on the south-east Australian continental shelf and slope', Fact sheet - Climate Variability in Agriculture Research and Development, Canberra, http://www.cvap.gov.au/netsKoslow.html.

Australian and New Zealand Environment and Conservation Council 1995, *Maritime Accidents and Pollution: Impacts on the Marine Environment from Shipping Operations*, Australian and New Zealand Environment and Conservation Council marine Accidents and pollution Implementation Group, Canberra.

Australian National Audit Office 1996, *Commonwealth Fisheries Management: Australian Fisheries Management Authority*, The Auditor-General Performance Audit, Audit Report no. 32, AGPS, Canberra.

Barnes, D.J. Cuff, C. and Lough, J.M. 2001, Rising atmospheric CO2 and coral reefs. In: Changes in the Marine Environment. Proceedings of the 2001 Annual Conference of the Australian Marine Sciences Association run in association with the New Zealand Marine Sciences Society, Townsville, 3-6 July, Calladine, Ainsley and Waycott, Michelle (eds). James Cook University for AMSA.

Brewer, D.T. Eayrs, S.J. Rawlinson, N.J.F. Salini, J.P. Farmer, M. Blaber, S.J. Ramm, D.C. Cartwright, I. and Poiner, I.R. 1997, 'Recent advancements in environmentally friendly trawl gear research in Australia', in Hancock D.A. (ed.) *Proceedings Sustainable Fisheries through Sustaining Fish Habitat*, proceedings of the Australian Society for Fish Biology Workshop, Victor Harbour, 12-13 August. Bureau of Resource Sciences, DPIE, AGPS, Canberra, pp. 537-543.

Burnes, k. Codi, S. Furnas, Heggi, D. M. Holdway, D. McAllister, F. and Mitchell, A. 1997, *Dispersion and Fates of Produced Formation Water Constituents in a Northwest Shelf Shallow Water Ecosystem and Bass Strait*, Energy Research and Development Corporation, Report no. ERDC 3241/1, Canberra.

Campbell, David 1999, 'Negotiating the establishment and management of Indigenous coastal and marine resources', in *Use of Property Rights in Fisheries Management*, Shotton, Ross (ed.) FAO Fisheries Technical Paper 404/2, Proceedings of the FishRights99 Conference, Fremantle, Western Australia, 11-19 November.

----- 2000, *Economic Issues in Valuation of and Compensation for Loss of Native Title Rights*, Australian Institute of Aboriginal and Torres Strait Islander Studies, Native Title Research Unit, Land, Rights, Laws: Issues of Native Title, vol. 2, no. 8.

------ 2002, 'Change in fleet capacity and ownership of harvesting rights in the Australian southern bluefin tuna fishery ' FAO, Rome, in press

----- Stokes, Adam and Brown Debbie 1996, 'Issues in monitoring fisheries management performance,' ABARE paper presented at VIII International Fisheries Economics and Trade Conference Marrakech, Morocco, 1-4 July.

Chesson, Jean and Clayton, Helen 1998, *A Framework for Assessing Fisheries with Respect to Ecologically Sustainable Development*, Fisheries Resources Branch, Bureau of Resource Sciences, Canberra.

Commonwealth of Australia 2001, *Tasmanian Seamounts Marine Reserve: Draft Management Plan*. Environment Australia, Canberra.

Edwards Ron 2001, 'The way forward: Bilateral negotiations – the experience of the Australian prawn and rock lobster industries in the European Union', *Outlook 2001*, ABARE, Canberra.

Environment Australia 2000, *Coasts and Oceans: Urban Stormwater Initiative*, www.ea.gov.au/coasts//pollution/.

------ 2001, *Tasmanian Seamounts: Draft Management Plans*, Environment Australia, Canberra.

EPA 2000, *Victorian Stormwater Action Programme*, www.epa.gov.au/Programmes/Stormwater/.

Everett, John 1997, 'Fisheries and climatic change: The IPCC second assessment', in Hancock, D.A. Smith, D.C. Grant, A. and Beumer, J.P. *Developing and Sustaining World Fisheries Resources: The State of science and Management*, 2nd World Fisheries Congress. 1996, Brisbane, CSIRO, Melbourne, pp. 109-115.

Fletcher, W. Chesson, J. Sainsbury, K. Hundloe, T. and Fisher, M. 2001, 'ESD reporting: Developing a framework for fisheries: Progress, Problems and benefits', *Outlook 2001*, ABARE, Canberra.

