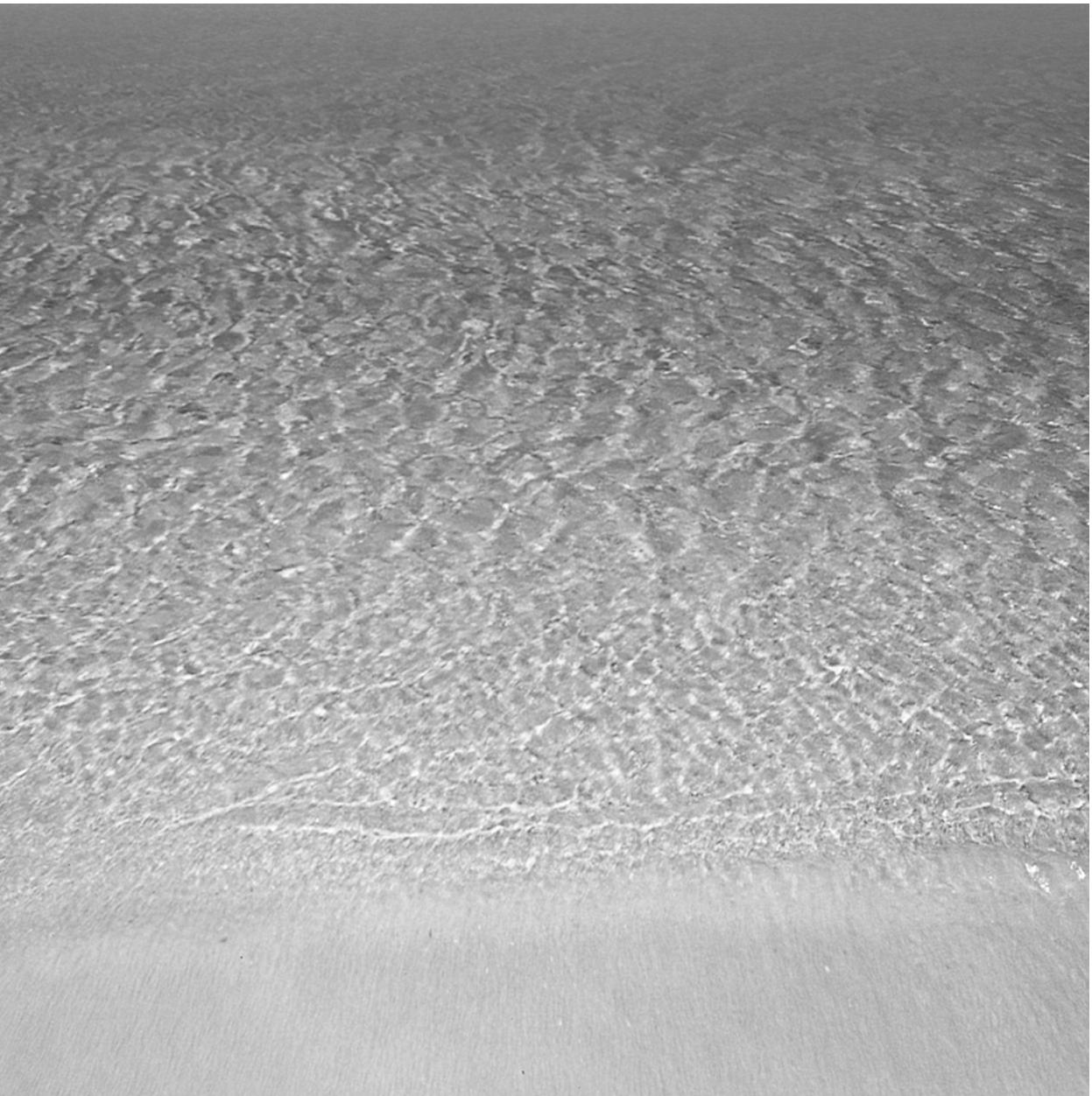
ESD REPORT
SERIES No. 2

Shark Bay Scallop Fishery



Department of Fisheries

Ecologically Sustainable Development
Catching Sustainability
FRDC – Subprogram

Australian Government
Fisheries Research and Development Corporation

Fish for the future

Authors:
Kangas, M., Weir, V., Fletcher, W. and Sporer, E.

Department of Fisheries
Western Australian Fisheries and Marine Research Laboratories
PO Box 20
North Beach WA 6920
Telephone (08) 9203 0111
Facsimile (08) 9203 0199
Website: http://www.fish.wa.gov.au

Published by the Department of Fisheries, Western Australia
ESD Report Series No. 2, January 2006
ISSN: 1448 - 3599 ISBN: 1 877098 22 1

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1.0 Introduction

Ecologically Sustainable Development (ESD) is the concept that seeks to integrate short and long-term economic, social and environmental effects in all decision-making. The Western Australian Government is committed to the concepts of ESD and these principles are implicitly contained in the objectives of the *Fisheries Resources Management Act 1994* (FRMA). More recently, the Minister for Fisheries released a "*Policy for the Implementation of Ecologically Sustainable Development for Fisheries and Aquaculture within Western Australia*" (Fletcher 2002) to articulate, in a practical manner, how the Department of Fisheries can demonstrate to both the government and the broader community that these requirements are being achieved.

A major element of this policy was the requirement for reporting on the progress of each commercial fishery against the major ESD objectives by the end of 2003. This document forms part of this process being the ESD report for the *Shark Bay Scallop Fishery.*

The reporting framework used to generate these ESD reports is the National ESD Framework for Fisheries (see Fletcher et al., 2002 or www.fisheries-esd.com for details). This framework operates by identifying the relevant issues for a fishery within 3 main categories of Ecological wellbeing, Human wellbeing and Ability to achieve; completing a risk assessment on each of the identified issues and then providing suitably detailed reports on their status.

Due to recent changes in the Australian Governments environmental legislation (the EPBC Act, 1999) administered by the Department of Environment and Heritage[1], all export fisheries are now required to have an assessment on their environmental sustainability. As a consequence, the initial series of assessments for fisheries has concentrated on the environmental and governance components of ESD of this fishery. The social and economic elements of ESD will be covered in the next phase of assessments.

The reporting of performance for each fishery is the responsibility of the Department in conjunction with the relevant Management Advisory group and/or associated stakeholders. Consequently, the completion of this report has involved a substantial level of consultation and input from many groups including a public comment period. The list of participants involved in this development is located in Appendix 2.

This material has also been used as the basis to submit an application to Environment Australia to meet the requirements of the Commonwealths' *Guidelines for the Ecologically Sustainable Management of Fisheries*. A copy of the application section of this submission, which was submitted in July 2002, is located in Appendix 7. The Shark Bay Scallop Managed Fishery was awarded an exemption to Part 13A of the EPBC Act for the next five years. A copy of the recommendations imposed for this exemption are located in Appendix 8. Where relevant, these conditions have now been incorporated into the Performance Reports of the fishery (see Section 5).

These ESD reports provide a comprehensive overview of the information pertaining to each fishery. A major element of which is the explicit determination of the operational objectives, performance measures and indicators that will be used to assess performance of the fishery. Most importantly these reports include appropriately detailed justifications for the levels chosen and the methods used. Therefore, the annual *State of the Fisheries* only reports on the evaluation of performance of this fishery against these sets of "agreed" objectives/performance measures, the full justifications will not be presented in the *SoF* reports. The relationship of these documents is summarised in Figure 1.

[1] *During the time this assessment was completed, this department was called Environment Australia (EA). Throughout this document, references to EA should be taken to mean DEH.*

As stated in the Department's ESD policy, it is expected that the ESD report, and therefore the objectives and performance measures, will be reviewed every 5 years to ensure that they remain relevant and appropriate with current scientific protocols, social attitudes and prevailing environmental conditions. This will coincide with the next assessment cycle under the *EPBC Act*. The material presented here relates to the time of the application, not time of publication.

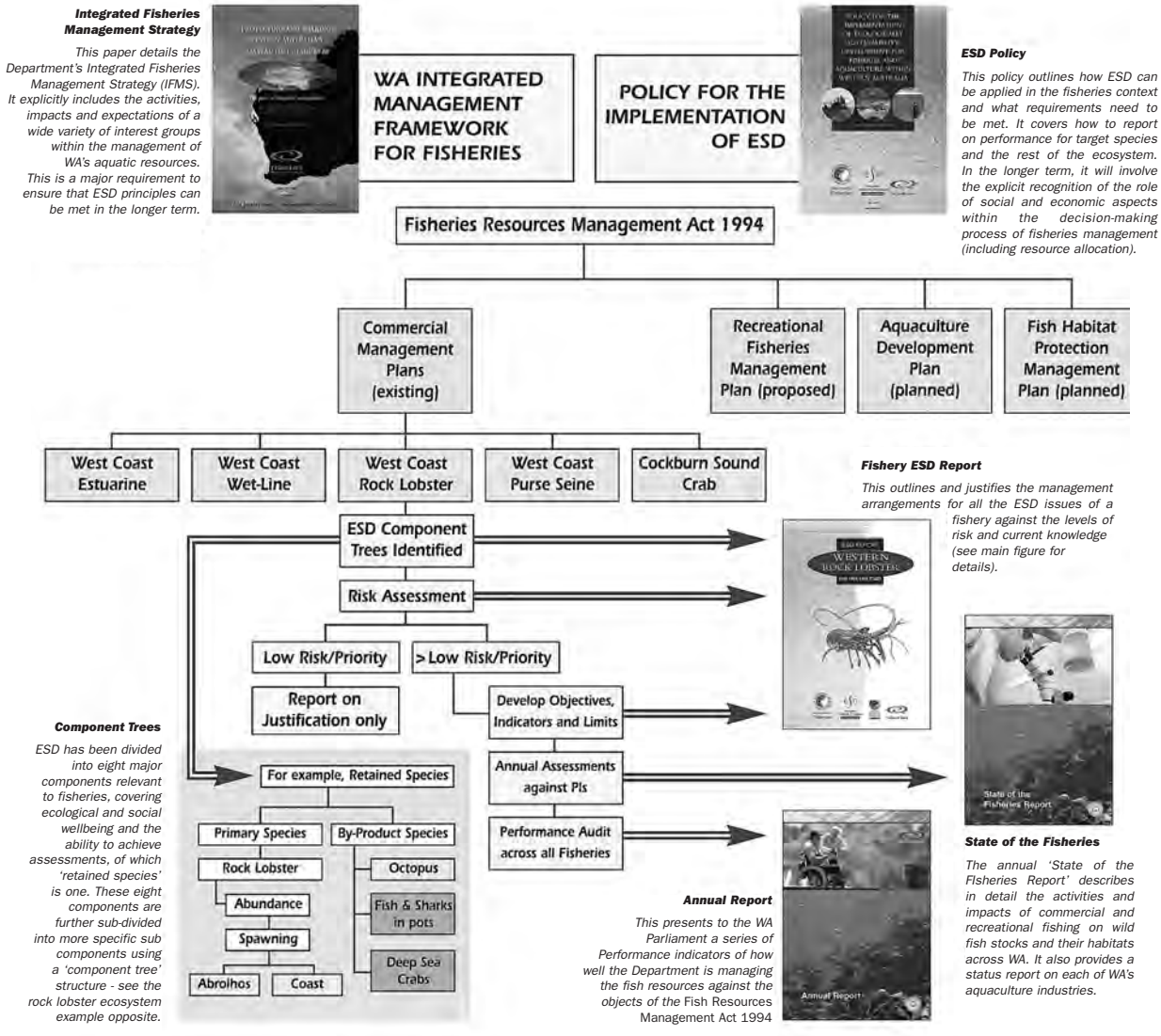

Figure 1. Summary of process for completing ESD reports and their relationship with the Annual Report and State of Fisheries Reports. (Example shown is for the West Coast Bioregion and the Western Rock Lobster fishery.)

2.0 Overview

The Shark Bay Scallop (SBS) Managed fishery is usually Western Australia's most valuable scallop fishery with a landed value that ranges between $2 to 58 million. The SBS is an otter trawl fishery that targets the western saucer scallop *Amusium balloti* within small regions of Shark Bay. This fishery has operated under a detailed and sophisticated management regime since the 1960s with catches over the last 30 years ranging from 121 to 4,414 tonnes per year. This large range of catches is mainly due to the naturally induced variations in recruitment that affect most scallop fisheries.

The *Fish Resources Management Act, 1994* (FRMA 1994) provides the legislative framework to implement the management arrangements for this fishery. The FRMA 1994, and the specific management plan for the SBS fishery, adheres to arrangements established under relevant Australian laws with reference to international agreements as documented in (Section 5.8.2).

Management of the fishery is aimed at catching scallops at the best size and condition for the market, thereby maximising the economic return, whilst maintaining appropriate levels of the breeding stock. The current management plan for the Shark Bay Scallop managed fishery is a formal statutory document that dictates the management measures for the fishery. The Shark Bay Scallop Management Advisory Committee achieves cooperative management of this fishery through the provision of advice on these arrangements.

There is a large amount of relevant and accurate information on the biology and recruitment status of the scallop species. There is also a sophisticated suite of management arrangements in place in this fishery including zones, closed seasons & VMS monitoring of the fleet, along with proactive management. Each of these has been refined through time, and is subject to regular reviews to achieve the overall aim of successful management, which has resulted in the maintenance of scallops stocks as well as the successful continuation of the fishery. In summary these arrangements include:

- Limited number of vessels operating in fishery
- Two sets of licences (Class A and Class B) with different requirements in crew size, gear and time closures
- Closed season between November and April (variable starting time depending upon recruit levels)
- 24 hour a day trawling allowed for Class A
- Temporary or permanent area closures, which relate to important nursery grounds or no marketable product in the area
- Gear controls that include restrictions on the mesh size (Class A 100mm; Class B 50mm) and the number of nets (2), the length of trawl net head rope (Class A 7 fathoms; Class B 8 fathoms), and the size of the trawl otter boards and ground chains.
- Extensive "unfished" licence area resulting in approximately only 30% of licenced area actually being fished
- Requirement of Vessel Monitoring System on all fishing vessels

Compliance policing is a major part of attaining adherence to the input controls and closures imposed on this fishery. Sea patrols and radar watches are conducted on a random basis during the season. The use of VMS from 2002/03 on the vessels will help the Department of Fisheries monitor vessel location and speed, thus increasing compliance with closures while decreasing the need for untargeted patrol activities. Additionally, the compliance staff conducts license and gear inspections both at sea and in port.

Research into the biological and environmental aspects of WA scallop stocks and commercial exploitation, has been carried out by the Department of Fisheries since the late 1960s. This research has aimed at maximising the economic returns from the available scallop resource, while managing its use and harvest at ecologically sustainable levels to conserve and protect the State's aquatic ecosystems. The department has been conducting pre-season surveys that monitor the strength of scallop recruitment in Shark Bay since 1982. These surveys measure the abundance of pre-recruits to the Shark Bay population each year and provide an annual index of recruitment, which is independent of catch records. As a result, annual management arrangements can be tailored to the expected abundance of scallops due to the significant correlation (0.81) that was determined between the abundance of pre-recruits and the following year's catch. Additional fishery-independent research will continue investigating the environmental influences that affect recruitment to scallop stocks in Shark Bay. The collection of fisheries dependent data (voluntary logbooks, CAESS and processor unload records) for stock assessment and monitoring of the scallops will continue.

The life history and distribution of the western saucer scallop are well known. Saucer scallops are broadcast spawners, releasing their eggs and sperm into the surrounding waters for fertilisation to occur in the water column. Early growth of this species is rapid and in Shark Bay most appear to live no more than two years and usually attain a maximum size around 115 mm. Scallops derived from early in the spawning season (April-July) reach sizes around 50-60 mm in shell height by November, some 6-7 months after fertilisation. A size suitable for commercial harvest (>90 mm shell length) is reached by March-April the next year, within approximately one year. Saucer scallops are filter feeders, removing small organic material and particulates from the surrounding water.

Assessments of current performance demonstrate that the scallops are being maintained above levels necessary to maintain ecologically viable stock levels.

In summary:

- The recruits/residual stock must be above a level that allows a start to the following season to be set – this is the performance measure for this stock.
- The level of capture of other by-product species by this fishery is too small to have a significant impact on their dynamics.

The status of the scallop stock is determined from a pre-season survey of recruitment and residual stock conducted between November and December. This survey enables the start date of the fishery to be determined and allows for the management and presence of sufficient spawning stock from year to year. The level of residual and recruit abundances on the trawl grounds in the pre season survey is used in a matrix that determines the opening date of the fishery ensuring an adequate level of spawning will have taken place prior to fishing. Recruitment of this species is highly variable and as a result catch varies greatly from year to year independent of the level of spawning that generated it.

The fishery has also taken a positive response to minimise wider ecosystem interactions. Trawling is restricted to a relatively small area of the Shark Bay region, and these are predominately over sandy substrates. Bycatch reduction devices and turtle excluding devices are currently being phased-in which will minimise or eliminate the potential for impacts on other species.

It is generally believed that the bycatch numbers of fish and other species are relative low in this fishery due to the larger mesh size nets used, clumped distribution of the scallops, and lower trawling speeds. A formal risk assessment for all the non listed and threatened bycatch species identified by the component tree were ranked as either negligible or minor risks. Three of these are not actually captured in the net but on rare occasions interact with the trawling operations.

The assessment for the impacts on listed or threatened species, including those with direct interaction but no capture, found that the SBS fishery was a negligible risk to green turtles; and a minor risk to seasnakes, syngnathids and loggerhead turtles. For the direct interaction but no capture category, this assessment concluded that the fishery was of minor risk to cetaceans, dugongs, loggerhead turtles and green turtles.

The issues that relate to the broader ecosystem identified for the SBS fishery were also assessed using a formal risk assessment process. Of the seven issues identified for the SBS fishery, two (impacts on sand/shell and coral/sponge habitat) were rated as moderate risk, two (impact of taking everything and discarding fish) were rated as minor risk and three (discarded shell, translocation and turbidity) were rated as negligible. This assessment suggests that the SBS fishery is operating in an ecologically sustainable manner.

3.0 Background on the SBS Fishery

3.1 DESCRIPTION OF THE FISHERY

The SBS fishery exists within the waters of Shark Bay off the mid west coast of Western Australia (WA) (Figure 2). The physical area of the fishery is described as:

> *"the waters of the Indian Ocean and Shark Bay between 23°34' south latitude and 26°30' south latitude adjacent to Western Australia on the landward side of the 200m isobath, together with those waters of Shark Bay south of 26°30' south latitude"* (Figure 3).

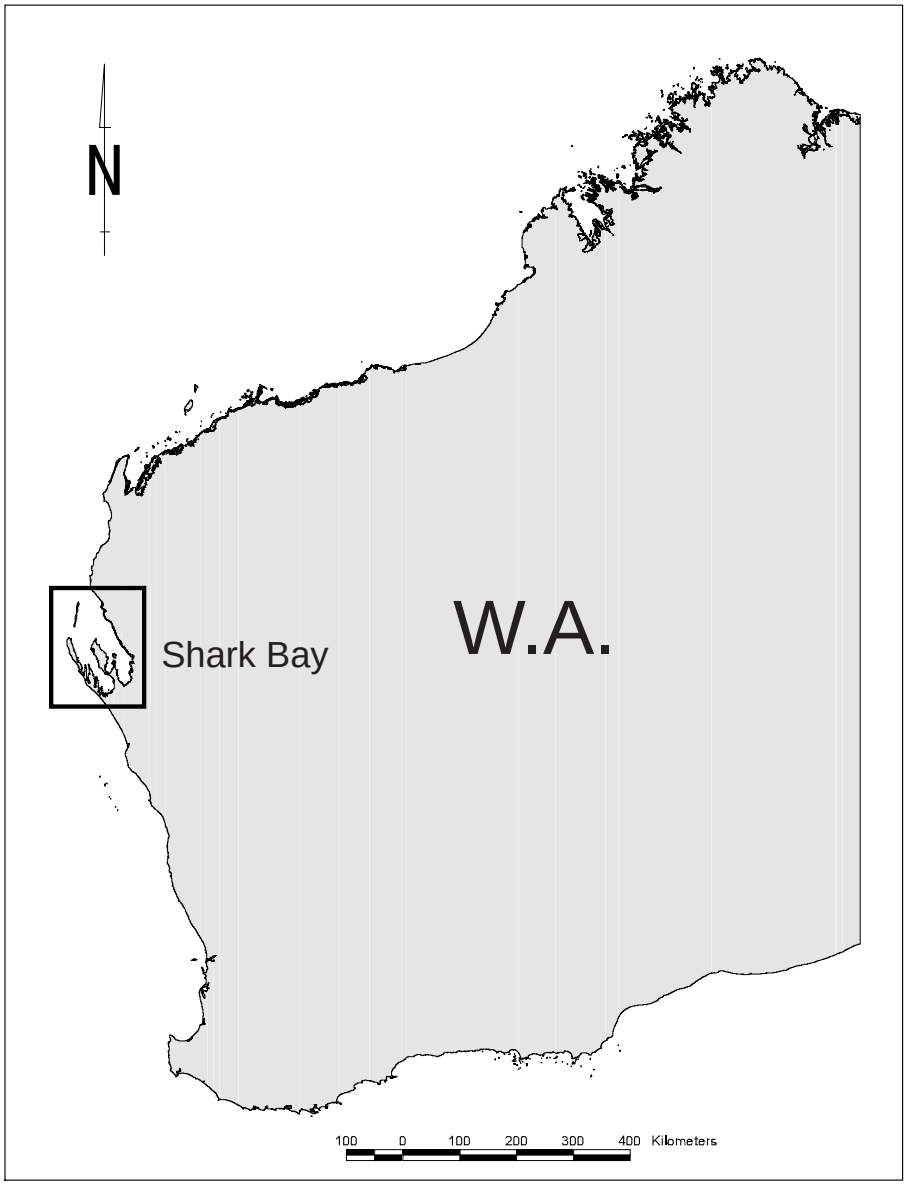

Figure 2. SBS fishery locality map.

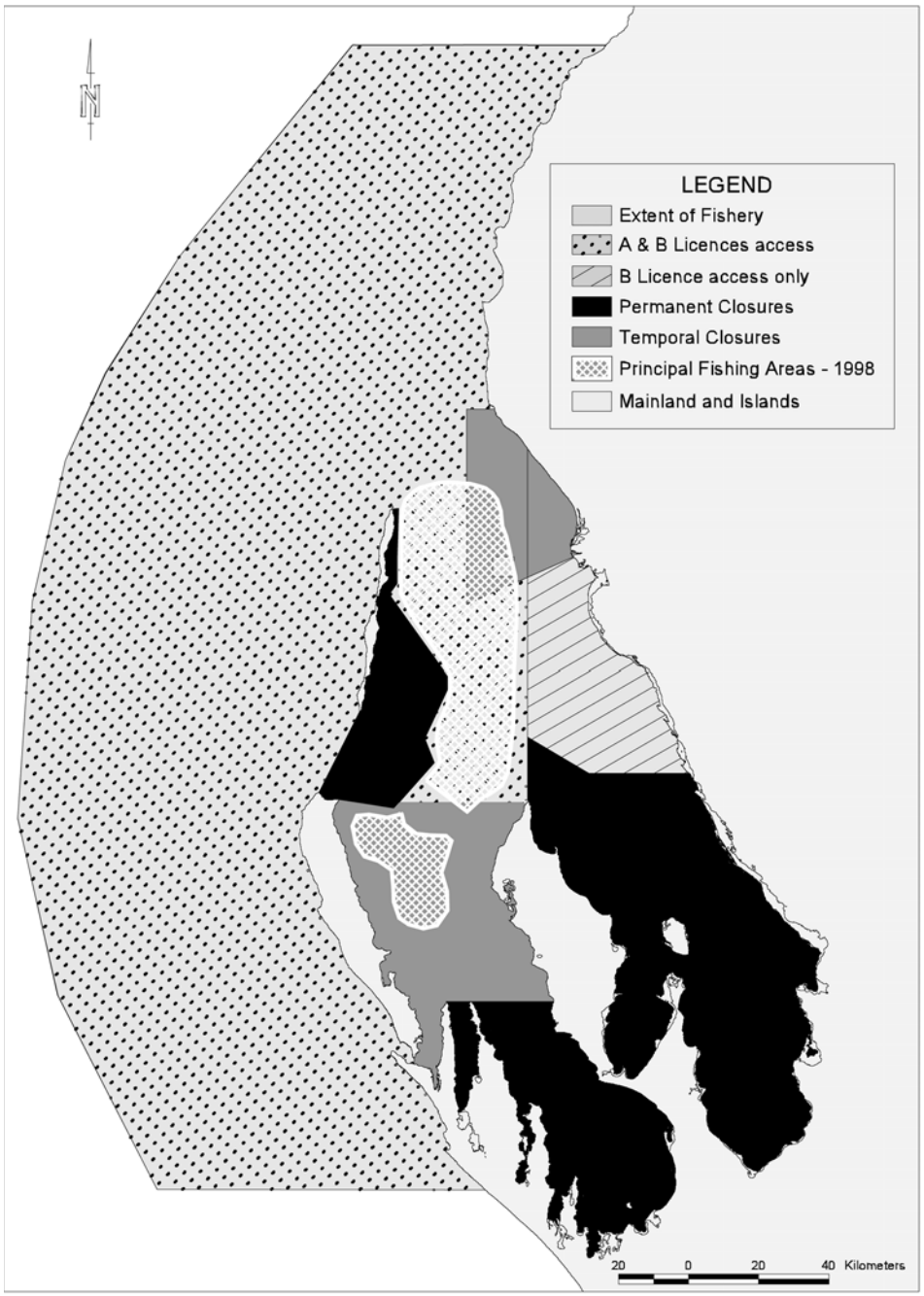

Figure 3. SBS fishery major features.

Within this overall area, scallop trawling only occurs in waters east of the outer islands of Shark Bay, in depths between 16 m and 40 m. Additionally, within the functional area of trawling, there are differences in fishing boundaries according to what type of licence is held. Currently, the scallop fishery consists of two types of licences, Class A and B. There are fourteen vessels with Class A licenses that are solely scallop trawlers and account for 70% of the catch. Twenty-seven (27) vessels possess Class B licenses, which allow them to fish for prawns (in the Shark Bay Prawn Managed Fishery) and scallops. The boundaries for the Class A vessels are the waters of Shark Bay and Denham Sound west of longitude 113°30'36"E and north of a line running due east from the northern

extremity of Cape Bellefin to Peron Peninsula. The vessels with Class B licences are endorsed to fish the waters of Denham Sound north of the Cape Bellefin line and most of the waters of Shark Bay. B-class licence holders are allowed to operate east of the 113°30' 36"E line running northwards from Cape Peron but may not operate in the eastern gulf of Shark Bay (Figure 3). A permanent closure for both licences exists for a reef area eastward of the Naturaliste Channel, between the northern end of Dirk Hartog Island and the southern end of Dorre Island and along the eastern margins of Dorre and Bernier Islands (Figure 3).

In the late 1960s and during the1970s, scallops in Shark Bay were taken mostly as by-product from vessels fishing for prawns, and were not targeted until the late 1970s (Joll, 1989). By the early 1980s, the number of vessels attracted to Shark Bay to fish for scallops increased dramatically and a specific management plan for scallop fishing was introduced in 1987 (Joll, 1989). Over the period since 1982, the annual catch and value of the fishery have varied greatly. For the last 18 years, annual catches have ranged from 121 to 4,414 tonnes meat weight (Figure 4), depending primarily on the naturally variable strength of recruitment flowing from the breeding season of the previous year. Consequently, the fishery's value has also fluctuated on an annual basis, ranging from $2 to $58 million. Despite the highly variable annual catches, the Shark Bay Scallop Managed Fishery is WA's most significant scallop fishery, although in some years large catches have been taken in other scallop fisheries (Sporer and Kangas, 2001).

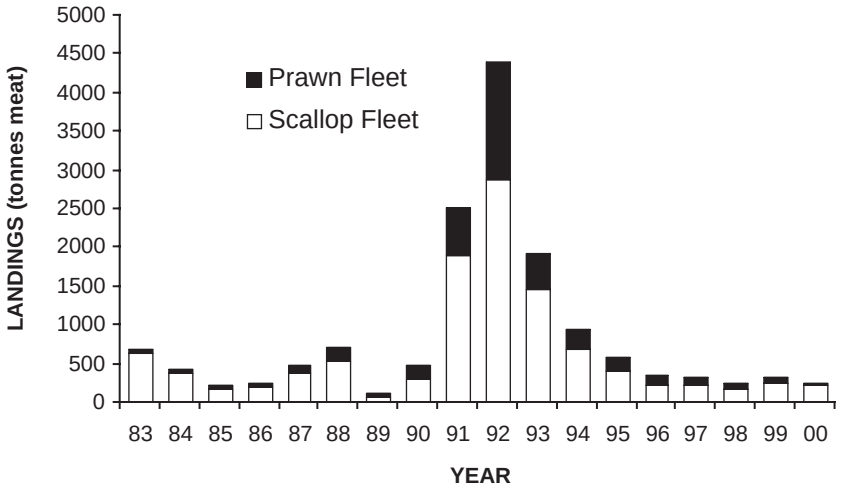

Figure 4. Shark Bay scallop landings for scallop (A-class) and prawn (B-class) licensed vessels between 1983 and 2000.

Fishing Methods

There is only one target species for the SBS and this influences the gear used in the fishery. The A-class boats in the SBS fishery tow two low-opening demersal otter trawl nets (7 fathoms headrope length, mesh size 100 mm). The B-class boats tow two otter trawl nets with a headrope 8 fathoms in length and mesh size no greater than 60 mm. Tow speed is around 2.5 to 3 knots for A-class vessels as this is the most effective speed when targeting scallops, while shot durations can vary from around 20 minutes up to 150 minutes, depending on scallop abundance. Two otter boards, each 2.27 metres in length and 0.91 metres in height (2.44 metres in length and 0.91 metres in height for Class B vessels) are attached at the extremities of each net at the opening (Figure 5). Forces produced

by water flowing over the otter boards open the trawl nets laterally. The lateral spread is vital to catch efficiency of trawl gear and this determines the area swept. Generally, the opening width of the net is between 60% and 85% of the length of the headrope. A ground chain with links of a maximum of 10 mm diameter metal is attached by short dropper chains to the footrope. The ground chain travels across the sea floor and disturbs scallops so they swim up from the seafloor and into the path of the oncoming net. Low opening nets have the headrope as a lead-ahead, which creates a net veranda and is set in front of the footrope and ensures that scallops disturbed by the ground chain do not usually pass over the headrope. The mesh size used is 100 mm (Class A only) to allow prawns to escape through the mesh. The setting of the ground chain is designed to make it skim over the sand and not dig into the sea floor.

In 2000/01, preliminary bycatch reduction grid trials were commenced in the trawling fisheries. As a result, in 2002 all scallop trawlers were required to tow at least one net with a grid (Bycatch Reduction Device - BRD). In 2003, all scallop trawlers were required to operate with a BRD into both nets (Figure 6) except for the grid exemption area/time given to the prawn fleet.

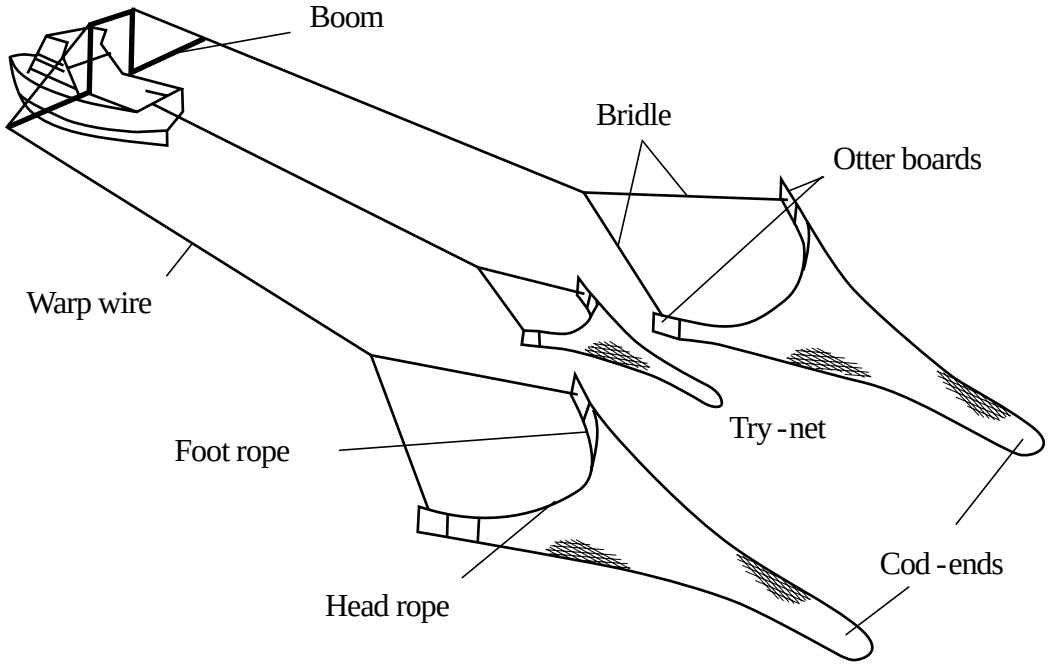

Figure 5. The standard twin otter rig and try gear used by scallop trawlers in Shark Bay.

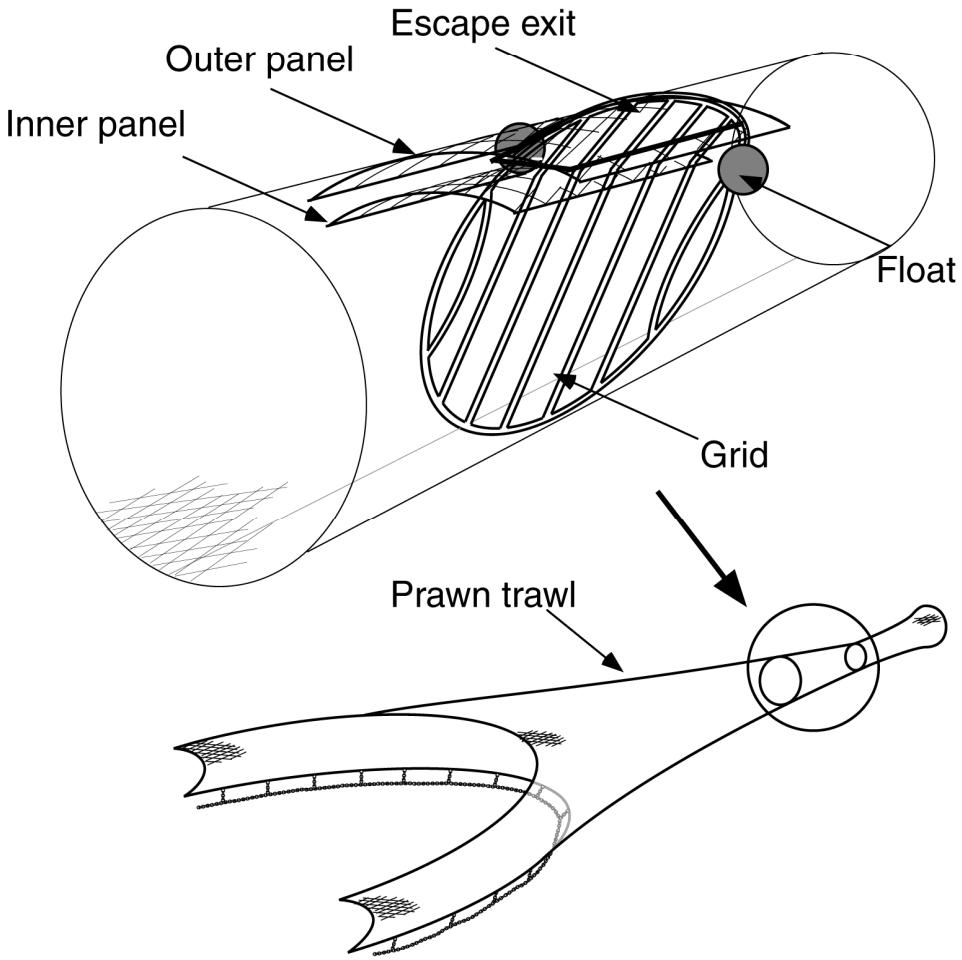

Figure 6. Diagrammatic representation of the type of bycatch reduction device used in Shark Bay, and its location in the prawn trawl (same as for scallop) net.

Management

Management of the fishery is aimed at catching scallops at the best size and condition for the market, thereby maximising the economic return, whilst maintaining breeding stock levels. Because the scallop stock commences spawning in mid-April (continuing through until the end of November) and meat condition declines as spawning continues, the process of setting the opening date of the season balances breeding stock levels (measured by a pre-season survey of stock abundance) and the seasonal decline in meat condition associated with spawning.

The current management plan for the SBS fishery is a formal statutory document that provides the framework for the management measures for the fishery. The Shark Bay Scallop Management Advisory Committee (SBSMAC) forms the basis for cooperative management of this fishery through the provision of advice. The advice provided allows for the management to be tailored to providing adequate levels of spawning stocks whilst achieving the best economic return from the available scallop resource. The management framework aims to catch scallops at a size and reproductive condition that maximizes meat weight and condition while maintaining sustainability of the fishery.

Management of the SBS fishery is based on limited entry, boat size, gear controls, area closures and the timing and duration of the fishery.

Small numbers of vessels and limited entry fishery. There are a limited number of vessels operating in the fishery. The SBS fishery has 14 "A" class vessels that target scallops and 27 "B" class vessels that primarily target prawns but also take scallops. Entry to the fishery is limited and no further vessels may be licensed.

Seasonal closure. The fishery is generally closed between November and around April. The closure is generally aligned with the Shark Bay Prawn Managed Fishery closure times but the A-class (scallop-only) vessels usually cease fishing before the declared closure date as the scallop catch rates are usually reduced to levels that are not economic for scallop-only vessels. This usually occurs prior to the closing date of the prawn fishery.

Area closures. Only the deeper soft bottom areas are open for scallop trawling. Permanent closure areas are in place for both prawn and scallop boats (Figure 3). The Denham sound area is generally open after 1 August. However, the scallop survey leading up to the 2000 season, showed reasonable densities in Denham Sound, and as a result the area was opened for a period of 3 days at the end of April/beginning of May.

Time closures. During the scallop season trawling by A-class vessels can take place 24 hours a day. B-class vessels are limited to specified prawn trawling hours (normally 1700 – 0800) or 15 hours per day.

Crew restrictions. Scallop trawlers (A-class boats) are limited to thirteen crew members. B licensed vessels are limited to six crew members.

Gear controls (Net size, board size, net mesh size and size of try gear). Specifications for these input controls are part of the Management Plan and are attached. Compliance policing is a major part of attaining adherence to the input controls and closures imposed on this fishery. Compliance staff conduct license and gear inspections in port prior to the start of the season and sea patrols are conducted on a random basis during the season to check gear at sea.

Vessel Monitoring System. In 2000, the Vessel Monitoring System (VMS) was introduced into the SBS fishery. The VMS enables the Department of Fisheries to monitor a vessel's location and speed, with particular attention being paid to the surveillance of closed areas.

By-product Species. It should be noted that there is currently no effort directed at the management of by-product species of this fishery. However, due to the mesh size and low trawl speed, the by-product species taken in this fishery are a very minor component of the catch.

History

Scallops were first identified in WA waters in 1904, when the government survey vessel Rip reported finding the saucer scallop, *Amusium balloti* in several trawls conducted in south-west coastal waters (Gale, 1905; Laurenson et al., 1993). During the late 1950s and early 1960s exploratory trawling was undertaken in the Shark Bay area by the research vessels *Lancelin* and *Peron* (Penn and Stalker, 1979). This action revealed potential commercial quantities of prawns and scallops, but it wasn't until 1966 that scallop landings were first reported. For several years scallops were taken as a by-product from vessels fishing primarily for prawns, but due to a short-lived upsurge in catch in the late 1960s and a number of vessels began targeting scallops (Joll, 1989).

Targeted fishing for scallops ceased during 1971-72, probably as a result of poor recruitment. Fishing recommenced in 1973 and vessel numbers targeting scallops gradually increased over the ensuing 10 years.

By the early 1980s, the number of vessels attracted to the fishery escalated dramatically (Joll, 1989). Improvements in techniques for processing the catch at sea, increases in price due to higher product quality and an apparent increase in stocks made scallop fishing in Shark Bay increasingly lucrative (Joll, 1989). Subsequent increases in fishing pressure were further compounded by the efforts of the then 35 Shark Bay prawn trawlers, which began to retain scallops caught while targeting prawns. These increases in fishing activity led to a much higher proportion of the resident stock being taken, with fewer scallops surviving to the maximum age of 3 years (Joll, 1989). Federal export regulations at the time prevented much of the scallop catch from being exported, as it was subject to advanced larval nematode infection. As the age composition of the stock was lowered, however, more scallops were caught at younger ages before serious infection could develop. This increased both the proportion of the catch suitable for export and the value of the product (Joll, 1989).

After peaking at 26 vessels in 1982, the size of the scallop fleet was reduced to 14 vessels in 1983, pending a four-year biological review of the fishery. Following review recommendations, Shark Bay was declared a limited entry fishery in 1987, restricted to 14 dedicated scallop vessels operating alongside the then 35 vessels endorsed to fish the limited entry prawn fishery, under a catch-sharing arrangement (Joll, 1989). The Shark Bay prawn fleet was itself reduced to the current 27 vessels in 1990 to limit the available effort that could be expended on prawn stocks, and to improve vessel economics.

Limitations on daily fishing time for scallops were introduced in Shark Bay in 1988 to aid in the orderly fishing of scallop stocks by both scallop and prawn vessels. Trawling was limited to a 15-hour period from 1700 hrs to 0800 hrs the following morning, but the practice was abandoned in 1993 in the interests of crew safety and improved (fresher) product. Twenty four-hour trawling was reinstated for dedicated scallop trawlers to allow the catch to be more steadily processed rather than stockpiled during the fishing period for later processing.

Management arrangements utilized since the mid-1980s have ensured that adequate spawning stock levels are maintained such that there is an adequate level of spawning stock present when spawning commences. While the approach has been generally successful in maintaining stocks, annual variations in recruitment seem to be dominated by environmental factors that are inversely correlated with the strength of the Leeuwin Current.

Non-Retained Species

While target stocks are relatively well maintained in this fishery, public concern in recent years has increased regarding general bycatch resulting from fishing activities, particularly trawling. As a result of the limited information on the bycatch generated by this fishery, a two-year research program on the implementation of BRDs began in 2000. This program included an observer program designed to record, identify and quantify bycatch in the SBS fishery. The bycatch generated by scallop trawling is relatively minimal compared to that of other trawling fisheries primarily because of the larger mesh size used, targeting of scallop aggregations and slower trawling speeds.

A draft Bycatch Action Plan (based upon the detailed information presented later in this report) has been prepared for this fishery based on consultation with the conservation, recreational fishing and commercial fishing sectors.

Research

Research into the biological and environmental aspects of WA scallop stocks and commercial exploitation, has been carried out by the Department of Fisheries since the late 1960s. This research

was aimed at determining the basic biology of the species to ensure that the scallops are harvested at ecologically sustainable levels whilst achieving the best economic returns from the available scallop resource.

The Department has been conducting pre-season surveys that monitor the strength of recruitment in Shark Bay since 1982 (further details in Section 5.1.1.1). These annual surveys measure the abundance of residual scallops remaining from the previous season and the new recruits to the Shark Bay population, providing an annual index of recruitment and stock abundance that is independent of fishery catch records (Joll and Caputi, 1995a). These data allow the annual management arrangements to be tailored to the expected abundance of scallops available to the fishery because of the significant correlation (0.81) between the pre-season stock abundance index and the following year's catch (Joll and Caputi, 1995a).

Additional fishery independent research will continue investigating the environmental influences that affect recruitment of scallop stocks in Shark Bay. More specifically, research into the effects that the Leeuwin Current has on the scallop recruitment and spawning or fertilisation activities will be further investigated. It is expected that the use of temperature sensors (which began in 1992) and thermal satellite imagery combined with altimeter data for sea level determination will provide a much greater insight into the annual, seasonal and regional variations of the Leeuwin current and assist in improving assessments of the regional impact of the current on scallop recruitment (Caputi et al., 1996).

In addition, the fleet has provided a detailed record of all scallop catch taken since the 1980s in a research logbook system completed by all vessels. The collection of fishery dependent data (voluntary logbooks, catch and effort statistics system (CAESS) and processor unload records), which forms part of the stock assessment data set, will continue.

3.2 BIOLOGY OF SAUCER SCALLOP

Distribution and Stock Structure

The saucer scallop, *Amusium balloti*, belongs to the family Pectinidae. The western population of *A. balloti* has a distribution spanning most of the WA coast, having been recorded from Broome in the north to Esperance in the south (Figure 7). The greatest numbers are found in Shark Bay and around the Abrolhos Islands (Joll, 1989). The eastern population of *A. balloti* occurs from Innisfail, Queensland to Jervis Bay, New South Wales (Kailola et al. 1993).