Galeano, D., Johnson, C., Levantis, C., Shafron, W. 2001, *Australian Fisheries Surveys Report 2000*, ABARE, Canberra.

Gooday, Peter Brown, Debbie and Hardcastle, Susan 2001, 'Fisheries products: Outlook and important trade issues for Australia', *Outlook 2001*, ABARE, Canberra.

Gordon, H. Scott 1954, 'The economic theory of a common property resource: The fishery', *Journal of Political Economy*, vol. 62, no. 1, pp. 124-42.

Hartman, Jessica Klijn, N. Cox, Anthony 2000, *Seafood Trade liberalisation in the APEC Region*, ABARE Research Report 2000.3, Australian Bureau of Agricultural and Resource Economics, Canberra.

House of Representatives Standing Committee on Primary Industries, Resources and Rural and Regional Affairs 1997, *Managing Commonwealth Fisheries: The Last Frontier*, Parliament of the Commonwealth of Australia, AGPS, Canberra.

Jenkins, G.P. Edgar, G.J. May, H.M.A. and Shaw, C. 1992, 'Ecological basis for parallel declines in seagrass habitat and catches of commercial fish in Western Port Bay, Victoria', in Hancock D.A. (ed.) *Proceedings Sustainable Fisheries through Sustaining Fish Habitat*, proceedings of the

Australian Society for Fish Biology Workshop, Victor Harbour, 12-13 August. Bureau of Resource Sciences, DPIE, AGPS, Canberra, pp. 124-136m.

Johns, Murray 2001, 'Ballast water – The international framework and Australia's new management arrangements', National Shipping Industry Conference, Sydney, 8-9 March.

Jones, Madeleine J. 1994, *Fishing Debris in the Australian Marine Environment*, Bureau of Resource Sciences Research Report, AGPS, Canberra.

Jordan, A.R. Mills, D.M. Ewing, G. and Lyle, J.M. 1998, *Assessment of Inshore Habitats Around Tasmania for Life-History Stages of Commercial Finfish Species*, Marine research Laboratories – Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart.

Knuckey, I.A. 2000, *South East Fishery Integrated Scientific Monitoring Program. 1999*, Report to the South East Fishery Assessment Group, Marine Freshwater Research Institute, Queenscliff, Victoria.

Lyle, Jeremy 2000, *Assessment of the Licensed Recreational Fishery of Tasmania (Phase 2), Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Taroona.*

Lyle, M. Jeremy Coleman, Anne P.M. West, Laurie Campbell, David and Henry, Gary W. 2002, 'An innovative methodology for the collection of detailed and reliable data in large-scale Australian recreational fishing surveys', in Pitcher, T.J. and Hollingworth, C.E. *Evaluating Recreational Fisheries: Economic and Social Balance Sheet*, chapter 15, Blackwell Science – Fish and Aquatic Resources Series, in press.

McCauley, R.D. 1994, 'Marine biological communities susceptible to effects of seismic surveys', in Swan, J.M. Neff, J.M. and Young, P.C. (eds) *Environmental Implications of Offshore oil and Gas Development in Australia: The Findings of an Independent Review*. Australian Petroleum Exploration Association, Energy Research and development Corp. Canberra, pp. 19-121.

McIlgorm, Alistair and Pepperell, Julian 1999, *A National Review of the Recreational Fishing Sector: A Report to Agriculture, Fisheries and Forestry Australia*, Dominion Consulting Pty Ltd.

Maynes, Gerry 1995, 'Application of environmental conventions to commercial fisheries', in *Outlook: Commodity Markets and Natural Resources*, pp. 309-318 ABARE, Canberra.

Maunsell McIntyre 2000, *Victorian Ports Strategic Study*, Final Report to the Victorian Department of Infrastructure/Department of Treasury and Finance, Melbourne.

Myers, Gary D. Native title rights in Natural Resources: A comparative perspective, paper presented to the joint session of *The Past and Future of Land Rights and Native Title* Conference, (co-sponsored by the Australian Institute of Aboriginal and Torres Strait Islander Studies and the Native Title Representative Bodies Network); and *Land and Sea: Our Shared Environment* (20th National Environmental Law Association Annual Conference) Townsville, Queensland, 28-31 August.

Pauly, D. Christensen, V. and Walters, C. 1998, 'Fishing down marine food webs', *Science* vol. pp. 57: 860-863.

Prince, J.D. 2001, 'The Ecosystem of the South East Australian Fishery and Fisher Lore', *Journal of Marine Freshwater Resources*, vol. 52, no. 3, pp. 431-49.