Although there is some uncertainty regarding the species of the two populations and varying usage of nomenclature, it is likely that the eastern population and western population are the same species or sub-species. However, in Kailola et al. 1993, the eastern and western populations are referred to as separate sub-species (Ballot's saucer scallop in the east and Western saucer scallop in the west) as a result of research conducted in Queensland. This research found that not only were there differences in the genetic make-up of the two populations but the degree of difference indicated that there is probably no interbreeding between the two (Kailola et al., 1993). In this report the Department of Fisheries will refer to the commercial scallop caught in the SBS fishery as the saucer scallop, *Amusium balloti* from the western population.

Although *A. balloti* has an extensive distribution, it tends to be restricted to areas of bare sand in the more sheltered environments found in the lee of islands and reef systems. The species has been reported occurring in depths from 10-75m in discrete beds, up to 15km in length, at densities of up to 1 per m^2 (Dredge, 1988; Kailola et al., 1993).

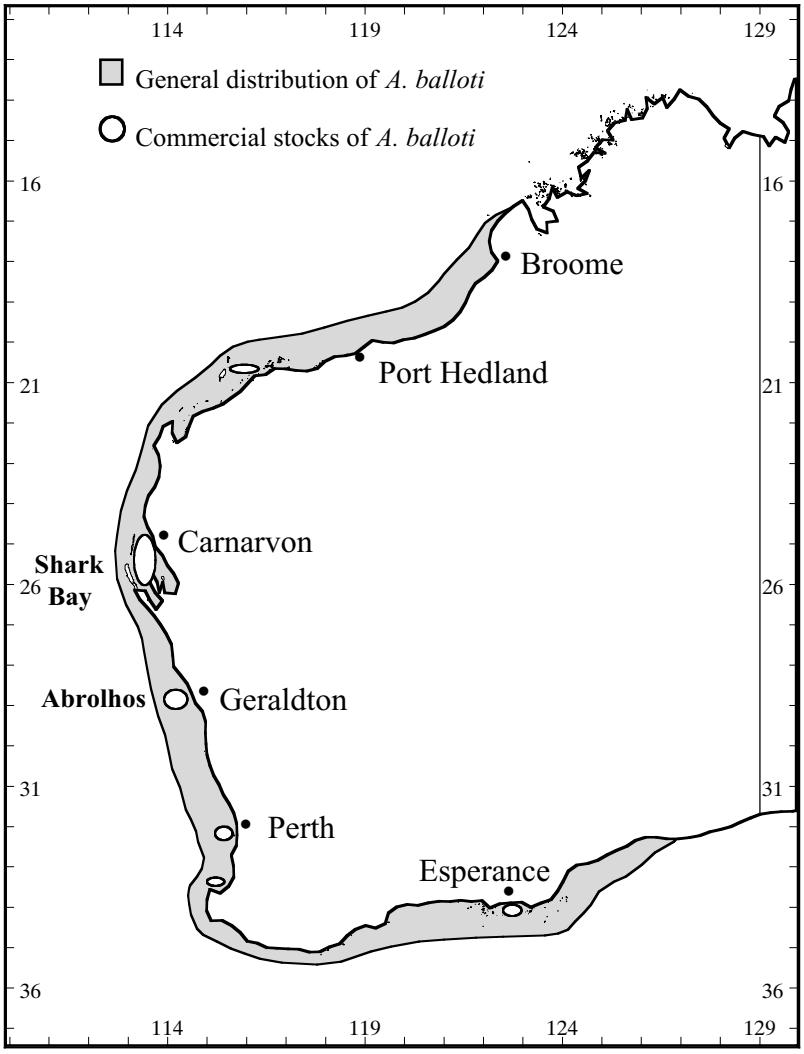

Figure 7. Map showing the distribution of the saucer scallop, Amusium balloti in Western Australia.

Life History

Early growth of this species is rapid and although saucer scallops have been recorded reaching 140 mm in length and living up to 3-4 years, in Shark Bay most appear to live no more than two years and usually attain a maximum size around 115mm (Heald, 1978; Dredge, 1988).

The reproductive cycle among Shark Bay scallop stocks begins with the onset of gametogenesis in late March/early April, with spawning occurring 4 to 8 weeks after the onset of gametogenesis (April/May through to December) (Joll and Caputi, 1995a). Although it was originally believed that the reproductive cycle of the saucer scallop was triggered by changes in water temperature in the range of 18°-23°C, recent research conducted by Joll and Caputi (1995a), has found that the relationship between changes in gonad weight and water temperature is tenuous for *A. balloti* on the WA coast.

Saucer scallops are broadcast spawners, releasing their eggs and sperm into the surrounding waters for fertilisation to occur in the water column (Kailola et al., 1993). The life cycle for the saucer scallop is depicted below in Figure 8.

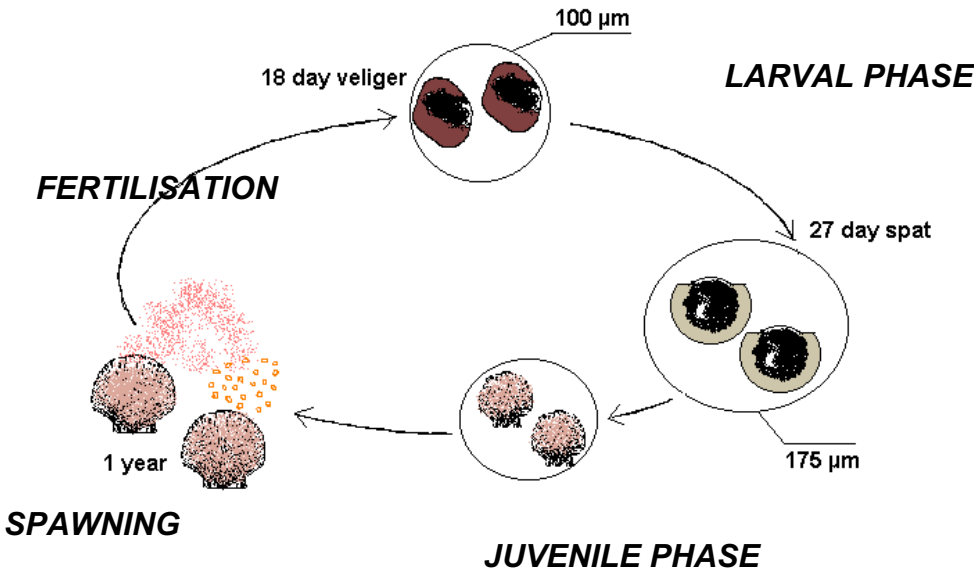

Figure 8. Life cycle of the saucer scallop, *Amusium balloti*.

The planktonic, larval phase of the saucer scallop lasts between 12 and 24 days (Rose et al., 1988), although more recent work has produced settled spat at nine days (P. McGowan, pers. comm.). Success of the larval phase appears to be governed by prevailing oceanographic events, which greatly influence recruitment patterns and settlement locations. The predominant oceanographic influence along the WA coast is the Leeuwin Current, a southward flowing current of relatively warm, tropical water that is low in salinity (Joll and Caputi, 1995b). While the environmental mechanisms relating to the recruitment variability of *A. balloti* are yet to be fully understood, it appears that in years of strong Leeuwin Current there is an increased likelihood that larvae are flushed away from areas of suitable recruitment habitat. This hypothesis is supported by research data, which indicates that in years when the current flow is strong, scallop recruitment in Shark Bay is low and vice versa (Joll and Caputi, 1995b). It is also quite possible that the Leeuwin Current could have some temperature effects on spawning or fertilisation because of associated warmer waters (Joll and Caputi, 1995b).

Following the larval phase, juvenile scallops settle out as spat over a period of several days (Rose et al., 1988). During this time, they crawl actively using a well-developed, ciliated foot, and do not appear to attach permanently to the substrate (Rose et al., 1988). A week after settlement, a byssal notch and associated threads develop on the dissoconch of the right valve, although attachment to the substrate remains very weak and is never permanent (Rose et al., 1988).

Growth of new recruits to the wild stock population is rapid. Scallops derived from early in the spawning season (April-July) reach sizes around 50-60mm in shell height by November, some 4 to 6 months after fertilisation. A size suitable for commercial harvest (>90 mm shell length) is reached by March-April the next year, within approximately one year (Joll and Caputi, 1995a). It is around this stage that the recruits mature and enter the breeding stock (Joll and Caputi, 1995a) although some early recruits pass through a precocious (but probably not functional) sexual development in September and November of the year of their settlement (Joll, pers. comm.).

Saucer scallops are filter feeders, removing small organic material and particulates from the surrounding water. Known predators include loggerhead turtles (*Caretta caretta*), pink snapper (*Pagrus auratus*) and octopus.

3.3 MAJOR ENVIRONMENTS

3.3.1 Physical Environment

Shark Bay has a semi-arid to arid climate with hot, generally dry summers and mild winters. The waters of Shark Bay cover an area of about 13,000 km^2. It is for the most part a shallow embayment with an average depth of 9 m and a maximum depth of 29 m. Water depths increase to the north and west where the bay opens into the Indian Ocean reaching a maximum of around 40 m in the Naturaliste and Geographe Channels.

The large seagrass beds in the bay influence the hydrology of the area, slowing water currents as they pass over the beds, and allowing increased deposition of suspended sediments. This has led to the development of large sedimentary banks (e.g. Faure Sill). The restrictions on water flow imposed by these seagrass banks has resulted in the unusual hydrologic structure in Shark Bay characterised by salinoclines and three major water types namely oceanic (salinity 35-40 ppt), metahaline (40-56 ppt) and hypersaline (56-70 ppt). This distinct salinity pattern influences the distribution of marine flora and fauna within the bay, leading to three biotic zones.

The islands bordering the bay and the seafloor itself are of sedimentary origin, predominantly limestone and sandstones (Logan and Cebulski, 1970). In Shark Bay, water movement is largely influenced by wind and tide. The waters of the Bay are influenced by semi-diurnal tides (two high water per day), which have a maximum range of about 1.5 metres. Stratification of water due to different and elevated salinities has resulted from these influences in Shark Bay.

In the Shark Bay region, the rainfall is low approximately 20 cm per year while the evaporation rate under the influence of the summer trade winds reaches approximately 220 cm per year. The combination of high evaporation rate with the extensive sand banks that slow water movements into the southern bays results in high salinities of up to 60–70 ppt (twice seawater) in areas such as Hamelin Pool. The temperature range in shallow waters can be between 15°C (June/July) and 35°C (Feb/Mar) (Penn and Stalker, 1979).

3.3.2 Economic Environment

The majority of the annual catch is destined for export as frozen scallop meat to Asia, principally via Hong Kong markets. Very small quantities of scallops are occasionally left ‘roe-on’, or in the half-shell to supply boutique markets for these products.

Wholesale market prices for scallops have fluctuated markedly over the last ten years, plummeting from $17.50/kg in 1989 to around $8.50/kg in 1991 due to oversupply in the marketplace, before steadily improving to a peak at around $30.00/kg in 1995. Price variability has arisen primarily in response to product availability and condition, although poor marketing in the face of a large supply and price manipulation by Hong Kong buyers was blamed for the low prices in the early 1990s. Exchange rates are also a significant factor in the Australian dollar price.

Size and condition of the meat play an integral part in determining the market value of scallop meat, and consequently these factors greatly influence selection of appropriate seasonal opening dates. Higher prices are usually paid for larger scallops, so it is desirable to open the scallop fisheries when meats may reasonably be expected to be better than the 40/lb criterion, as this size is preferred on the export market.

3.3.3 Social Environment

The fishery has had considerable impact on regional WA. There are 41 boats operating in this fishery, 14 with Class A licences and 27 with Class B licences. Class A vessels operate with 13 crew members while Class B vessels operate with a maximum of 6 crew members. In addition, there is also scallop processing and support staff employed in Carnarvon and Fremantle. As a result, the SBS fishery employees a large number of individuals in the Gascoyne region providing in excess of 300 jobs including the fishing fleet, processing and fleet maintenance, plus indirect employment for service providers during the season from April to November.

4.0 Outline of reporting process

4.1 SCOPE

This ESD report was generated by assessing "***the contribution of the Shark Bay Scallop fishery to ESD".*** This assessment examined the benefits and the costs of the SBS fishery across the major components of ESD (see Table 1). In doing so, it will provide a report on the performance of the fishery for each of the relevant ecological, economic, social and governance issues associated with this fishery. Given the timeframes involved, only the criteria required for the "*Guidelines for the Ecologically Sustainable Management of Fisheries"*, which cover mainly the environmental elements of ESD (outlined below in Table 1) were generated for this report.

Table 1. Main National ESD reporting components.

Only those elements in **bold*** are reported in this report.

NATIONAL ESD COMPONENTS
Contribution to Ecological Wellbeing
Retained Species*
Non-Retained Species*
Other Environmental Issues*
Contribution to Human Wellbeing
Indigenous Community Issues
Community Issues
National Social and economic Issues
Ability to Achieve
Governance*
Impact of the environment on the fishery

4.2 OVERVIEW

There were four steps involved in completing the ESD report for the SBS fishery. It was based upon using the National ESD process, which is outlined in detail in the WA ESD policy paper (Fletcher, 2002) and in the "How to Guide" (Fletcher et al., 2002) located on the fisheries-esd.com website:

1. The issues that needed to be addressed for this fishery were determined at a stakeholder workshop. This process was facilitated by adapting the set of "Generic ESD Component Trees" into a set of trees specific to the SBS fishery.
2. A risk assessment/prioritisation process was completed that objectively determined, which of these identified issues was of sufficient significance to warrant specific management actions and hence a report on performance. The justifications for assigning low priority or low risk however, were also recorded.
3. An assessment of performance for each of the issues with sufficient risk to require specific management actions was completed using a standard set of report headings where operational objectives, indicators and performance measures, management responses etc were specified.
4. An overview assessment of the fishery was completed including an action plan for activities that will need to be undertaken to enable acceptable levels of performance to continue or, where necessary, improve the performance of the fishery.

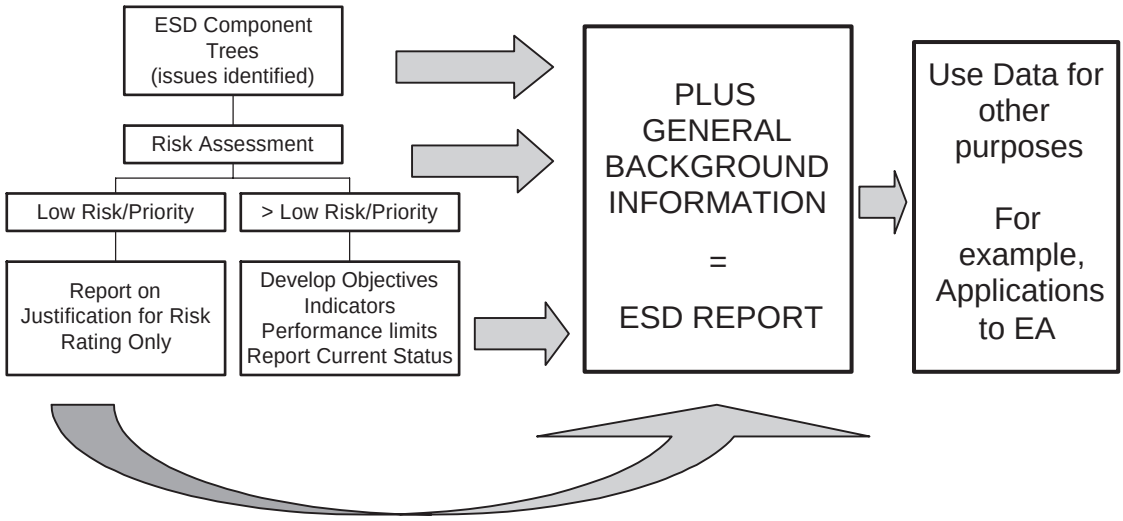

Figure 9. Summary of the ESD reporting framework processes.

4.3 ISSUE IDENTIFICATION (COMPONENT TREES)

The National ESD reporting framework has eight major components, which fall into three categories of the "contributions to ecological wellbeing", "contributions to human wellbeing" and "ability to achieve the objectives" (Table 1). Each of the major components is broken down into more specific sub-components for which ultimately operational objectives can be developed.

To maximize the consistency of approach amongst different fisheries, common issues within each of the components were identified by the then SCFA and ESD Reference Groups within each of the major component areas and arranged into a series of "generic" component trees (See Fletcher (2002) and the www.fisheries-esd.com web site for a full description). These generic trees were used as the starting point for identifying the issues. These trees were subsequently adapted into trees specific to the SBS fishery during an open consultative process involving all stakeholder groups. This was achieved by expanding (splitting) or contracting (removing/lumping) the number of sub-components as required (see Fig. 10).

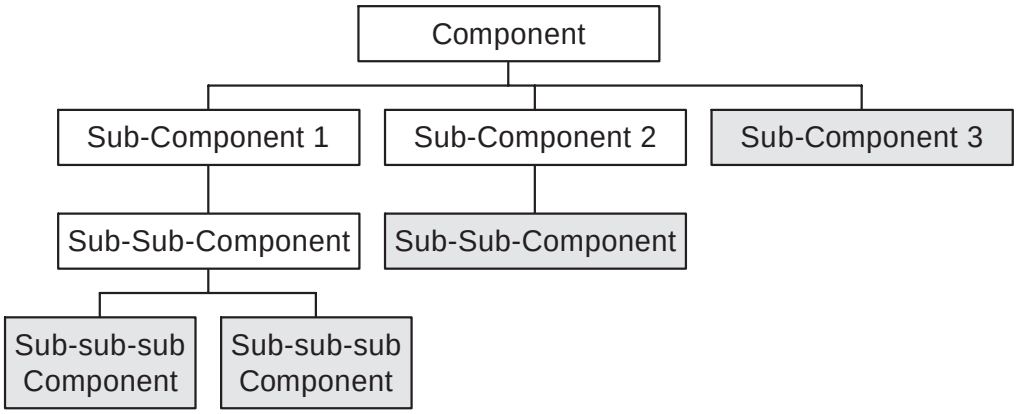

Figure 10. Example of a component tree structure.

The trees for the SBS fishery were developed prior to the first workshop and reviewed at the first workshop in June 2001. The stakeholders present during this meeting covered the commercial industry, recreational fishers, environmental groups, EA, Department of Environmental Protection (DEP), Department of Fisheries staff and the Fisheries Research and Development Corporation (FRDC) project team (full attendance list in Appendix 2.1).

4.4 RISK ASSESSMENT/PRIORITISATION PROCESS

After the components/issues are identified, a process to prioritise each of these needs was completed using a formal risk assessment process. The risk assessment framework that was applied at the workshop was consistent with the Australian Standard AS/NZS 4360:1999 Risk Management, concentrating on the risk assessment components. Risk Assessment processes are well documented but, in summary, they consider the range of potential consequences of an issue/activity and how likely those consequences are to occur. The combination of the level of consequence and the likelihood is used to produce an estimated level of risk associated with the particular hazardous event/issue in question.

A realistic estimate of the consequence level of each issue was made by the group. This level was from 0-5, with 0 being negligible and 5 being catastrophic/irreversible (see Appendix 3 for details of consequence tables). This assessment was based upon the combined judgement of the participants at the workshop who collectively had considerable expertise in the areas examined.

The level of consequence was determined at the appropriate scale for the issue (see Appendix 3). Thus for target species the consequence of the SBS fishery was based at the population level and not at the individual level, obviously catching one fish is always catastrophic for the individual but not always for the population. Similarly, when assessing possible ecosystem impacts this was done at the level of the whole ecosystem or at least in terms of the entire extent of the habitat, not at the level of an individual patch or individuals of non-target species.

The likelihood of a consequence occurring was assigned to one of six levels from remote to likely. In doing so, the workshop group again considered the likelihood of the consequence actually occurring (not just the activity) based upon their collective wisdom, which included an understanding of the scale of impact required.

From these two figures (consequence and likelihood), the overall risk value, which is the mathematical product of the consequence and likelihood levels (Risk = Consequence x Likelihood), was calculated. Finally each issue was assigned a *Risk Ranking* within one of five categories: Extreme, High, Moderate, Low and Negligible based on the risk value (see Table 2).

Only the issues of sufficient risk (Moderate, High & Extreme), - those that require specific management actions - generally need to have a full performance reports completed. Nonetheless, the rationale for classifying issues as a low or even negligible risk was also documented and formed part of the ESD report. This allows all stakeholders and interested parties to see why issues were accorded these ratings. This process is summarized in Figure 9 (above).

Table 2. Risk ranking definitions.

RISK	Rank	Likely Management Response	Reporting
Negligible	0	Nil	Short Justification Only
Low	1	None Specific	Full Justification needed
Moderate	2	Specific Management Needed	Full Performance Report
High	3	Possible increases to management activities needed	Full Performance Report
Extreme	4	Likely additional management activities needed	Full Performance Report

4.5 COMPONENT REPORTS

Only the issues of sufficient risk or priority that require specific management actions have a full performance report completed (which forms Section 5 of this report). Nonetheless, the rationale for classifying issues as low risk/priority was also documented and forms part of the report so that stakeholders can see where all the identified issues have finished.

For each of the lowest level sub-components (assessed as being of sufficient risk/priority to address), a detailed assessment of performance is generated. The then SCFA Working Group in conjunction with the ESD Reference Group has agreed upon a set of 10 standard headings that need to be addressed (Table 3). Added to this list a further heading, "**Rationale for Inclusion**". This specific heading allows the issues raised within the risk assessment process to be explicitly recorded.

Table 3. The National ESD report headings used in this report.

1. Rationale for Inclusion
2. Operational Objective (+ justification)
3. Indicator
4. Performance Measure (+ justification)
5. Data Requirements
6. Data Availability
7. Evaluation
8. Robustness
9. Fisheries Management Response
- Current
- Future
- *Actions if Performance Limit exceeded*
10. Comments and Action
11. External Drivers

The completion of these component reports commenced after the first workshop in June 2001. Progress towards completing these reports was subsequently made by a variety of Department of Fisheries staff. The final component reports were reviewed at the second workshop held in October 2001.

4.6 APPLICATION TO MEET EPBCA REQUIREMENT

The material generated by the ESD reporting process, which is contained with the risk assessment and performance reports was used to meet the requirements of the Commonwealth Environment Protection and Biodiversity Conservation Act (1999). This involved submitting an application that addressed each of the criteria of the Commonwealth guidelines for the assessment of sustainable fisheries. This information is provided in Appendix 7.

4.7 OVERVIEW TABLE

The following table provides a summary of the material presented in the report.

Issue	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Robustness	EA Guidelines Covered	Actions
RETAINED SPECIES (Component Tree)						1.1	
5.1.1.1 Scallop	Yes	Abundance of pre-recruits in Shark Bay	Monitoring of Recruits/ Residual stock to ensure the start date of the season is set so that there is adequate level of breeding stock present when spawning commences.	Acceptable	Medium/High	1.1.1 – 1.1.7	Continue current monitoring, management and assessment arrangements
5.1.2.1 Cuttlefish	No- Negligible Risk	N/A	N/A	N/A	N/A	1.1.8	Review Risk at Next Major Assessment
5.1.2.3 Blue Swimmer Crabs	No- Negligible Risk	N/A	N/A	N/A	N/A	1.1.8	Review Risk at Next Major Assessment
5.1.2.2 Bugs	No- Negligible Risk	N/A	N/A	N/A	N/A	1.1.8	Review Risk at Next Major Assessment
NON-RETAINED SPECIES (Component Tree)						2.1,2.2	
5.2.1.1 Loggerhead Turtles	Yes – but Minor Risk	Until BRDs fully implemented, survival of turtles should be monitored	90% of turtles captured from non-BRD nets returned alive	Acceptable	High – with Observer Program Low – with fishery dependent means	2.2.2, 2.2.4, 2.2.6	Vessels are required to have one BRD net and one standard in 2002. Observer program will monitor turtle captures in 2002. Following observer program turtle captures will be collected by fishery dependent means. All nets will need to have BRDs in 2003.

Issue	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Robustness	EA Guidelines	Actions
NON-RETAINED SPECIES (cont.)						2.1, 2.2	
5.2.1.2 Green Turtles	No- Negligible Risk	N/A	N/A	N/A	N/A	2.2.2, 2.2.4, 2.2.6	Review Risk at Next Major Assessment
5.2.1.3 Syngnathids	No – Minor Risk	N/A	N/A	N/A	N/A	2.2.2, 2.2.4, 2.2.6	Review Risk at Next Major Assessment
5.2.1.4 Seasnakes	No – LOW Risk	N/A	N/A	N/A	N/A	2.2.2, 2.2.4, 2.2.6	Review Risk at Next Major Assessment
5.2.2.2 Interaction with Green and Loggerhead Turtles	No – LOW Risk	N/A	N/A	N/A	N/A	2.2.2, 2.2.4, 2.2.6	Review Risk at Next Major Assessment
5.2.2.1 Interaction with Dugongs and Cetaceans	No – LOW Risk	N/A	N/A	N/A	N/A	2.2.2, 2.2.4, 2.2.6	Review Risk at Next Major Assessment
5.2.1.5 Discarded Fish	No – Negligible Risk	N/A	N/A	N/A	N/A	2.2.2, 2.2.4, 2.2.6	Review Risk at Next Major Assessment
5.2.1.6 Invertebrates	No – Negligible Risk	N/A	N/A	N/A	N/A	2.2.2, 2.2.4, 2.2.6	Review Risk at Next Major Assessment
GENERAL ENVIRONMENT (Component Tree)						2.3	
5.3.1.1 Impact on ecosystem (take of retained and non-retained)	No – LOW Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review Risk at Next Major Assessment
5.3.1.2 Impact to Sand/Shell	No – LOW Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Continue GIS monitoring of trawled area
5.3.1.3 Impact to coral/ sponge	No – LOW Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Continue GIS monitoring of trawled area
5.3.2.1 Impact of Discarding Fish	No – LOW Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review Risk at Next Major Assessment
5.3.2.2 Impact of Discarding Shells	No – Negligible Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review Risk at Next Major Assessment

Issue	Objective Developed	Indicator Measured	Performance Measure	Current Performance	Robustness	EA Guidelines	Actions
5.3.3.1 Turbidity	No – Negligible Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review Risk at Next Major Assessment
5.3.3.2 Translocation	No – Negligible Risk	N/A	N/A	N/A	N/A	2.3.1 – 2.3.5	Review Risk at Next Major Assessment

5.0 Performance reports

5.1 RETAINED SPECIES

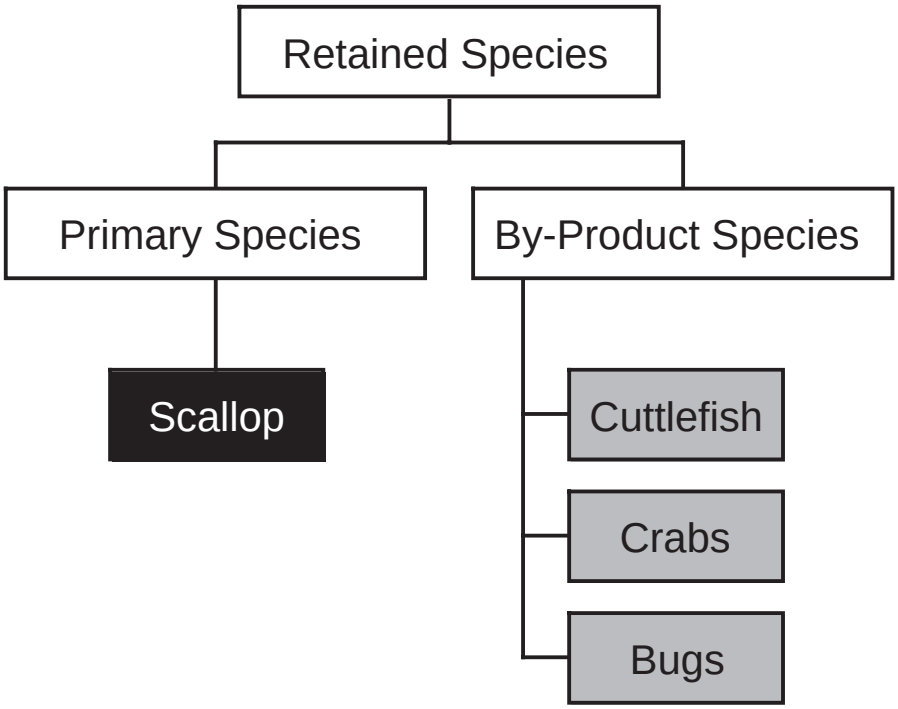

Figure 11. Component tree for the retained species.

Black boxes indicate that the issue was considered high enough risk at the June 2001 Risk Assessment workshop to warrant having a full report on performance. Grey boxes indicate the issue was rated as a low risk and no specific management is required – generally only the justification is presented.

5.1.1 Primary species

5.1.1.1 Scallops

Rationale for Inclusion

Scallops (*Amusium balloti*) are the major target species for the SBS fishery.

ERA Risk Rating: Impact on breeding population (C2 L5 MODERATE)

In terms of consequence, fishing for scallops was determined to have only a 'moderate' impact on the breeding population level. The dynamic management arrangements for this fishery are based on a pre-season survey that provides an estimate of the level of effort that can be placed on the stocks to optimise harvesting levels while sustaining breeding stock levels. This consequence was considered 'likely' to occur with management designed to ensure that this moderate level of harvesting occurs. The overall risk rating is therefore 'moderate'.

Operational Objective

Ensuring there is sufficient breeding stock at the time of spawning to minimise the risk of recruitment overfishing.

Justification

Scallops can be fished to reasonably low levels due to their life history strategies of short life span, high fecundity and high natural mortality and the absence of any recognisable stock-recruitment relationship at stock levels normally experienced in the fishery. Spawning in the early part of the spawning season (April-June) is responsible for the majority of the recruitment each year particularly in years of high recruitment. Catches become uneconomic well before the part of the population contributing to recruitment is significantly depleted. Again, although there is likely to be some level of reduction in the spawning biomass of scallops at which subsequent recruitment will be adversely affected, no statistically significant relationship has yet been shown to exist for stock levels which have been experienced in Shark Bay. Nonetheless, a precautionary approach is being taken to ensure the sustainability of the scallop stock by the setting of a start date to the season, which encourages high levels of spawning stock in the early part of the spawning season and, overall, an adequate level of breeding stock during the whole spawning period.

Indicator

An annual biological survey, designed to measure the abundance of pre-recruits to the Shark Bay population, provides an index of recruitment, which is independent of fishery catch records. The survey is usually carried out in November, as this is the earliest time that juveniles are large enough to be caught by trawls to allow for the assessment of their distribution and density. The mixture of residual and recruit abundance on the trawl grounds in this survey is used in a matrix to determine the opening date of the fishery (see Table 4), which ensures that an adequate level of spawning stock is present during the spawning period.

In addition, catch data from voluntary logbooks is collected on a daily basis. This information allows for an accurate assessment of the total effort in the fishery and spatial distribution of scallops in Shark Bay because it provides the Department of Fisheries with information on hours fished, areas of operation and estimated catch per trawl. Independent data on the spatial operation of the fleet is also available from VMS.

Performance Measure

For acceptable performance, the Recruits/Residual Stock index should be above a level that allows a start to the following season to be set, which ensures that there is an adequate level of breeding stock during the spawning period.

Justification

Scallops spawn from mid-April to November and therefore the opening of the fishing season must also vary each year to ensure that an adequate level of spawning stock to be present when spawning commences. A significant correlation has been determined between the abundance of pre-recruits in November and the following year's catch and this allows annual management arrangements to be tailored to the expected abundance of scallops. Thus in high abundance years, fishing can commence once the scallops are large enough to market (which could be as early as mid-March, prior to the commencement of spawning if the stock abundance is composed of a high proportion of residual (older) scallops). In low abundance years the starting date is set later to ensure sufficient spawning stock is present through the spawning period so that adequate stock levels are maintained in the important early part of the spawning season and that some spawning will have occurred prior to any harvesting.

For fishing to occur the following year, the index must be sufficiently high that the season can open prior to the end of May. In cases where the stock abundance index is not so low as to not open the

fishery a very short fishing season may be provided for (e.g. a 3-day fishing season was permitted in Denham Sound in 2001).

Since a spawning stock and recruitment relationship has not been experienced in this fishery, annual management arrangements are based on the relationship between the stock abundance index for the November survey and following year's catch, which has been successful in maintaining the stock for the past 20 years. Even so, the Department of Fisheries in the next few years will be looking into more explicitly defining a bottom line for this fishery (a point at which fishing is either not commenced or is terminated). Currently, the end of the season is economically driven, with fishers stopping at around 6 - 7 kg/hr or 120 - 150 kg/day.

The process of setting an opening date for the season is balanced between providing adequate stock abundance levels for egg production and allowing the fishery to capture scallops at appropriate market sizes and quality:

- *Marketable meat size. New recruits reach a marketable meat size by somewhere between mid March and the end of April. Meat size then reduces relative to a scallop of the equivalent size as the meat shrinks during spawning (although this is offset to some extent by growth in shell size).*
- *Marketable meat quality. Meat quality decreases during the year once spawning commences. Also, scallops begin to show increased larval nematode lesion by October/November as the nematode worms develop.*

Table 4. Opening date schedule.

ESTIMATED CATCH (meat wt.)	ABUNDANCE RECRUITS	ABUNDANCE RESIDUALS	OPENING DATE*
Low (<300 t)	Low	Low	15 May
Med (300 - 600 t)	Moderate Low	Low Moderate	1 May 15 April
High (600 - 1,500 t)	High Moderate Low	Low Moderate High	15 April 15 April 1 April
Very high (>1,500 t)	High Low	Low High	1 April 15 March

* Or nearest suitable day.

+ Estimated catch derived from stock abundance index to catch relationship (see Figure 11).

Data Requirements for Indicator

Data Requirement	Availability
Fishery Independent Recruit/Residual Surveys	Yes, since 1982
Catch utilising commercial catch and effort information provided through voluntary daily logbooks completed by 100% fishers	Yes, available on an annual basis

Evaluation

Summary: The management arrangement for the past years has ensured that the start date of the season has been set to allow for an adequate level of spawning to occur during the spawning period.

Scallop landings have varied dramatically over the last 15 years (Figure 12) depending primarily on the strength of recruitment. Recruitment strength is mainly independent of spawning stock size being largely environmentally driven (see external drivers section below).

The status of the stock is determined from a pre-season (November-December) survey of recruitment and residual stock. This survey enables the start date of the fishery to be determined and allows management of the spawning stock. For example, the recruitment of juveniles to the stock in 1998 was low to moderate, as measured using the data from the November scallop survey. This level of recruitment was reflected in the catch (1,700 tonnes whole weight) taken in 1999, which was in the middle of the range projected for the season. Likewise, in 1999 the recruitment of juveniles to the stock was at the low end of the range, as measured using data from the November scallop survey. This level of recruitment was reflected in the catch taken in 2000; however, the catch projection was not realised because the small meat size of the scallops produced a lower than expected ratio of total meat to whole weight. Additionally, the fishing effort was also 21% lower than the previous year because scallop boats did not fish beyond the end of June, when the remaining scallops showed small meat size and poor condition.

The total scallop catch in 1999 for this fishery was 1,700 tonnes whole weight. The Class A fleet caught 1,250 tonnes whole weight or 73% of the total catch, with the Class B fleet taking 450 tonnes whole weight.

For the 2000 season, the catch projection was approximately 1,500-2,750 tonnes (whole weight), based on the November 1999 survey, which indicated that recruitment was higher than the previous year but still low (Figure 12). The resulting total catch for 2000 was 1,345 tonnes (whole weight). The Class A fleet (all 14 boats fished in 2000) caught 1,220.5 tonnes whole weight or 90.7% of the total catch, with the Class B fleet taking 124.5 tonnes whole weight.

The catch projection for the 2001 season is approximately 1,000-1,700 tonnes (whole weight), based on the November 2000 survey (Figure 13), which indicated that recruitment was lower than last year but residual stock was higher due to the lower level of fishing in 2000 (Figure 12).

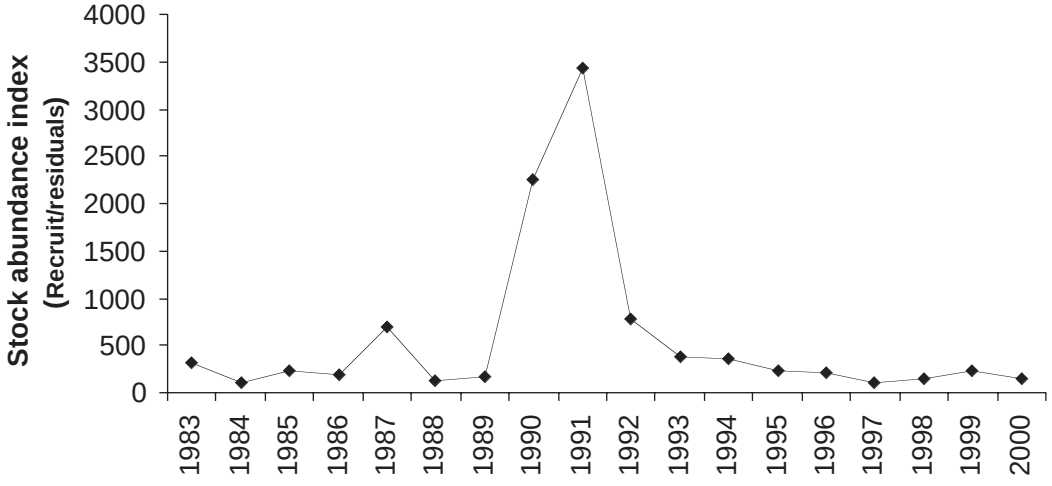

Figure 12. Stock abundance index (recruits and residuals) for the SBS fishery.

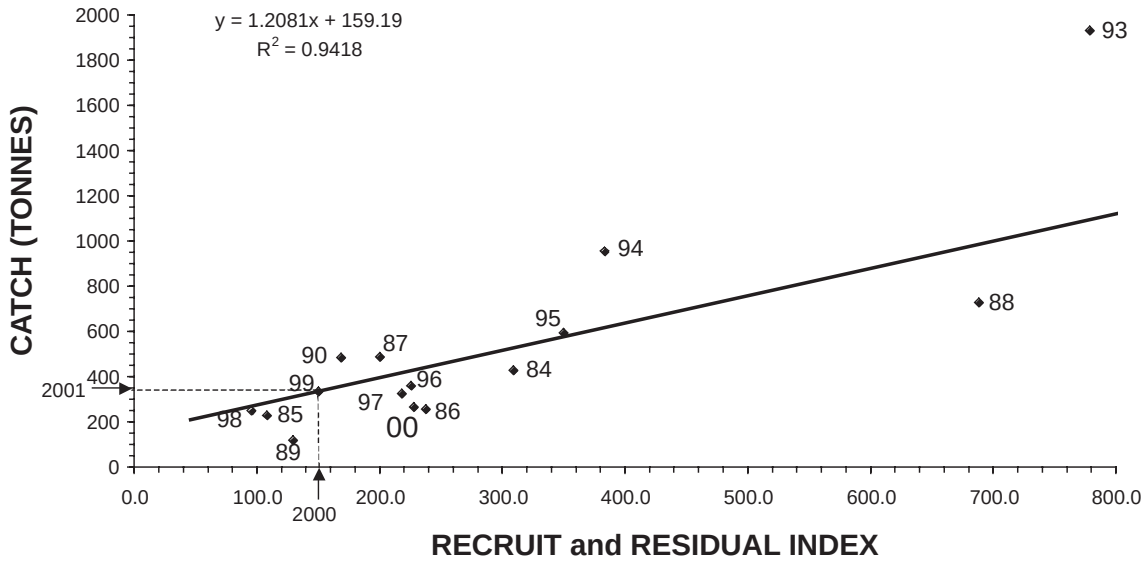

Figure 13. Relationship between recruit/residual index (stock abundance index) and the commercial catch the following year.

Robustness

Medium/High

The estimates are considered relatively robust as they:

a) Provide a statistically demonstrated high degree of confidence.

b) They are direct estimates of recruitment strength.

c) Estimates are calculated by a source independent of the fishers.

d) Research has been reviewed in scientific journals.

Fisheries Management Response

Current: The fishery is managed through a series of input controls:

a) The number of licence holders.

b) The sizes of vessels that they can use.

c) The types and number of nets, including mesh sizes and ground gear.

d) The annual fishing season is for a limited period and includes variable opening timing and area closures limiting the opportunity for fishers to take scallops.

Furthermore, the Department of Fisheries management arrangements include:

- Compliance policing, which includes the use of VMS and gear checks.
- Monitoring of improvements in technology that may increase fishing efficiency.
- Ensuring that any significant declines in the breeding population either from environmental effects or due to fishing are observed in time to implement appropriate management interventions.

Future: Some of the input controls currently in place will be reviewed such as the 375-boat hull unit formulation. This rule notionally sets limits to the size and engine power of a vessel and has been an integral part of the input controls in this fishery. In simple terms the rule (which is a provision of the management plan) requires that the vessel does not exceed 375 boat units, calculated by the formula:

Boat units = Hull units + engine units where;

$$\text{Hull units} = \frac{\text{Measure Length x Breadth x Depth x 0.6 (dimensions in metres)}}{2.83}$$

Engine units = Installed engine power measure in kilowatts.

In recent years questions about the usefulness and ability of the Department to enforce the 375-boat hull unit formulation has been raised. Use of other methods of containing total effort (i.e. monitoring total area swept, effort per target species) will be evaluated during the review.

Actions if Performance Limit Exceeded:

The following strategy will be adopted prior to the beginning of the next season in the event that the performance limits are exceeded:

1. Find out why the acceptable catch range has not been met or is significantly over the acceptable range. Evaluate if there has been a shift in targeting of scallops that can explain the variation. If:
   a) Lowered catch levels are due to effort reduction then no action to be taken.
   b) An increase is due to a one-off environmental fluctuation then no action will be undertaken.
   c) There is a significant increase, or an increasing trend over three years in the catch of scallops, strategies to further protect the breeding stock by further reducing the total effort expended in the fishery (including a reduction in the length of fishing season or within season closures) will be investigated. These actions can be initiated within a season or prior to the beginning of the next season.

Comments and Action

There is a process of continual improvement in the on-going development and refinement of the methods used to determine stock estimates. This relates to both the collection of information and method of analysis. The use of a Geographic Information System (GIS) for analysing data has commenced. This will provide the Department of Fisheries with more comprehensive data from which to generate the distribution and density of scallops and density of trawl activity in Shark Bay.

External Driver Check List

Environmental factors such as: climatic changes, ocean currents (often measured using sea-surface temperature patterns) are known to affect the levels of recruitment of scallops.

In Shark Bay the predominant environmental factor affecting recruitment of scallops is the Leeuwin Current (Joll and Caputi, 1995a). During years with a strong Leeuwin Current there is an increased likelihood that larvae are flushed away from areas of suitable recruitment habitat. It is quite possible that the current could also have some effect on spawning or fertilization because of associated variations in water temperature (Joll and Caputi, 1995a). If the recruitment level is consistently below the expected recruitment based on the strength of the Leeuwin Current, then the impact of breeding stock may need to be re-examined.

The most significant risk factors in the context of external drivers are probably cyclonic activity and to a lesser degree the potential for significant environmental pollution (i.e. oil or chemical spills in key breeding areas) or habitat degradation. Major changes in circulation patterns caused by different climatic forces would have an impact on recruitment patterns.

5.1.2 By-product species

5.1.2.1 Cuttlefish

Rationale for Inclusion

The SBS fishery retains some squid and larger cuttlefish caught as a by-product. (Note: the squid catch is low due to their small size and ability to escape through the 100 mm mesh.)

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

Catches of cuttlefish have decreased in the recent years since the level in 1996 of around 4 tonnes (Table 5) to the current levels, which are less than 1 tonne.

Table 5. By-product species recorded (in kilograms) as landed by the SBS fishery, 1995-2001.

By-product Species	1995	1996	1997	1998	1999	2000	2001
Blue swimmer crab	820	203	8,109	12,497	8,332	467	3,597
Cuttlefish		4,349	2,292	2,394	1,258	843	
Shark, other		135	37	76			
Cod			20			80	
Other fish			20	24			
Squid			40	75			
Sweetlip			23				
Bugs				276		485	111

In terms of impact on breeding stock levels of cuttlefish, the consequence of the SBS fishery is considered "negligible". This is due to the small and isolated catch in comparison to the extensive population size and distribution of cuttlefish along the WA coastline (*Dr. Fred Wells*[*]*, pers. comm.*).