----- Baelde, P. and Wright G. 1998a), *Synthesis of Industry Information on Fishing Patterns, Technological Change and the Influence of Oceanographic Effects of SEF Fish Stocks*, Report to the Fisheries Research and Development Corporation, 97/114, Biospherics Pty Ltd. P.O. Box 168, South Fremantle, W.A. 6162.

------ and Griffin, D. (2001). 'The spawning dynamics of the eastern gemfish (*Rexea solandri*) in relation to regional oceanography', Journal of Marine Freshwater Research, vol. 52, pp. 611-22.

----- Walters, C. Ruiz-Avila, R. and Sluczanowski, P. 1998b, 'Territorial user's rights in the Australian abalone fishery', *in Proceedings of the North Pacific Symposium on Invertebrate Stock Assessment and Management*, Jamieson, G.S. and. Campbell, A. (eds) *Canadian. Special Publication of Fisheries and Aquatic Sciences*. vol. 125. pp. 367-375.

----- Brown, L. Walker, T. (1999). *Pilot Fishery-Independent Fixed-Station Survey for Southern Shark Stocks: Final Report to Shark FAG*, Australian Fisheries Management Authority, Canberra.

----- & Shepherd S.A. (1992). Australian fisheries for abalone and their management', in Shepherd, S.A. Tegner, M.J. Guzman, del Proo, S.A. (eds.) *Abalone of the World: Biology, Fisheries and Culture*, Blackwells, Oxford.

----- 1989, *The fisheries biology of the Tasmanian stocks of Haliotis rubra*. Ph.D. thesis, University of Tasmania, Hobart, Australia.

Sinderman, Carl J. 1996, *Ocean Pollution: Effects on Living Resources and Humans*, Marine Science Series, CRC Press, Boca Raton, New York and London.

Stanber, J.L. Ahsanullah, M. Nowak, B. Eriksen, R. and Florence, T.M. 1996, *Toxicity Assessment of Waters from Macquarie Harbour Western Tasmania Using Algae, Invertebrates and Fish*', a joint program between the Supervising Scientist and the Department of Environment and Land Management Tasmania. Barton, ACT.

Smith, Perry Griffiths, Greg and Ruello, Nick 1998, *Price Formation on the Sydney Fish Market*, ABARE Research Report 98.8, Canberra.

Stimson. Robert J. Daly, Maurice T. Jenkins, Olivia Roberts, Brian H. and Ross, Stuart 1996, *Tourism in Australia: An Overview of Trends, Issues and Prospects*, Occasional Paper no. 23, Bureau of Tourism Research, Canberra.

Smyth, Dermot 2001, 'Management of sea country: Indigenous people's use and management of marine environments', in Baker, Richard, Davies, Jocelyn and Young, Elspeth (eds) *Working on Country: Contemporary Indigenous Management of Australia's lands and Coastal Regions*, Oxford University Press, pp. 60-75.

Sutinen, John G. 1996, *Fisheries Compliance and Management: assessing Performance*, A report to the Australian Fisheries Management Authority, Canberra.

United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution 1994, Final Working Group Report, Third International Conference of Marine Debris, Miami, Florida, 8-13 May.

URS Australia Pty Ltd 2001, *Review of Environmental Impacts of Petroleum Exploration and Appraisal Activities in Commonwealth Waters*, Prepared for the Petroleum and Electricity Division, Commonwealth Department of Industry, Science and Resources, Canberra.

Victorian Land Conservation Council 1996, *Marine and Coastal: Special Investigations*, Government of Victoria, Melbourne.

Walker, T. 2001, *Basslink Project review of Impacts of High Voltage Direct Current Cables and Electrodes on Chondrichthyan Fauna and other Marine Animals*, Marine and Freshwater Resources Research Institute, Report no. 20, Department of Natural Resources and Environment, Victoria.

Walker, T., Johnson, D., Brown, D. and McLoughlin, K. 1998, *The Southern Shark Fishery, Fishery Assessment Report*, Southern Shark Assessment Group, Australian Fisheries Management Authority, Canberra.

Young, J.W., Jordan, A.R., Bobbi, C., Johannes, R.E., Haskard, K. and Pullen, G. 1993,' Seasonal and interannual variability in krill (*Nyctiphanes australis*) stocks and their relationship to the fishery for jack mackerel (*Trachurus declivis*) off eastern Tasmania, Australia',. *Journal of Marine Biology*, vol 116, no. 1, pp. 9-18.