While the species composition of cuttlefish in Shark Bay is not known, Adam (1979) reviewed the cuttlefish present in Western Australia. Four species, all of which occur in Shark Bay have a maximum shell length of >100 mm and are thus possible fishery species. All are geographically widespread species at or near the end of their ranges. Two species (*Sepia apama* and *S. novaehollandiae*) are temperate species near the northern limit of their ranges. The other two (*S. cultrata* and *S. pharonis*) are widespread tropical species near the southern limit of their ranges. The Shark Bay distributions are thus a small proportion of the total ranges of these species. Cuttlefish have short lifespans, on the order of 1-2 years. For example, *Sepia apama* requires a single year to reach adult size. Mass mortalities after spawning have been reported (Lu, 1998).

[*] *Dr Fred Wells, Senior Curator of Molluscs, WA Museum.*

In addition, cuttlefish are most common where there are rock outcrops, seagrass beds, and other areas, which provide habitat diversity and protection. As a result, a significant proportion of the populations in Shark Bay would be unavailable to be caught by trawling operations because they do not occur in trawling areas (*Dr Fred Wells*[*]*, pers. comm.*). Due to fishery closures much of the potential trawl area is, in fact, not fished, further protecting the species.

Worldwide, loliginid squids constitute major molluscan fisheries worth millions of dollars. The standing stock on the North West Shelf has been estimated at 4,500 tonnes (Liu and Yeh, 1984). The species composition of the catch in Shark Bay is not known, but one of the species present is *Sepioteuthis lessoniana*. Loliginids typically mature in one year or less. Their lifespan is short, 1-2 years, ranging up to 4 years in some species. *Sepioteuthis lessoniana* reaches sexual maturity in less than 100 days in Queensland (Dunning & Lu, 1998). Additionally, the distribution of squid over the bottom substrate and vertical movement in the water column means only a small proportion is vulnerable to trawling.

In terms of the risk assessment it was determined that it is "likely" that the fishery was having only a "negligible" impact in this respect, resulting in an overall 'negligible' risk ranking for this issue.

5.1.2.2 Bugs

Brief Justification

The SBS fishery catches and retains bugs (*Thenus orientalis*) as a by-product.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

It was determined 'likely' that the fishery could have a "negligible" impact on the breeding population of bugs in Shark Bay due to the following:

- The fishery catches less than 1 tonne of bugs per year (Table 5), which is minimal compared to the extensive population size and wide geographical range of these species;
- Bugs have a long larval life and an offshore phase allowing them to disperse widely.

5.1.2.3 Blue swimmer crabs

Rationale for Inclusion

The SBS fishery catches and retains blue swimmer crabs (*Portunus pelagicus*) as a by-product.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

Since 1998, when the catch of crabs in the fishery peaked at around 12 tonnes, catches have decreased to less than a tonne (467 kg) in 2000 and 3,597 kg in 2001 (Table 5). The risk assessment determined that it was 'likely' that the fishery would only be having a 'negligible' impact on the breeding stock levels of blue swimmer crabs, resulting in an overall 'negligible' risk ranking, due to the following:

- In Western Australia, the blue swimmer crab distribution extends from Albany to the Northern Territory border, and inhabits a wide range of inshore and continental shelf areas, from the intertidal zone to at least 50m in depth (Fisheries WA, 2002).
- There is a comparatively limited area where blue swimmer crabs are caught but they are found both north and south along the coast and in deeper waters that are generally not fished.

- The SBS fishery takes only a very small proportion of the total catch of blue swimmer crabs. In the 1999/2000 seasons, the commercial fisheries around the State took 673 tonnes of blue swimmer crabs. The commercial fisheries in Shark Bay caught 182 tonnes of blue swimmer crabs. The commercial crab catch is made using a large variety of fishing methods. Trawling constitutes 8% of the total crab catch for the state with traps taking the most crabs, (85%) (Fisheries WA, 2002).
- A developmental commercial trap fishery for crabs exists in Shark Bay that lands much larger quantities of crabs annually. The developing blue swimmer crab fishery for crabs will be the primary system for management of this species in Shark Bay.
- As the legal size at first capture is well above the size at maturity, in all sectors of the fishery, the breeding stock levels are expected to be adequate to maintain stocks (Fisheries WA, 2002)
- Some crabs are thrown back, particularly undersized individuals. Many of the crabs hauled up in the trawl nets are still alive, and the survival of discarded individuals is generally estimated to be around 85%, based on experimental trials on trawl discard mortality in Cockburn Sound in 1999 and 2000 (Melville-Smith et al., 2001).

5.2 NON-RETAINED SPECIES

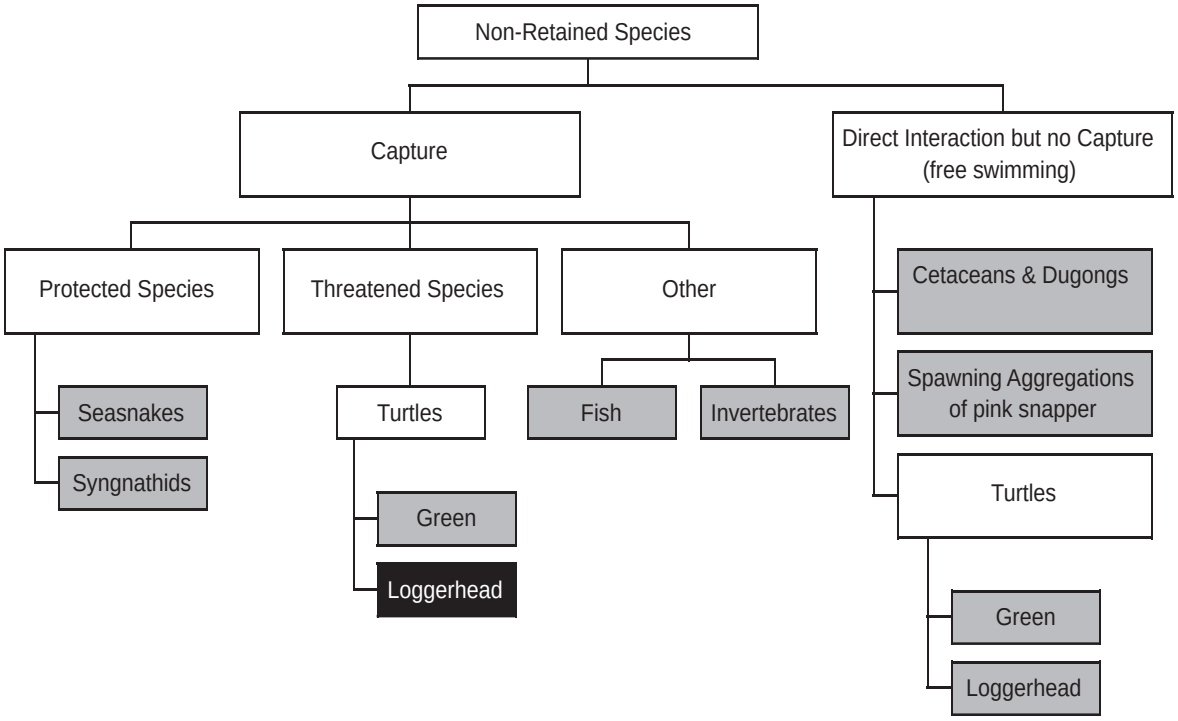

Figure 14. Component tree for the non-retained species.

Black boxes indicate that the issue was considered high enough risk at the June 2001 Risk Assessment workshop to warrant having a full report on performance. Grey boxes indicate the issue was rated as a low risk and no specific management is required – only the justification is presented.

5.2.1 Captured in nets

5.2.1.1 Threatened/listed species loggerhead turtles

Rationale for inclusion

Loggerhead turtles (*Caretta caretta*) have been caught incidentally in the SBS fishery over the period of its operation. Loggerhead turtles are considered threatened species under Commonwealth legislation and the equivalent State wildlife conservation legislation as a result of the current status of their populations.

ERA Risk Rating: Impact on breeding population (C1 L3 LOW)

During the risk assessment workshop, this component was considered a 'minor' risk, indicating that only a brief justification report is required. The determination of a minor risk was based on the fact that:

- The relatively short shot durations in the SBS fishery (from 20-150 minutes, depending on scallop abundance) minimises the chance that if a turtle is captured it will drown before it is brought to the surface in the trawl net and released at the completion of the shot. In addition, the slower speed of scallop trawls means less likelihood of capture and more chance of escape by the turtle swimming forward in the net.
- An on-board observer program run by the Department of Fisheries in the Shark Bay Prawn Managed Fishery over the past 4 years, which operates in a similar area to the scallop fishery, and through similar methods, has recorded the capture of 15 turtles. This is considered a very low number of captures. All turtles caught in the standard net were released alive.

The determination of a low risk was based on the low frequency of capture, trawl durations generally shorter than the lethal period for turtles, and the absence of any significant numbers of dead loggerhead turtles recorded in the area. This, coupled with the introduction of BRDs, which will eliminate this danger to turtles, indicated a low and decreasing risk. It was determined that a full report would be developed to explore this issue once BRDs have been fully implemented.

Operational Objective

Minimise the interactions and ensure that the scallop-trawling operations do not adversely impact on the breeding populations of the loggerhead turtles.

Justification

Turtles are a protected species and impacts as a result of the scallop-trawling fishery should be managed.

Indicator

Until BRDs are fully implemented, the survival of turtles caught in trawl nets should be monitored.

Performance Measure

Ninety percent of the turtles captured from non-BRD nets returned alive.

Justification

Until the full introduction of BRDs, at least 90% of turtles should be returned alive. This level is set high as a precautionary measure due to the protected and threatened status of this species, but also in recognition that accidental losses might still occur.

Data Requirements for Indicator

Data required in order to measure this indicator is:

- number of turtles caught (recorded on a shot by shot basis), and
- number of turtles returned alive (recorded on a shot by shot basis).

Data Requirements and Availability

Observations of turtle capture and release will be required to be recorded. This may involve a combination of logbook data and independent observer data. In addition, some means of monitoring the survival of the turtles after capture should be developed and incorporated into the data collection.

Evaluation

Summary: This fishery should be monitored to make sure that at least 90% of the turtles captured are returned alive.

There has been only minimal observer data collected from the SBS fishery. The Department of Fisheries continued the observer program for the 2002 season in the SBS fishery. However, an observer program was conducted on the Shark Bay Prawn Managed Fishery (which operates in a similar manner and over similar area) over 4 seasons (in conjunction with BRD trials) and this program has recorded turtles captured across the fleet. During this period a total of 15 turtles were caught in total, all in the non-BRD net. No turtles have been caught in the BRD nets. Of the loggerhead turtles caught over this period 100% were returned alive, due to the typically short trawl durations (< 1 hour) in Shark Bay.

It is expected that no turtles will be caught following the full introduction of BRDs to the SBS fishery in 2003.

Robustness

Proportion of turtles returned alive from standard nets.

During the 2002 season, when vessels towed one standard and one BRD net, an observer program for the SBS fishery was conducted to monitor turtle captures. During this period, the robustness of data would be high. Following the observer program, data will be collected by fishery dependent means and will therefore be of low robustness.

Fisheries Management Response

Current: Some vessels in the fishery trialled BRDs in 2001.

Future: The implementation plan of BRDs to the SBS fishery has been developed. The vessels in the fishery fished with one standard and one BRD net in the 2002 season. From the commencement of the 2003 season, the licence condition was amended to state that all nets used in the fishery must have BRDs fitted.

Actions if Performance Limit is Exceeded: *Proportion of turtles returned alive:* If less than 90% of the turtles are returned alive, a report will be prepared to assess the circumstances.

Comments and Action

Summary of Actions:

- Introduce 100% BRD coverage to the fleet in 2003.

External Driver Check List

None.

5.2.1.2 Threatened/listed species green turtles

Rationale for Inclusion

Green turtles (*Chelonia mydas*) are considered a vulnerable species under Commonwealth and the equivalent State wildlife conservation legislation as a result of the current status of their populations and are a common inhabitant of Shark Bay waters.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

In terms of the impact of the SBS fishery on the green turtle breeding population, the risk assessment determined that it was 'likely' that the fishery would be having a 'negligible' impact. This rating was determined because although investigations have shown that green turtles occur commonly in Shark Bay and use several areas as breeding locations, there have been few reports of green turtles being caught in a trawl net through the fishery's duration. This is most likely due to the fact that green turtles prefer to reside in seagrass habitats, which trawls are excluded from and/or avoid. It is thought possible that green turtles may occasionally be affected by trawling when vessels fish close to seagrass banks however with the introduction of bycatch reduction devices, even in these circumstances green turtles would not be caught.

5.2.1.3 Protected species syngnathids

Rationale for Inclusion

Syngnathids are the collective group containing organisms such as seahorses, sea dragons and pipefish. Syngnathids are occasionally incidentally caught in the SBS fishery and are generally discarded, presumed to be dead. Catch rates of all small finfish bycatch are low due to the 100mm mesh size. Syngnathids are a protected species under the EPBC Act.

ERA Risk Rating: Impact on breeding population (C1 L2 LOW)

The potential consequence of the scallop trawling operations on breeding levels of syngnathids was considered 'minor'. Anecdotal evidence from observer program results has suggested that very low numbers of syngnathids are caught by the prawn fishery, in the order of 1 per night across the whole fleet. Furthermore, it is suggested that the occurrence of syngnathids appears to be area specific and often syngnathids may not be caught for many nights in a row. The scallop fleet, which in numbers is smaller than the prawn fleet, fishes for less time of the year (1-4 months), has larger mesh sizes and travels at slower speeds is likely to catch even less than these numbers. It was considered 'unlikely' that this level of consequence would result, as trawling occurs over areas that are mostly unfavourable to syngnathids, which are known to favour seagrass and detached algal communities.

Opportunistic data will be collected on the catch of syngnathids, by observers and other technical staff on the vessels from time-to-time. This data will continually be compiled to provide a better profile of syngnathid catches in this fishery.

5.2.1.4 Protected species seasnakes

Rationale for Inclusion

Seasnakes are regularly caught in low numbers in the SBS fishery and are generally alive when discarded. All species in the family Hydrophiidae and family Laticaudidae are considered protected under the commonwealth legislation.

Seasnakes are common in Shark Bay. Six of the 22 species known to occur in Western Australia have been recorded in Shark Bay, including *Aipysurus pooleorum*, which is endemic to the region. Commercial utilisation of dead seasnakes taken as bycatch in licensed commercial fishing operation is permitted, subject to specific licensing by CALM under the *Wildlife Conservation Act 1950*. The scallop fishery holds none of these licences.

ERA Risk Rating: Impact on breeding population (C1 L2 LOW)

During the risk assessment workshop, this component was considered a 'minor' risk due to the following:

- Anecdotal evidence suggests that caught seasnakes are alive and aggressive.
- A study of seasnake survival following being caught by trawlers in the Gulf of Carpentaria indicated that 60% of seasnakes survived (Wassenberg et al., 1994).
- Most species are considered abundant or common in Shark Bay and are not known to be vulnerable.
- Stobutzki et al. (2000) reported that in commercial trawls greater than 180 mins mortality of seasnakes ranged from 20-59%. Considering that shot durations in the SBS fishery rarely exceed 120 mins, mortality of seasnakes in this fishery would be lower.
- Although there is no specific data currently available on seasnake capture rates in SBS fishery, there is data available from an observer program conducted in the prawn fishery, which operates in the same area. In the prawn fishery, 194 seasnakes were caught from 916 trawls (924 hours of trawling). Of the seasnakes caught, 99% of individuals were returned alive.

5.2.1.5 Discarded fish

Rationale for Inclusion

Trawling is a relatively non-selective form of fishing. As a result, while trawling for scallops, other species are caught. Among these other species are small fish (which include both adults of small species, and juveniles of other larger fish species). These fish are generally not of commercial value and are discarded. Teleost species caught are generally dead when discarded however elasmobranchs are usually returned alive.

The impact of this source of mortality on the sustainability of those caught and discarded species is explored here.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

It is generally agreed that the extent of bycatch generated from scallop trawling is relatively minimal compared to that generated by prawn trawling. A two-year FRDC funded research program on the implementation of bycatch reduction devices to the SBS fishery commenced in July 2000. This

includes an observer program designed to record, identify and quantify bycatch in the Shark Bay Scallop Managed Fishery.

Based on SBS fishery BRD trials conducted in April 2001, 75% to 95% of the total bycatch was crabs, primarily blue swimmer of which the larger ones are retained and the smaller ones are discarded. Less than 20 individuals of fish are usually caught per net, the main species being goatfish, grinners, flathead and a few gurnard. The fish are generally less than 15 cm in length.

The reason for the low amount of discards is threefold. Firstly, the larger 100 mm mesh size used on the scallop nets (designed to avoid the capture of prawns and reduce the catch of small scallops) allows a large proportion of fish to escape from the net, meaning that very few fish that enter the net are retained. Secondly, the clumped distribution of scallops allows trawlers to target aggregations of scallops without collecting high numbers of non- targeted species. Thirdly, the lower trawling speed (2.5 – 3 knots) probably allows some of the stronger swimming species to escape via the mouth of the net.

Since the number of individuals discarded is minor, it was determined 'likely' that this would have a 'negligible' impact on the breeding populations of those species.

5.2.1.6 Invertebrates

Rationale for Inclusion

The shallows of Shark Bay support a diverse and abundant invertebrate community of zoogeographical significance (Fisheries WA, 1996). This has been attributed to the spatial isolation, high organic productivity and extensive seagrass beds and carbonate sand flats. Studies to date have revealed that there are 218 species of bivalve molluscs in the region with 75% of these coming from a tropical range, 10% from a southern Australian range and 15% being west coast endemics (Slack-Smith, 1990). Trawl gear interacts with the sea bottom where many of these species reside, and therefore there is a necessity to investigate this issue.

ERA Risk Rating: Impact on breeding population (C0 L5 NEGLIGIBLE)

It was only considered 'possible' that the SBS fishery could even have a 'negligible' impact on invertebrate breeding populations in Shark Bay. This low ranking is due to the following:

- Diver and underwater TV observations suggest that the scallop trawl areas of Shark Bay are typically sand bottom and contain few large invertebrates (*Dr. J. Penn*, pers. comm.)*.
- The trawl gear is configured in a manner that largely precludes the capture of invertebrate species living on or in the substrate. The gap of approximately 150 to 300 millimetres between the ground chain and the footrope of the net is designed to reduce damage to the net through contact with the ground. This specifically serves to minimise the capture of immobile and slow moving benthic organisms (and inanimate objects), as they pass through the gap between the ground chain and the footrope. By contrast, mobile species (such as scallops and prawns) are stimulated to swim by the ground chain and move up into the water column above the footrope and are subsequently caught in the net.
- Some large immobile organisms and inanimate objects may also be 'flicked' up into the water column by the ground chain and subsequently captured in the net.

** Dr. Jim Penn, Department of Fisheries – Research Division*

- As part of the management arrangements for the SBS fishery, the Department of Fisheries is currently seeking funding to undertake a survey of bycatch species throughout Shark Bay in order to ensure that bycatch species of the scallop fishery are adequately represented outside the trawl grounds to ensure sufficient refuge for these species. This survey will provide similar information on the distribution both within and outside trawl areas, of other invertebrate species. The report will be reviewed following the completion of that study.

5.2.2 Interaction but no capture

5.2.2.1 Threatened species green and loggerhead turtles

Rationale for Inclusion

Loggerhead and green turtles occur in Shark Bay and are a threatened and vulnerable species (respectively) under Commonwealth and State legislation. This component addresses the issue of interaction between the fishery and loggerhead and green turtles that do not result in capture and, in particular, the issue of turtles being hit by the hull of the vessels in the fishery, and disturbance of breeding aggregations of turtles by vessel movements.

ERA Risk Rating: Impact on breeding populations (C0 L5 NEGLIGIBLE)

For the issue of possible interactions (without capture) of loggerhead and green turtles, it was considered 'likely' that the SBS fishery would have a 'negligible' impact on the breeding populations, due to the following:

- There have been no reports of green turtles interacting with trawl vessels (e.g. being knocked by boats or nets but not being captured), but formal recording of such events that might occur has not been attempted.
- The fact that green turtles prefer to reside in seagrass habitats, which trawls are excluded from and/or generally avoid suggest that such incidents are likely to be very few in any case.
- The relatively slow speed at which trawlers travel is also likely to be a mitigating factor. Most of the reports of marine wildlife being hit by boats etc. involve high-speed boats that leave limited time for an animal to move out of the path of the boat. Scallop trawlers travel at relatively slow speeds of 2 to 3 knots and up to 9 knots while steaming, and as such are unlikely to hit wildlife where avoidance behaviour is not impeded.
- CALM have determined that the most substantial breeding aggregation of loggerhead turtles in WA focuses their nesting activity within Shark Bay on beaches at the northern end of Dirk Hartog Island and that most beachings occur there after October. Current information regarding loggerhead turtle mating aggregations in Shark Bay is unavailable. The location and distribution of any of these is yet to be defined, so the possible further significance of the trawler and loggerhead turtle interactions presently recorded within the Denham Sound area into October is also uncertain. However, even though scallop trawlers can trawl for scallops in August after Denham Sound has opened, they have not done so for 5 years due to low scallop stock levels in this area. Male/Female associations for mating purposes can be expected to occur from 6-8 weeks prior to females beaching to lay the first eggs of the season. Internesting habitats are of importance to the wellbeing of the nesting female loggerhead turtles and are also presently unknown. However, the Shark Bay Trawl fishery season has ended by the time internesting habitat usage becomes important (*R. Prince*, pers. comm.*). Research on turtles in Shark Bay is the responsibility of CALM.

** Robert Prince, Department of Conservation and Land Management*

This issue will be revisited should further information on breeding aggregations become available from CALM.

5.2.2.2 Protected species dugongs and other cetaceans

Rationale for Inclusion

Shark Bay is an internationally significant dugong habitat supporting a population of approximately 10,000 individuals (Marsh et al., 1994). Dugongs are protected species under both State and Commonwealth legislation. This component addresses the issue of interaction between the fishery and dugongs and cetaceans, which does not result in capture in particular, the issue of dugongs being hit by the hull of the vessels in the fishery.

ERA Risk Rating: Impact on breeding populations (C1 L3 LOW)

For the issue of possible interactions (without capture) of dugongs, it was considered 'possible' that the SBS fishery may have a 'low' impact on the breeding populations, due to the following:

- Large numbers of dugongs and their young can be found on the Faure Sill and Wooramel Seagrass Bank and between Faure Island and Gladstone Bay during summer. All these areas are contained within the permanent nursery closure implemented in the 1960s (Marsh et al., 1994). Research indicates that dugongs migrate seasonally within the bay to find optimal water temperatures and consequently their habitat usage varies extensively from summer to winter (Anderson, 1986). Consequently, although trawling is physically separated from the areas used by dugongs for most of the winter season there is some overlap of trawlers and dugongs.
- Over the period of this fishery and the prawn fishery, the only recorded dugong taken in a trawl net, was putrid and presumed to be dead well before the trawl net captured it. Also, a dead dugong found in Bremer Bay was suggested to have drifted south (Leeuwin Current) and had marks consistent with propeller damage (*R. Prince*, pers. comm.*). Apart from these two reports there has been no evidence or record of a dugong capture or interaction over the period of these fisheries, which is in excess of 40 years. If the numbers of dugongs increase, this may increase the chances that this may occur.
- Surveys carried out in 1989 and 1994 have estimated the population of dugongs in Shark Bay to be stable at 10,000 individuals (Marsh et al., 1994; Preen et al., 1997; *R. Prince*, pers. comm.*).
- The interactions with dugongs will be reassessed at the next major review (in approximately five years) of the fishery.

** Robert Prince, Department of Conservation and Land Management*

5.3 GENERAL ENVIRONMENT

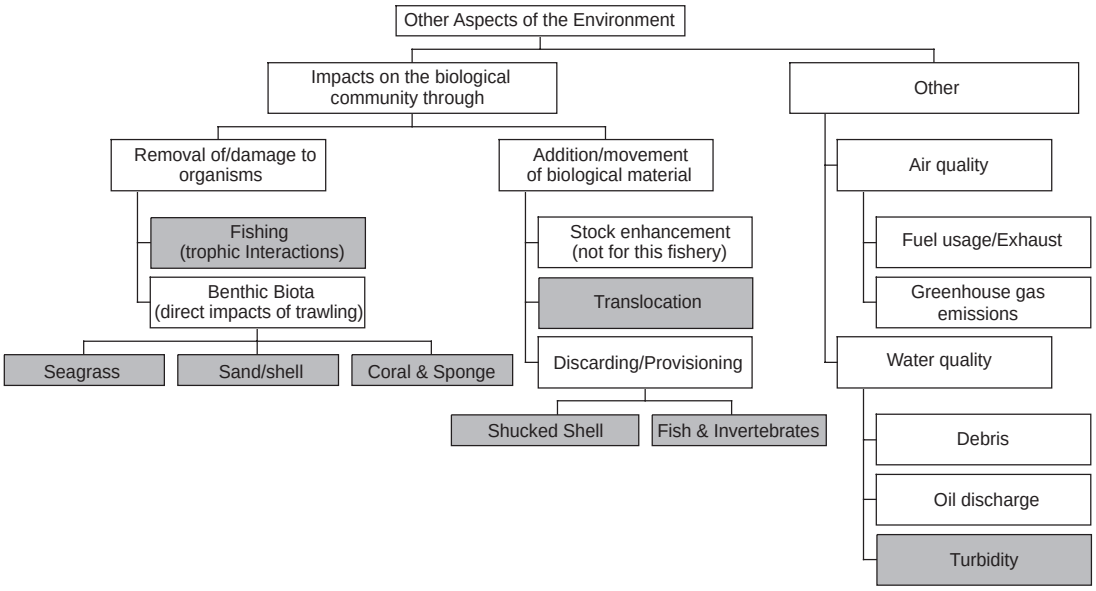

Figure 15. Component tree for the general environment.

Black boxes indicate that the issue was considered high enough risk at the June 2001 Risk Assessment workshop to warrant having a full report on performance. Grey boxes indicate the issue was rated as a low risk and no specific management is required – only the justification is presented.

5.3.1 Impacts from removal or damage to environment

5.3.1.1 Fishing impacts, through all retained and non-retained species removals on ecosystem

Rationale for Inclusion

Scallops play a role in the ecosystem: they provide a food source for crustaceans and fish, and also remove plankton from the water column. Additionally, the SBS Fishery takes some crabs, bugs and cuttlefish. The potential impact of reducing the number of retained and non-retained species from the environment, through fishing, is investigated here.

ERA Risk Rating: Impact on environment (C1 L2 LOW)

The risk of an impact on the environment, from reducing the amount of retained and non-retained was considered low as:

- This fishery, in terms of the total productivity of the Shark Bay region, takes little material.
- None of the species captured has an exclusive predator or food source.
- Scallops are one of many filter feeders, which exist in Shark Bay and their levels vary dramatically from natural variations.
- The fishery only operates in a small area of Shark Bay generally on non-fragile habitats (mostly sand) and then only for a short period of time each year.

5.3.1.2 Impact to sand/shell habitat and ecology

Rationale for Inclusion

Scallop trawling occurs mostly over the sand and shell habitats of Shark Bay. When trawling, ground chains and otter boards make contact with the sea bottom, disrupting organisms within the habitat. Evidence from video footage of trawled areas of Shark Bay suggests that trawling over sand has the effect of flattening this otherwise rippled and three-dimensional substrate. This may also indirectly affect the species that inhabit this area by changing the nature of their habitat.

ERA Risk Rating: Potential damage to sand/shell habitat (C1 L5 LOW)

The potential impact on the sand and shell habitat, as a result of the scallop trawling operations was considered to have only a MINOR consequence due to the following:

- The areas of Shark Bay that are extensively scallop trawled are estimated to be only about 11.5% (1,868 km^2) of the total waters in Shark Bay and at most 20% of the total sand habitat (at least 9000 km^2) in Shark Bay (Fisheries WA, 1996). This is based on the shot-by-shot information from commercial logbooks from scallop boats during 1999. This is a relatively small percentage of the total area of bay (16,224.8 km^2) and provides around 80% refuge even if that area trawled were extensively impacted. Seventy-three percent (73%) of all waters in Shark Bay are permanently closed to scallop trawling. Appendix 6 shows the general areas of scallop trawling for 1999, 2000 and 2001 by Class A licence boats in the fishery.
- The area is usually only trawled for less than 2 months a year, although it could be up to 7 months in a year of high scallop abundance.

Few studies have been done on the effects on scallop trawling. However, since prawn and scallop trawling are relatively similar, studies from prawn fisheries should be considered. There are a number of studies which have shown that even in the areas where prawn trawling occurs this does not cause significant effects to the infaunal community. A meta-analysis of fishing impacts by Collie *et al.* (2000) found that otter trawling had the least impact of all forms of trawling. Specifically, Kaiser and Spencer (1996) found no detectable difference between trawled and untrawled areas (beam trawl) within mobile sediment (sand) regions. Van Dolah *et al.* (1991) studied changes in infaunal communities over 5 months for areas closed to shrimp trawling. They concluded that the seasonal reductions in abundance and number of species sampled had a much greater effect than fishing. Finally, Jennings and Kaiser (1998) suggest that light shrimp trawls do not cause significant disturbance to communities in poorly sorted sediments in shallow water.

In Australia, Gibbs *et al.* (1980) found only minimal impacts on the benthic communities in sandy areas resulting from prawn trawling in Botany Bay, NSW. In southwest WA, Laurenson *et al.* (1993) compared trawled and untrawled areas using trawl samples and underwater video. Their study concluded that the dominant fauna of each area (sand bottom) showed marked similarities, although each group had a different group of less abundant species. The difference was attributed to the fact that the untrawled area was small and encroached in all directions by seagrass. Underwater video observation of both areas before and after the completion of the depletion experiment failed to detect any visual impact on the substrate or habitat. Extrapolating this study to Shark Bay would indicate that trawling causes only minor and short-lived impact to sandy habitats.

5.3.1.3 Impact to coral/sponge habitat

Rationale for Inclusion

Internationally, there has been concern about the impact of trawling on benthic habitats, and this has extended to Shark Bay. Coral (both soft and hard types) and sponge habitats are important sites for marine species. They provide habitat for fish and invertebrates and are the feeding and recruitment sites for many species. By virtue of their shape and physical structure, coral habitats are vulnerable to physical damage and given their generally slow growth rates, are slow to recover. Although sponges are faster growing and therefore more able to withstand fishing pressure, they are still vulnerable to physical damage.

There are coral (hard and soft) and sponge habitats in Shark Bay. The known areas of hard coral are on the eastern shores of Bernier, Dorre and Dirk Hartog Island and in the Sandy Point, Bar Flats and Egg Island areas. The most popular recreational coral sites are in the Marine Park and occur in the more sheltered waters of Dirk Hartog Island. Additionally, isolated coral outcrops such as those at Broadhurst Bight and Bar Flats are mostly subject to permanent closures under the trawl management plan. In Shark Bay, soft coral and sponge habitat occurs in the relatively oceanic areas inside of the 20m depth from Carnarvon to Quobba in the northern embayment, and did occur in the area west of Elbow Shoals prior to 1969. Sponges also occur intermittently on sandy bottoms within the bay.

ERA Risk Rating: Potential damage to coral/sponge habitat (C1 L2 LOW)

The impact of the scallop trawling activities on the coral and sponge habitats in Shark Bay is considered LOW. This was a result of the following factors:

- The area of Shark Bay that is open to scallop trawling is only 27% of the total area. Analyses of the trawled areas for 1999 show that only 11.5% of the Shark Bay region is actually trawled by the scallop fleet (Refer to Appendix 6). Furthermore this trawling activity has only occurred for less than 2 months each year for the past 5 years.
- Trawling is not possible over hard coral reef areas due to the loss of trawl gear and/or dangerous hook ups of the ground chains on the coral. Since the nets are expensive to purchase and time consuming to repair, fishing over this habitat is highly undesirable to fishers. Therefore, fishing over hard coral habitat is very unlikely in this fishery (*Dr. J. Penn*, pers. comm*.).
- At the commencement of trawling in Shark Bay exploratory trawls were undertaken. Reports from these exploration exercises document the sand and mud bottom nature of the Shark Bay indicating that trawling has not significantly altered the habitat form pre-fishing conditions. Extensive studies on the embayment habitats during the early 1960s (Logan and Cebulski, 1970), reported that the trawl ground areas consisted predominantly of sand sediments with molluscan, echinoderm and other micro-fauna, but does not mention sponges or soft corals.

** Dr. Jim Penn, Department of Fisheries – Research Division*

5.3.2 Addition of materials to the environment

5.3.2.1 Discarding fish

Rationale for Inclusion

Bycatch returned to the sea results in fish and, to a lesser extent, crustaceans being made available to others that would normally not have access to this food source. This may affect the feeding behaviour of some species, particularly predators, and increase abundances of other species throughout the water column and at the surface. For example, dead fish, which sink to the seafloor, become available to benthic scavengers and these fish would normally only be available, in that level of abundance, to pelagic predators.

Studies on the fate of discards through the trophic structure have not been undertaken in the SBS fishery, but this issue has been looked at in other fisheries:

- Britton and Morton (1994) reviewed this issue and found that discarding has had a "positive" impact on bird population numbers as they can follow the North Sea fleet and consume 50% of the discards. Other benthic fauna can only get what actually falls down on to the seabed and only in the area where they live (Ramsey et al., 1997). Hence, this study concluded that discarding would not have a major impact on immobile benthic species.
- In the Great Barrier Reef trawl fishery, a study showed that the majority of the discards were fish and about 40% floated and were mostly taken in the daytime by birds, dolphins and sharks (Poiner et al., 1999). Poiner *et al.* (1999) concluded that because discards are dispersed over the seabed and most scavengers forage over a restricted area discards probably do not cause a measurable seabed impact.
- In Moreton Bay, Queensland, Wassenburg and Hill (1987) found that crabs were a dominant scavenger of bycatch from the prawn trawl fishery, with 30% of their diet coming from this source (note over 65% of the bycatch material from this fishery sinks). This study also found that trawl discards have become the principal food source for three species of seabirds (Wassenberg and Hill, 1990). It is also thought that larger populations of the blue swimmer crab (*Portunus pelagicus*) occur in Moreton Bay than would normally exist because of the food provided by trawler discards (Wassenberg and Hill, 1987).

Of the discards, about 50% of the fish sink, and are mostly dead, becoming available to bottom feeders. However, in the case of the SBS fishery the fish bycatch is very low. Most of the crustaceans (primarily blue swimmer crabs) sink and most of these are alive when returned.

ERA Risk Rating: Impact on environment (C1 L3 LOW)

The impact of the provisioning as a result of discarding bycatch from the SBS fishery is considered 'unlikely' to have a 'minor' consequence. This was a result of the following factors:

- Although many studies have shown that various trophic groups fed on bycatch, few studies have found direct conclusive evidence of a resultant change in trophic structure.
- In Shark Bay, there is neither direct scientific evidence nor any anecdotal suggestion of changes to the food web from the removal of particular groups or species, or from food being cycled from the bottom of the sea floor to the surface.

- The area over which organisms are discarded is large (1,868km^2) and therefore any impacts would be diffused. For 1999, the estimated amount of discards is 500 tonnes (based on 2 times target catch of 250 tonnes and does not include discarded scallop shells and mantle tissue). Average of 0.3 tonnes of discards per km^2 or less than 1 gram per m^2.
- In addition to the bycatch being discarded, around 75-80% of the total weight of a scallop is also discarded. It is calculated that around 20 to 25% of the total weight of the scallop is the weight of the adductor tissue (which is kept) the rest of the scallop (i.e. mantle tissue) is discarded.
- The introduction of BRDs in the SBS fishery will further reduce provisioning, as BRDs will reduce the amount of bycatch generated by the fishery and therefore lead to a reduction in the amount of discards.
- Although it has been suggested that pied cormorants in Shark Bay (and crested tern populations in Exmouth Gulf) have increased in abundance as a result of discards from the inshore trawl fisheries (*Dr. N. Dunlop*, pers. comm.*), it is most likely that this is as a result of the prawn fishery (which has significant discards) and not the scallop fishery.

Even though this fishery generates a relatively minor amount of bycatch (compared to prawn trawl fisheries), this should be further reduced through the introduction of BRDs including grids in 2003 and possibly fish exclusion devices.

** Dr. Nic Dunlop, Conservation Council of WA*

5.3.2.2 Discarding scallop shells

Rationale for Inclusion

Scallop meat is removed from the shell (a process called shucking) at sea and the meat is generally packed and snap frozen at sea. Empty scallop shells are discarded overboard. The impact of discarding the shells is considered here.

ERA Risk Rating: Impact on environment (C0 L5 NEGLIGIBLE)

The impact of discarding scallop shell was considered 'likely' to be 'negligible'. Discarding of scallop shells has been an issue in the Abrolhos Islands Scallop fishery in the past when sometimes smaller boats were used. During rough conditions, shells were shucked and discarded in small discrete sheltered areas leading to an accumulation of shell. In Shark Bay, where the boats are larger, and conditions are calmer, shucking is undertaken continually and therefore the shells are widely distributed over areas where they would naturally occur.

5.3.3 General impacts on environment

5.3.3.1 Creation of turbidity from trawling

Rationale for Inclusion:

The interaction between the trawl gear and the bottom of the sea has the possibility of raising sediments into the water column, resulting in increased turbidity. If the levels as a result of trawling were significantly above the natural levels of turbidity, this could have implications for the local communities by reducing light availability for seagrass, or by smothering benthic organisms such as sponges and corals.

ERA Risk Rating: Impact on environment (C0 L5 NEGLIGIBLE)

The consequence of trawling in relation to the impact on turbidity was considered 'likely' to be 'negligible'. Due to the strong currents and tides in Shark Bay any turbidity caused by trawling is unlikely to be measurable and therefore, insignificant compared to that caused by natural water movements (*Dr. J. Penn*, pers. comm.*).

Also, surveys of sediment composition over all trawl grounds (Hall and Penn, 1979) indicated that the majority of the ground was coarse-sand dominated. That is, less than 10% of the sediment samples taken contained a noticeable mud component (>10% mud).

The softer sediment areas tended to be in more offshore locations away from seagrass areas. Secondly, the major source of turbidity in Shark Bay is from short-term river outflow following cyclonic rains, in the desert catchment.

** Dr. Jim Penn, Department of Fisheries – Research Division*

5.3.3.2 Translocation

Rationale for Inclusion

The movement of fishing vessels provides a mechanism for marine species to be transported beyond their natural range. In the extreme circumstance, fishing vessels could provide a vector for disease and exotic species. For scallop trawl vessels, their hulls mainly provide the opportunity for translocation, as these vessels do not contain ballasts.

ERA Risk Rating: Impact on environment (C0 L5 NEGLIGIBLE)

This risk of translocation of species occurring as a result of this fishery was considered 'likely' to be 'negligible' as vessels in Shark Bay have little interaction with fisheries in other regions, although some vessels have licences to operate in other trawl fisheries (Abrolhos, Kimberley, Nickol Bay/Onslow and Esperance). In practice, most of the vessel exchange is between Shark Bay and the Abrolhos and Nickol Bay/Onlsow fisheries. Given the relatively short distances between these areas and the degree of faunal overlap, the translocation risks are negligible. Any change to this would result in a reassessment of the risk.

Vessels do move to Fremantle for seasonal maintenance. Much of the western coast is connected via the Leeuwin Current and as such there is already a connection between Fremantle and the trawl grounds. The only known feral species in the Fremantle area is the fan worm *Sabella* sp, which is a temperate species and unlikely to survive if transported to the more tropical Gascoyne waters on trawl vessel hulls. It should also be noted that most vessel hulls undergo cleaning at the commencement of each season before movement back to the Gascoyne region.

5.4 GOVERNANCE

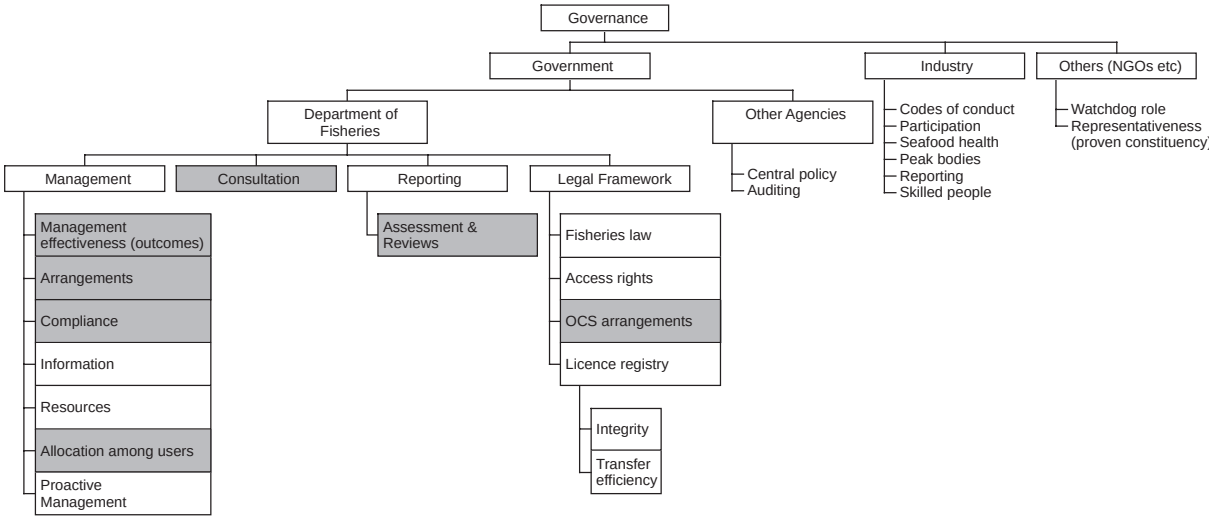

Figure 16. Component tree for governance of the SBS fishery.

Note: no generic components have been removed from the tree but only those boxes that are grey will be reported in this report.

5.4.1 Department of Fisheries – Management

5.4.1.1 Management effectiveness (outcomes)

Rationale for Inclusion

The effectiveness of management activities (e.g. spatial and temporal closures, limited entry, gear controls) should ultimately be reflected by the extent to which the fishery continues to produce expected outcomes (maintaining the annual catch of scallops at acceptable levels). Thus, if the catch of scallops is within the annual acceptable catch range then the community's expectation that variations in annual catch only result from annual changes in environmental conditions, or planned changes to the management of the level of commercial exploitation, will be maintained. However, due to the biology of scallops, their stocks typically undergo extreme fluctuations in abundance (as evidenced by the acceptable catch range). Therefore, any larger than normal unexplained variation (outside the natural fluctuation) that produces any significant and unexpected reduction in catch outside the annual catch range, is likely to be a reflection of a reduction in the management effectiveness and therefore reduce the community's confidence in the management of the resource and raise concerns about the ongoing sustainability of the fishery.

Operational Objective

To ensure that management arrangements are present and sufficiently effective to meet all the objectives of the fishery.

Justification

If all management arrangements developed for this fishery, including the restrictions on opening dates and compliance with the regulations are being maintained effectively then by controlling the exploitation rate the management arrangements should ensure that there is sufficient breeding stock such that the only influence on recruitment is environmental factors.

Indicator

An annual biological survey, designed to measure the abundance of pre-recruits to the Shark Bay population, provides an index of recruitment, which is independent of fishery catch records. The mixture of residual and recruit abundance on the trawl grounds in this survey is used in a matrix that determines the opening date of the fishery ensuring an adequate abundance of spawning stock (see Section 5.1.1.1).

Performance Measure

The stock-recruitment for scallops is the performance measure for the fishery even though environmental data indicate that the environment is the controlling factor in recruitment.

Justification

This performance measure takes into account that the potential spawning stock of scallops varies from year to year and therefore the fishing season should also vary each year to allow for sufficient spawning stock. Due to the significant correlation that was determined between the abundance of recruits and residual stock in November and the catch level in the following season, the Department of Fisheries is able to tailor annual management arrangements around the variations in scallop abundance from year to year.

Data Requirements for Indicator

The following data is required for this indicator:

Data Requirement	Data Availability
Pre-Season Catch Survey data	Yes – obtained annually.
Commercial catch and effort.	Yes – obtained annually.
Historical catch levels.	Yes - records available and accessible.
Level of fishing effort	Yes – number of vessels, days fished, hours trawled and areas of operation readily available.
Environmental indicators	Yes – key environmental indicators readily available.

Evaluation

Summary: The management arrangements of the past years have ensured that there is an adequate abundance of spawning stock from year to year. Therefore, the performance measure has not been triggered and current management strategies appear to be effective in achieving the overall objectives for the fishery.

As discussed in Section 5.1.1.1 scallop landings have varied dramatically over the last 18 years and are dependent primarily on the strength of recruitment. The recruitment strength for the scallop landings is largely environmentally driven and this leads to the variations seen in the catch of scallops from year to year. Currently, breeding stock levels for saucer scallop are adequate. The management regime is capable of counteracting any increase in effort efficiency which could lead to the breeding stock levels being reduced to undesirable levels.

In 2000, the annual acceptable catch range for the fishery changed from 121- 4,414 meat weight tonnes to 250-600 meat weight tonnes (1,250-3,000 whole weight tonnes). This annual acceptable catch range

is based on catches over a 5-year period, 1995-1999, which does not include the very high catches in the early 1990s and is more reflective of the average from 1984-1990 (Table 6). A full description for saucer scallop can be found in Section 5.1.1.1.

Table 6. The total catch (meat weight tonnes) of scallops in the SBS Fishery, 1983–2000.

Year	Total Catch of Scallops (meat weight tonnes)
1983	705.3
1984	431.2
1985	232.8
1986	259.5
1987	490.9
1988	731.2
1989	121.0
1990	486.7
1991	2532.0
1992	4414.0
1993	1934.6
1994	957.1
1995	596.0
1996	364.0
1997	328.5
1998	252.2
1999	339.9
2000	269.0

Robustness

Medium/High

The robustness is relatively high since the estimates are calculated by a source independent of the fishers and are direct estimates of recruit and residual stock levels.

Fisheries Management Response

Current: A variable start to the fishing season is used to ensure that breeding stock levels are adequate (outlined in Section 5.1.1.1).

Future: The Department of Fisheries is doing further work to both improve the input controls and understanding of the relationship between environmental factors and the scallop recruitment. The agency will continue to use input controls to adjust for variations in fishing efficiency.

Actions if Performance Limit is Exceeded: The Department of Fisheries has strategies available if further protection to the breeding stocks is needed. These strategies can be implemented prior to the beginning of the fishing season and include:

- Changes to the start of the fishing season;
- Reduction in the length of the fishing season; and
- Area closures.

Comments and Action

While the Department of Fisheries has been able to ensure that adequate levels of spawning stock occurs every year, it continues to investigate and refine its understanding of stock-recruitment and environment relationships.

External Driver Check List

Oceanographic features, in particular ocean currents are recognised as having a major impact on scallop recruitment. However, a range of other factors such as: climatic changes, cyclonic activity impacting habitat and water temperatures (which in itself is a reflection of currents) are known to affect the levels of recruitment of scallops. Over the coming years, the relationship between recruitment of scallops and the Leeuwin Current will be investigated to determine if a predictable relationship is possible. For more information, see Section 5.1.1.1

5.4.1.2 Management arrangements

Rationale for Inclusion

In Western Australia, a number of instruments are used to articulate the management arrangements for fisheries. The FRMA has elements that affect all fisheries and in addition to this there are Management Plans, Orders, Regulations, Ministerial Guidelines and Policy Statements. In cases where current management arrangements were developed under the previous Act (as was the case for the SBS), whilst the terminology is different (see Table 7 for details), the powers from the old Act have been transferred under various sections of the Transitional Provisions of the FRMA (**S 266** Savings and transitional provisions - Schedule 3 parts 8-12, 15-19).

The "Shark Bay Scallop Managed Fishery Management Plan" (the SBS Plan) which, in effect, is a set of rules as to how the fishery will operate, obtains its authority from the FRMA and, in conjunction with the Fish Resources Management Regulations, 1995 (FRMR) and relevant Ministerial Policy Guidelines, is the vehicle through which the fishery is managed. The SBS Plan and the associated documentation (which includes the ESD report) should include all information expected to be in a "Best Practice" set of management arrangements (as defined in the Department's ESD Policy - Fletcher 2002).

These arrangements should contain:

1. An explicit description of the management unit.
2. The issues addressed by the plan including the criteria to operate in the fishery, the manner of fishing, the fishing season, fishing zones, licence renewals, transfers and cancellations, fishers offences and major provisions and process for amending the plan.
3. Descriptions of the stocks, their habitat and the fishing activities.
4. Clear operational (measurable) objectives and their associated performance measures and indicators.
5. Clearly defined rules, including what actions are to be taken if performance measures are triggered.
6. Economic and social characteristics of the groups involved in the fishery.
7. Management and regulatory details for the implementation of the actual management plan.

8. The reporting and assessment arrangements.
9. How and when reviews of the plan will occur (including consultation mechanisms).
10. A synopsis of how each of the ESD issues is being addressed.

In the future, Ministerial Policy Guidelines will be developed to incorporate the ESD report, including all performance measures, responses and information requirements within one year and will include a clear timeframe for implementation. These guidelines will also include timeframes for all management responses and set out procedures to enable the amendment of management arrangements to respond to new information. All changes to the management plan or arrangements will be reported to DEH. The implementation of a decision rule to close the fishery or prevent commencement of the fishing season, when recruitment of scallops is sufficiently low will be developed as a priority.

Guidelines will also be developed to address permitted byproducts with a robust system developed to add or remove species as appropriate. Suitable catch triggers will be developed to ensure any changes in targeting behaviour can be determined and be addressed within clear timeframes. These guidelines will include mechanisms for any cross-jurisdictional activities regarding relevant target and byproduct species, including squid.

Table 7. Comparison of terminology.

Old Act	New Act (FRMA)
Limited Entry Fishery	Managed Fishery
Notice	Order
Arrangement	Arrangement

Operational Objective

The Department of Fisheries, in consultation with the SBSMAC and other stakeholders, maintain a watch brief on the management plan, related legislation, regulations and arrangements to ensure it remains relevant and aligned with the fishery's management objectives and that collectively they cover the 10 main principles.

Justification

To have an effective and understandable plan for the management of this fishery with all of the 10 principles covered within the suite of arrangements developed for the fishery.

Indicator

The extent to which the management plan and supporting documentation addresses each of the issues and has appropriate objectives, indicators and performance measures, along with the planned management responses.

Performance measure

This should be 100%.

Evaluation

As an over-arching sub-component the performance of the management arrangements is evaluated on two levels – the micro level, i.e. the relevance of individual clauses and the role they play and on the macro level, i.e. the relevance of the plan as a whole and the role that it plays.

Current Performance against each of the areas required within the "plan"[3]:

1. **An explicit description of the management unit** – The management unit is explicitly described within the "Declaration of the Fishery" section of the SBS Plan.
2. **The issues addressed by the plan** –The issues that need to be addressed by the SBS plan have been examined thoroughly and are documented within the ESD component trees and their reports.
3. **Descriptions of the stocks, their habitat and the fishing activities** – the SBS stock is well described in Section 2.1 and the fishing activities are described in Section 2.2.
4. **Clear operational (measurable) objectives and their associated performance measures and indicators** – These are located in Section 5 for each of the major issues. It is planned that these will be formally published as a set of Ministerial Guidelines
5. **Clearly defined rules, including what actions are to be taken if performance measures are triggered** – For each of these major issues, the management actions that are planned to be taken if performance limits were exceeded are now articulated in Section 5.
6. **Economic and social characteristics of the groups involved in the fishery** – A brief articulation of the economic and social characteristics is located in Section 3.3 and there is to be a greater level of detail accumulated during the process of completing the remainder of the ESD components.
7. **Management and regulatory details for the implementation of the actual management plan** – The regulations relating to the SBS fishery are located in both the SBS Plan and the FRMR and orders (A set of which has been provided to EA).
8. **The reporting and assessment arrangements** – These arrangements are documented in Section 5.4.4.1 and include annual reporting against current agreed performance limits and targets and a five yearly review of these arrangements and assumptions.
9. **How and when reviews of the plan will occur (including consultation mechanisms).** – A watching brief is maintained by the Department of Fisheries and SBSMAC on the functionality of the management arrangements. The FRMA clearly sets out how the process for the review of any management plan must occur.
10. **A synopsis of how each of the ESD issues is being addressed** – A synopsis of ESD issues has been compiled within the Overview Table of this report.

Robustness

High

The management plan and related legislation represent a comprehensive set of fisheries management legislation that is performing well. The fact that the management arrangements are contained within legislation provides a high degree of stability with respect to how the fishery is managed. This said, the processes for achieving management plan changes are well understood by the majority of stakeholders and the system is flexible enough so that the management process can respond to change stimuli.

Fisheries Management Response

Management has successfully administered the management plan and related legislation to achieve and pursue the stated objectives.

[3] *"Plan" – indicates all management arrangements.*

Comments and Action

The fishery is managed in a dynamic and consultative way (i.e. responds readily to changed circumstances), but fishers are often resistant to change; this means that before fishers accept changes to management arrangements, they require evidence of the need for such measures. While most fishers have a very high level of confidence in the Department's research activities, sometimes members of the industry demand certain knowledge before accepting the need for change and can be sceptical of research findings no matter how statistically valid. Individual fishers' views can understandably be greatly influenced by their own experiences and observations while fishing that sometimes may give them a contrary view of the state of the fishery. Nonetheless, there is generally a very good relationship between fishers and the Departmental research scientists and most will accept the advice of the researchers.

Interactions between the Class A licences (scallop fleet) and Class B licences ("prawn" fleet that has ability to catch scallops) regarding the way in which management arrangements may impact on the fleet shares of the available catch sometimes leads to tensions and conflicts in reaching an industry position on any proposed variations to management arrangements. Whilst such situations have been adequately resolved in the past, they continue to have the potential to be disruptive to the decision-making process.

External Driver Check List

- Resistance of fishers to change.
- Reluctance of Minister or Executive Director of the Department of Fisheries (ED) to exercise power.

5.4.1.3 Compliance

Rationale for Inclusion

Effective compliance is vital to achieve the management objectives of any fishery. This involves a mix of at-sea patrols and inspections, in-port inspections, aerial surveillance and VMS.

Operational Objective

To have sufficiently high levels of compliance, which give confidence the management arrangements are being effective.

Justification

The activities of the participants in the fishery need to be sufficiently consistent with the management framework and legislation to make it likely that the expected outcomes and objectives of the fishery will be achieved.

Indicators

- The levels of compliance with the legislation, including the estimated level of illegal fishing.
- Degree of understanding of rules governing operation of the fishery by licensees and the broader fishing community.

Performance Measure

Currently under development, but given the structure of this fishery it will be developed sensibly with all players having involvement.

Data Collection Requirements and Processes

1. Random Inspections of Vessels at sea and port.
2. On-going collection of data on illegal activities.
3. Comparative data on the relative effectiveness of certain compliance techniques.
4. VMS and other vessel surveillance data.

Evaluation

In the 2000/01 fishing season, there was one reported offence for the fishery. The current compliance techniques used in the SBS fishery are maintaining compliance by the fishers. Sea patrols are conducted on a random basis during the season. Aerial compliance checks have also been conducted although this method has been supplanted by VMS. The compliance staff also conducts licence and gear inspections both at sea and in port.

With the introduction of VMS to this Fishery in 2000, it was expected that random patrol activities could decrease over time although the introduction of BRDs is likely to increase the need for at-sea gear checks.

Currently, a FRDC project is underway to examine compliance in the Western Rock Lobster fishery. This project aims to develop data collection, analysis and reporting protocols for all Western Australian recreational and commercial fisheries.

Robustness

Medium

The difficulties in identifying all types of illegal activities will remain.

Fisheries Management Response

The Regional Services Division of the Department continues to gather intelligence on suspected and known illegal activity within the fishery and does so by using state of the art technology and sound procedures.

Comments and Action

The Department will continue to provide high standard compliance service to the SBS fishery. In 2000, the VMS was introduced into the SBS fishery, which enables the Department of Fisheries to monitor a vessels location, direction and speed. This allows for particular attention to be paid to fishery closure areas.

External Driver Check List

Changes to technology that may facilitate an increase in the level of non-compliance.

5.4.1.4 Allocation among users

There are no recreational or indigenous components to this fishery.

5.4.2 Department of Fisheries – legal arrangements

5.4.2.1 OCS arrangements

Although the licence area of the SBS fishery extends into Commonwealth waters, the functional fishing area is within State waters. Furthermore, the state has full jurisdiction for trawling to the 200m depth contour (which is the seaward boundary of the fishery) because of the Offshore Constitutional Settlement (OCS) arrangements all fishing occurs under the State jurisdiction, which precludes Commonwealth involvement.

5.4.3 Department of Fisheries – consultation

5.4.3.1 Consultation

Rationale for Inclusion

The FRMA has certain requirements with regard to consultation that must be undertaken in the course of managing fisheries. The management of the scallop fishery is based around an extensive consultation and communication process.

There are sections in the FRMA that relate to the development of a management plan (Section 64) and to the amendment of a management plan (Section 65). Given that the SBS already has a management plan, Section 65 is the most relevant.

This states that:

S 65. Procedure before amending management plan

(1) A management plan must specify an advisory committee or advisory committees or a person or persons who are to be consulted before the plan is amended or revoked.

(2) Before amending or revoking a management plan the Minister must consult with the advisory committee or advisory committees or the person or persons specified for that purpose in the plan.

(3) Despite subsection (2), the Minister may amend a management plan without consulting in accordance with that subsection if, in the Ministers opinion, the amendment is –

(a) required urgently; or

(b) of a minor nature

(4) If –

(a) the Minister amends a management plan; and

(b) the amendment is made without consultation because it is, in the Minister's opinion, required urgently,

the Minister must consult with the advisory committee or advisory committees or the person or persons specified for that purpose in the plan as soon as practicable after the plan has been amended.

In addition, under clause 9 of the Management Plan, the ED can only make decisions on openings and closings for the fishery after consultation with the licence holders.

The particular committee, which must be consulted for the SBS fishery is designated in the management plan as the SBSMAC. Section 41 gives the Minister the power to formulate a committee and create an instrument, which is gazetted to establish a committee.

In the future, opportunity will be provided to conservation, community and recreational fishing interests to participate in the processes of the main advisory body to the WA Fisheries minister for this fishery. Any relevant indigenous interests will also be considered through appropriate consultative mechanisms.

Operational Objective

To administer a consultation process that is in accordance with the requirements of the FRMA and Management Plan allowing for the best possible advice from all relevant stakeholders to be provided to the decision maker (Minister/ED) in a timely manner.

Indicators

- The Minister or ED (or the Department on their behalf) conforms to the consultation requirements of the FRMA and Management Plan.
- The level to which licencees consider that they are adequately and appropriately consulted.

Performance Measures

Advice provided to the Minister following each SBSMAC meeting.

Proper consultation procedures have been followed in any amendment of the management plan.

License holders and skippers meetings held annually.

Data Requirements

Views on the SBSMAC and related consultation processes collected from stakeholders at each annual meeting.

Documentation of the formal consultation procedures followed when an amendment is made.

Evaluation

Consultation on the management of the scallop fishery is conducted in an open, accountable and inclusive environment where all sectors of the industry and the Departments managers and researchers collectively identify and discuss appropriate courses of action.

Decision makers take due notice of advice provided on the basis of this consultation and give reasons for decisions, which vary from consultation-based advice.

Robustness

High

The consultation process is extremely well understood with relatively high levels of participation from the various stakeholder groups.

Fisheries Management Response

- The Department has strong links to the trawl industry through a formal statutory process. Under Section 41(2) of the FRMA the SBSMAC has the function to "*provide information and advise to the Minister on matters related to the protection and management of the fishery*".

Membership of the SBSMAC comprises; an independent Chairperson; Executive Director of the Department of Fisheries; an officer from the Department; and commercial scallop fishers. Terms of appointment are usually for two years however members can seek to be reappointed for additional terms.

SBSMAC has a number of sub-committees, which are chaired by SBSMAC members but nominations are sought from industry groups to make up the sub-committees.

The Department does, however, also provide independent advice to the Minister on the implications of any proposal from SBSMAC, or other body.

Comments and Action

The Department will continue to maintain a pathway for consultation (such as the SBSMAC) within the SBS industry.

External Driver Check List

Despite the robustness of the SBSMAC and other consultation processes used, disaffected parties may still seek to use political avenues to further their cause.

5.4.4 Department of Fisheries – reporting

5.4.4.1 Assessments and reviews

Rationale for Inclusion

It is important that the outcomes of the fisheries management processes administered by the Department for the SBS fishery are available for review by external parties. It is also important that the community is sufficiently informed on the status of this fishery, given that it is utilising a community resource. The reports that are currently provided annually are: the State of the Fisheries Report, the Annual report to the Office of the Auditor General (OAG); more irregular reports include this ESD report, and the application to EA. There is a longer-term plan to have the entire system of management audited by the Western Australia Environmental Protection Authority (WA EPA).

Operational Objective

Current: To report annually to the Parliament and community on the status of the fishery

Future: To develop an independent audit process for the fishery at appropriate intervals. To develop a process where all protected species interactions by commercial operations should be reported and coupled with an education program to ensure industry has the ability to make accurate reports.

Indicators

- The extent to which external bodies with knowledge on the management of fisheries resources have access to relevant material.

- Level of acceptance within the community.

Performance Measure

General acceptance of the management system by the community.

Data Requirements

The majority of data required to generate reports is already collected in the course of pursuing resource management objectives. The Department conducts an annual survey of the community with respect to its opinion on the status of the State's fisheries and their attitudes to the performance of the Department.

Evaluation

The Department has implemented more then one process to report on the performance of this fishery and in doing so has ensured that the community has access to this information.

In addition to this base level reporting the development of a new process that will see the fishery undergo regular independent audits, ensures this sub-component is well in hand.

The Department has been the recipient of a number of awards for excellence for its standard of reporting - Premiers Awards in 1998; 1999 for Public Service excellence; Category Awards in Annual Reporting in 1998, 1999, 2000; Lonnie Awards in 2000, 2001.

Current Reporting Arrangements for this fishery include:

State of Fisheries

The performance of the fishery is reported annually against the agreed objectives in the State of the Fisheries Report. This document is available in hard copy format but is also available from the Department's web site in PDF format.

Annual Report

A summary of this report is presented within the Department's Annual Report and is used in some of the Performance Indicators that are reviewed annually by the OAG. The OAG also periodically audits that the information (both the data and processes) used to generate these reports.

ESD

This ESD Report (of which the material in the application was a subset), not only covers the environmental aspects of the fishery but the full social and economic issues. It is now available from the website.

Reports to Industry

Each year, the status of the resource, effectiveness of current management and any proposals for alterations to arrangements are presented to license holders and skippers. This includes the production of a summary report, which is provided to the audience.

Robustness

High

Fisheries Management Response

Current: For many years the Department has produced substantial and high quality documents that report on the operation of the Department and the status of its fisheries (including the SBS fishery)– these reports are the Annual Report and the State of the Fisheries.

Future: In line with the new Commonwealth Government requirements the Department of Fisheries is in the process of developing a tri-partite memorandum with the Western Australian Environmental Protection Authority and the OAG to conduct a regular audit of the fishery.

Comments and Action

The processes already established and those new external review processes that are all but established, will ensure that there will be many opportunities for the appropriateness of the management regime, and importantly the results it produces, to be reviewed.

External Driver Check List

The assessments provided by independent review bodies and the community.

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7.0 Appendices

APPENDIX 1. TERMINOLOGY

Terminology for trawl gear

Booms	Steel structures to support trawl gear, outboard of the boats centre line.
Bridles	Wire rope connecting otter boards to towing warp. The bridle length in this fishery is 25 to 30 fathoms.
Codend	Netting connected to the end of the trawl net to gather the accumulated catch during each tow. Releasing a drawstring can open the end of the bag and then the contents can be emptied onto the boats sorting table.
Drop chain	Length of chain (approximately 150mm) connecting footline to ground chain at about 1m intervals. This results in a gap between the footline and the ground chain that allows benthic objects to pass beneath the trawl net.
Footline	Lower frame line to which netting is attached in a trawl.
Ground chain	The chain is of similar length to the footline and travels across the seabed. Prawns and scallops react to the oncoming chain by rising from the substrate and into the net over the footline.
Headline	Upper frame line to which netting is attached in a trawl.
Lazy line	Rope connected to the codend to allow it to be hauled onboard the boat.
Lead-ahead	Where the headline is forward of the footline to form a verandah of netting to prevent prawns from escaping over the head line when they are disturbed by the ground chain.
Net	On a trawl, consists of netting hung between two frame lines. The lower frame line includes the ground chain that is connected by drop chains. Mesh size permitted in this fishery is no less than 100mm.
Otter board	A solid device set at an angle of attack to the tow direction to generate a lateral hydrodynamic force to spread or open the net or trawl system.
Spread	Is the lateral distance that the headline is opened while the gear is working. Spread is expressed as a percentage of headline length and is called spread ratio.
Warp	Main towing wire from booms to bridle.

APPENDIX 2. ATTENDEES LISTS

A2.1 Workshop 1

Attendees:

Bill Aird, Denham RFA

David Adams, Exmouth RFAC

Emma Hopkins, Department of Environmental Protection

Felix Correia, Correia Holdings Pty Ltd.

Fred Wells, Snr Curator WA Museum

Heidi Grief, Department of Fisheries

Graeme Stewart, Industry – Shark Bay Prawn

Guy Leyland, WAFIC

Hamish Ch'ng, Industry Shark Bay Scallop

Jim Penn, Department of Fisheries

Jo Bunting, Department of Fisheries

Keith Shadbolt, Denham RFAC

Kerry Truelove, EA

Lindsay Joll, Department of Fisheries

Malcolm McGowan, Industry – Shark Bay Scallop

Mark Flanigan, EA

Martin Holtz, Recfishwest

Mervi Kangas, Department of Fisheries

Nic Dunlop, Conservation Council of WA

Nick D'Adamo, CALM

Paul Bowers, Aboriginal Lands Trust

Peter Lombardo, Industry – Shark Bay Prawn

Phil Unsworth, Department of Fisheries

Prof Di Walker, University of Western Australia

Richard Patty, Norwest Seafood

Rick Fletcher, Department of Fisheries

Rod Berg, Office of the Auditor General

Stephen Hood, Industry – Exmouth Gulf Prawn

A2.2 Workshop 2

Attendees:

Bill Aird, Denham RFAC

Bob Hoult, Denham

David Adams, Exmouth RFAC

Errol Sporer, Department of Fisheries

Felix Correia, Correia Holdings Pty Ltd.

Heidi Grief, Department of Fisheries

Hamish Ch'ng, Industry Shark Bay Scallop

Jenny Shaw, Department of Fisheries

Jim Penn, Department of Fisheries

Jo Bunting, Department of Fisheries

Keith Shadbolt, Denham RFAC

Les Moss, Shire of Shark Bay

Lindsay Joll, Department of Fisheries

Mark Hook, Shire of Shark Bay

Martin Holtz, Recfishwest

Mervi Kangas, Department of Fisheries

Nic Dunlop, Conservation Council of WA

Paul Bowers, Aboriginal Lands Trust

Prof Di Walker, University of Western Australia

Richard Patty, Norwest Seafood

Rick Fletcher, Department of Fisheries

Robert Prince, CALM

Rod Berg, Office of the Auditor General

Stephen Hood, Industry – Exmouth Gulf Prawn

APPENDIX 3. NATIONAL ESD CONSEQUENCE LEVELS AND LIKELIHOOD DEFINITIONS FOR RISK ASSESSMENT

Scope

- Retained/Non Retained/Protected species – assessed at level of locally reproducing population –unit stock
- Ecosystem – indirect impacts due to flow on effects on food chain assessed at the Regional/ Bioregional level
- Habitat (attached species – e.g. seagrass) assessed at the regional habitat level defined as the entire habitat equivalent to that occupied by the exploited stock.

A3.1 Table– Risk Matrix

		Consequence					
Likelihood		**Negligible**	**Minor**	**Moderate**	**Severe**	**Major**	**Catastrophic**
		0	**1**	**2**	**3**	**4**	**5**
Remote	1	0	1	1	1	1	1
Rare	2	0	1	1	1	2	2
Unlikely	3	0	1	1	2	2	3
Possible	4	0	1	2	2	3	4
Occasional	5	0	1	2	3	4	4
Likely	6	0	1	2	3	4	4

A3.2 Table Summary Consequence Definitions

Level	Ecological
Negligible	General – Insignificant impacts to habitat or populations, unlikely to be measurable against background variability. **Target Stock/Non-retained:** undetectable for this population **By-product/Other Non-Retained:** Area where fishing occurs is negligible compared to where the relevant stock of these species reside (< 1%) **Protected Species:** Relatively few are impacted. **Ecosystem:** Interactions may be occurring but it is unlikely that there would be any change outside of natural variation **Habitat:** Affecting < 1% of area of **original** habitat area *No Recovery Time Needed*
Minor	**Target/Non-Retained:** Possibly detectable, but little impact on population size and none on their dynamics. **By-product/Other non-retained:** Take in this fishery is small (< 10% of total) compared to total take by all fisheries and these species are covered explicitly elsewhere. Take and area of capture by this fishery is small compared to known area of distribution (< 20%). **Protected Species:** Some are impacted but there is no impact on stock **Ecosystem:** Captured species do not play a keystone role – only minor changes in relative abundance of other constituents. **Habitat:** Possibly localised affects < 5% of total habitat area *Rapid recovery would occur if stopped - measured in days to months.*
Moderate	**Target/Non Retained:** Full exploitation rate where long term recruitment/ dynamics not adversely impacted **By-product:** Relative area of, or susceptibility to capture is suspected to be less than 50% and species do not have vulnerable life history traits **Protected Species:** Levels of impact are at the maximum acceptable level **Ecosystem:** measurable changes to the ecosystem components without there being a major change in function. (no loss of components) **Habitat:** 5-30 % of habitat area is affected. **:** or, if occurring over wider area, level of impact to habitat not major *Recovery probably measured in months – years if activity stopped*

Level	Ecological
Severe	**Target/Non Retained:** Affecting recruitment levels of stocks/ or their capacity to increase **By-product:Other Non-Retained:** No information is available on the relative area or susceptibility to capture or on the vulnerability of life history traits of this type of species Relative levels of capture/susceptibility greater than 50% and species should be examined explicitly. **Protected Species:** Same as target species **Ecosystem:** Ecosystem function altered measurably and some function or components are missing/declining/increasing outside of historical range &/or allowed/facilitated new species to appear. **Habitat:** 30 - 60 % of habitat is affected/removed. *Recovery measured in years if stopped*
Major	**Target/Non Retained:** Likely to cause local extinctions **By-product:Other non-retained:** N/A **Protected Species:** same as target species **Ecosystem:** A major change to ecosystem structure and function (different dynamics now occur with different species/groups now the major targets of capture) **Habitat:** 60 - 90% affected *Recovery period measured in years to decades if stopped.*
Catastrophic	**Target/NonRetained:** Local extinctions are imminent/immediate **By-product/Other Non-retained:** N/A **Protected Species:** same as target **Ecosystem:** Total collapse of ecosystem processes. **Habitat:** > 90% affected in a major way/removed *Long-term recovery period will be greater than decades or never, even if stopped*

A3.3 Table – Likelihood Definitions

Level	Descriptor
Likely	It is expected to occur
Occasional	May occur
Possible	Some evidence to suggest this is possible here
Unlikely	Uncommon, but has been known to occur elsewhere
Rare	May occur in exceptional circumstances
Remote	Never heard of, but not impossible

APPENDIX 4. ACRONYMS

BRDs	Bycatch Reduction Devices
CAESS	Catch and Effort Statistics System
CALM	Department of Conservation and Land Management
DEP	Department of Environmental Protection
EA	Environment Australia
ED	Executive Director (of Department of Fisheries)
EPBCA	Environment Protection and Biodiversity Conservation Act 1999
ESD	Ecologically Sustainable Development
FRDC	Fisheries Research and Development Corporation
FRMA	Fish Resources Management Act 1994
FRMR	Fish Resources Management Regulations 1995
GIS	Geographic Information System
OAG	Office of the Auditor General
OCS	Offshore Constitutional Settlement
SBS	Shark Bay Scallop Managed Fishery
SBSMAC	Shark Bay Scallop Management Advisory Committee
SBS Plan	Shark Bay Scallop Managed Fishery Management Plan
SCFA	Standing Committee for Fisheries and Agriculture
VMS	Vessel Monitoring System
WA	Western Australia
WA EPA	Western Australia Environmental Protection Agency
WAFIC	WA Fishing Industry Council

APPENDIX 5. RESEARCH

Strategic research and development planning

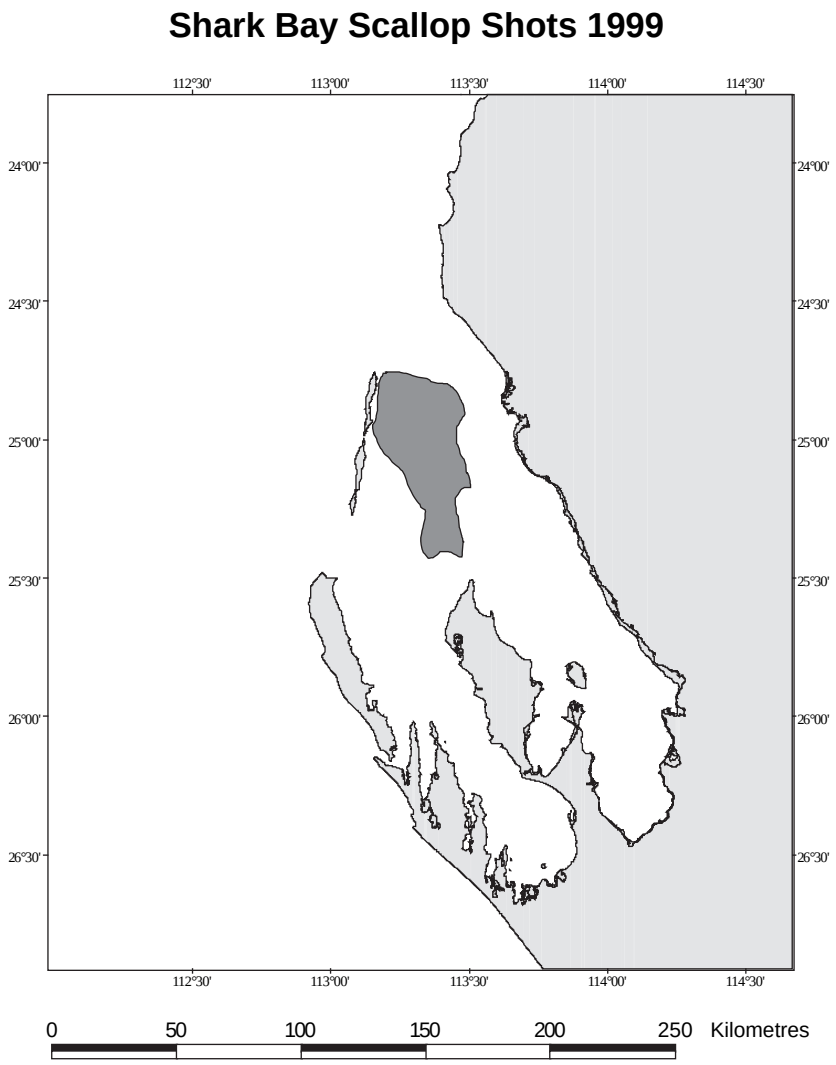
Project -SBay scallops	Res.Group	Link	Gap	1970s	1980s	1990s	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
TARGET STOCK MANAGEMENT													
1. Annual Stock Assessment													
Stock-recruit-enviro effects	**FWA**				✓	✓	✓	✓	✓	✓	**x CR**	**x CR**	**x CR**
Fishery Modelling/Depletion	**FWA**											**x CR**	
2. Fishery Databases													
Research logbooks	**FWA**			✓	✓	✓	✓	✓	✓	**x CR**	**x CR**	**x CR**	**x CR**
CAES returns	**FWA**			✓	✓	✓	✓	✓	✓	**x CR**	**x CR**	**R**	
Fishing power monitoring				✓	✓	✓	✓	✓	✓	**x CR**	**x CR**	**x CR**	**x CR**
Processors returns	**I**			✓	✓	✓	✓	✓	✓	**x CR**	**x CR**	**x CR**	**x CR**
Effort impact assessment (GIS)	**FWA**										**x CR**		
Fishery indep surveys	**FWA**				✓	✓	✓	✓	✓	✓	**x CR**	**x CR**	**x CR**
3. Biology													
Reproduction	**FWA**			✓	✓								
Growth	**FWA**				✓								
Meat condition/ shell growth	**FWA**									**x**			
Catchability/Depletion exp.	**FWA**				✓					**x**			
ENVIRONMENTAL MANAGEMENT													
Bycatch monitoring	**FWA**									**FRDC/ CR**	**FRDC/ CR**		
Habitat/effort impacts	**FWA**		✓								**x CR/ FRDC**	**x CR/ FRDC**	
Bio-diversity monitoring	**FWA**		✓								**x CR/ FRDC**	**x CR/ FRDC**	
Marine Park Monitoring	**FWA**		✓										

SOCIOECONOMICS													
1. Resource allocation/native title													
Aquaculture/Reseeding (ranching)	**I/FWA**					✓							

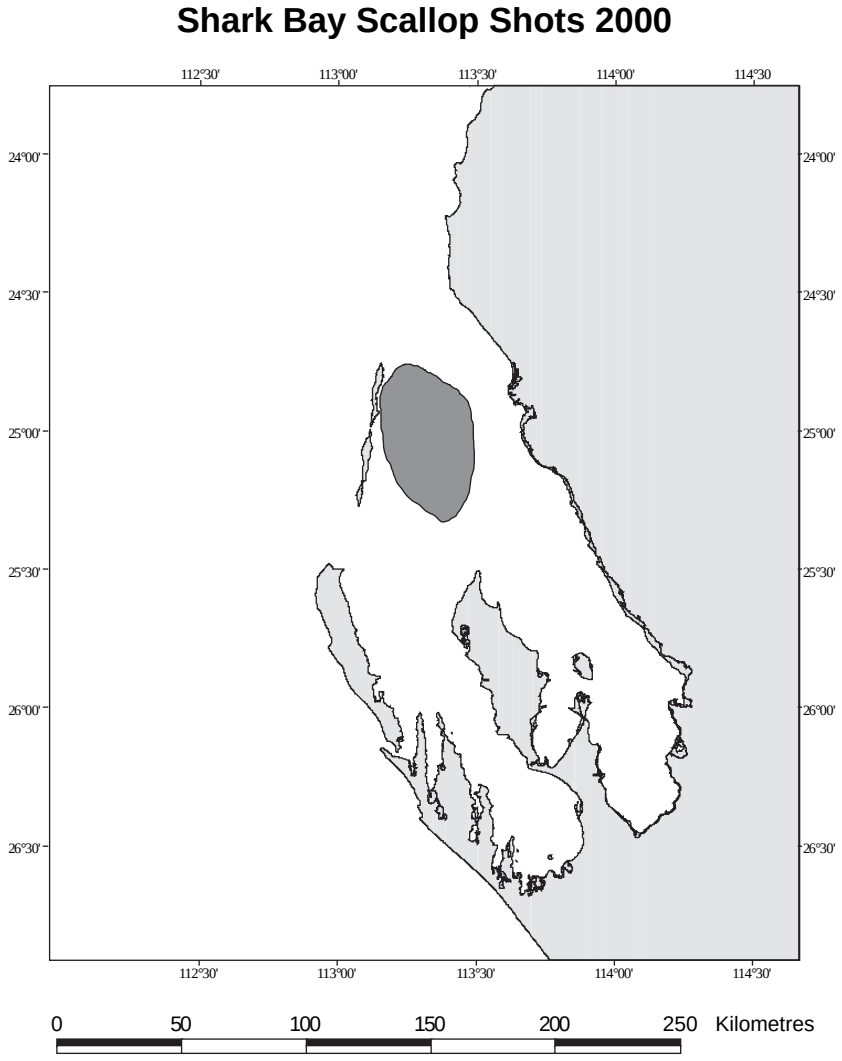
Native Title													
Marine Parks	**CALM**												
World Heritage Areas	**CALM**												
Project -SBay scallops	**Res.Group**	**Link**	**Gap**	**1970s**	**1980s**	**1990s**	**1997/98**		**1999/00**	**2000/01**	**2001/02**	**2002/03**	**2003/04**
2. Economics													
Economics	**I/FWA**												
Database grades etc.	**I/FWA**				✓								
Market research	**I**				✓								
Fuel consumption/expenses	**I**									**x**			
3. Gear, vessels and vessel design													
Gear development/mesh size	**I/FWA**						✓	✓	✓	✓			
Bycatch reduction devices	**I/FWA**							**NHT**	**NHT**	**FRDC/ CR**	**FRDC/ CR**		
Bison boards	**FWA**				✓								
4. Public health/quality													
On board handling/processing	**I**												
Occ. Health and Safety	**FWA/I**												
Product quality certification	**I**												

APPENDIX 6. FIGURES

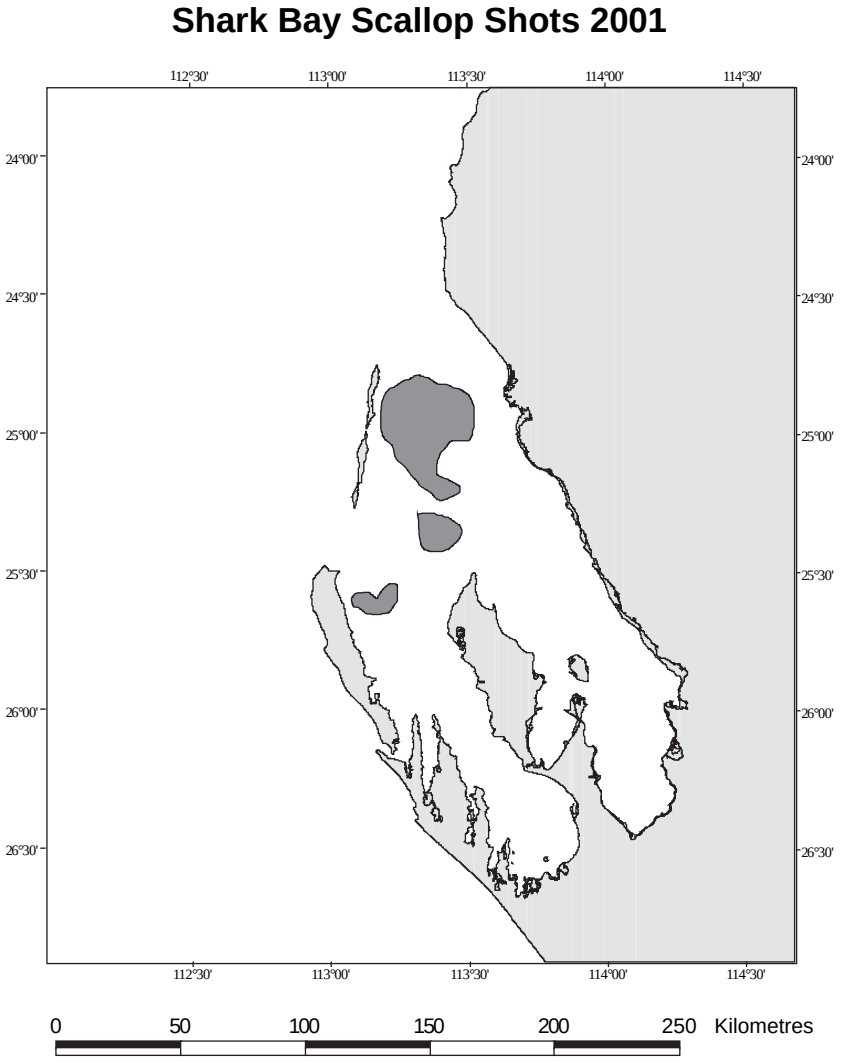
A6.1 General Area of Trawling by the Scallop Fleet (Class A Licence Vessels) in Shark Bay in 1999.



A6.2 General Areas of Trawling by the Scallop Fleet (Class A Licence Vessels) in Shark Bay in 2000.



A6.3 General Area of Trawling by the Scallop Fleet (Class A Licence Vessels) in Shark Bay in 2001.



APPENDIX 7. MATERIALS SUPPLIED TO ENVIRONMENT AUSTRALIA AGAINST THEIR SPECIFIC GUIDELINES

SECTION 4. Assessment of the SBS Management Regime against the Commonwealth (EA) Guidelines for assessing the Ecologically Sustainable Management of fisheries

GENERAL REQUIREMENTS OF THE EA GUIDELINES

The management arrangements must be:

Documented, publicly available and transparent

As per the FRMA *"the Executive Director is to cause a copy of every order, regulation and management plan in force under this Act –*

- *To be kept at the head office of the Department; and*
- *To be available for inspection free of charge by members of the public at that office during normal office hours."*

In addition to the legislative requirements, the current management regime, as documented in the formal set of management regulations, can be purchased by interested parties from the State Law Publisher.

Of more relevance, is that any discussion papers and proposals for modifications to these management arrangements are distributed widely to stakeholder groups automatically and other interested individuals by request in hard copy format. Where appropriate, they are now also available from the Departmental web site www.fish.wa.gov.au

Developed through a consultative process providing opportunity to all interested and affected parties, including the general public

S64 and S65 of the FRMA define the requirement for procedures that must be undertaken before determining or amending all management plans. More specifically, the management arrangements for the SBS fishery have been developed through formal consultation with the industry and community through the SBSMAC. Depending on the nature of the matter under consideration, submissions may also be sought from industry groups (e.g. WA Fishing Industry Council - WAFIC), other stakeholder groups (e.g. Recfishwest, Conservation Council of WA) and the general public.

The ESD Report for the SBS fishery was developed through a consultative process that included a wide variety of stakeholders including members of the Shark Bay scallop trawl industry, government (Departments of Fisheries, Conservation and Land Management and Environment), recreational/regional groups (Recfishwest, Denham Shire Council), non-government environmental groups (Conservation Council of WA), Environment Australia and invited specialists (WA Museum, University of WA). Details of the methods used to generate this report including how the issues were identified, how these identified issues were subjected to a risk assessment, and how the objectives etc were developed are described in Section 3.5. Attendees at each of the workshops are listed in Appendix 2.

Ensure that a range of expertise and community interests are involved in individual fishery management committees and during the stock assessment process

The range of expertise and community interests that have been involved in the process of determining management and reviewing stock assessments is extensive. The groups that have been involved in the generation and review of the information contained in this report include:

- Department of Fisheries, WA;
- Department of Environment, WA;
- Department of Conservation and Land Management (CALM);
- The scallop trawling industry;
- Western Australian Fishing Industry Council (WAFIC);
- Recfishwest;
- Conservation Council of WA;
- University of WA; and
- Museum of WA.

The general consultation methods used for this fishery are summarised in the Governance Section 5.4.3.1. The attendee list for each meeting can be found in Appendix 2.

Be strategic, containing objectives and performance criteria by which the effectiveness of the management arrangements are measured

The ESD Component Reports (see Section 5) contain the available objectives, indicators and performance measures for measuring the effectiveness of the management arrangements for the SBS fishery.[2]

For some components, the objectives, indicators and performance measures are well established and the data are available to demonstrate levels of performance over time. For other components, the objectives, indicators and performance measures have only just been developed and/or the necessary data collection is only just being initiated. The status of this information is documented within each of the individual component reports within the National ESD Report in Section 5.1-5.4.

Be capable of controlling the level of harvest in the fishery using input and/or output controls

The FRMA and specifically the management plan for the SBS fishery provides the legislative ability to control the level of harvest within this fishery. This is achieved through the use of a sophisticated and effective combination of input control measures based upon limiting the number of vessels allowed to operate in the fishery, the amount (and type) of gear each of these boats may use, along with a set of seasonal and spatial closures.

These arrangements have been varied during the past 11 years to ensure that management remains appropriate to achieve the sustainability objectives for the fishery. Thus there have been changes to the opening of the fishing season based on pre-season spawning surveys; changes to compliance policing (e.g. VMS fitted to vessels); changes to gear requirements (e.g. use of BRDs); and changes to fishing grounds (e.g. permanent and temporary closures).

[2] *It is proposed that these will be collated and formally published as a set of Ministerial Guidelines in the near future.*

Contain the means of enforcing critical aspects of the management arrangements

The Department of Fisheries WA employs a large number of operational staff to ensure compliance with the critical aspects of the management arrangements for the SBS fishery. This includes at-sea patrols to ensure restrictions on gear and other operational rules are being adhered to while closed seasons and areas are enforced by both VMS and at-sea patrols.

Given the value of the licences, fishers themselves are also a source of information on illegal activities. A full summary of these compliance activities and their effectiveness is provided in Section 5.4.1.3.

Provide for the periodic review of the performance of the fishery management arrangements and the management strategies, objectives and criteria

There is an annual review of the performance of the major aspects of the SBS fishery through the completion of the "State of the Fisheries" report. This is updated and published each year following a review by the Office of the Auditor General. It forms an essential supplement to the Department's Annual Report to the WA Parliament with the latest version located on the Departmental website www.fish.wa.gov.au.

The ESD Component Reports contain a comprehensive performance evaluation of the SBS fishery based upon the framework described in the ESD policy (Fletcher, 2002). This includes the development of objectives, indicators and performance measures for all aspects of this fishery and includes status reports for those components that are not subject to annual assessment. This full assessment, including an examination of the validity of the objectives and performance measures, is planned to be completed and reviewed externally every five years.

Be capable of assessing, monitoring and avoiding, remedying or mitigating any adverse impacts on the wider marine ecosystem in which the target species lives and the fishery operates

Capabilities for the assessment, monitoring and avoidance, remedying or mitigating any adverse impacts on the wider marine ecosystem are documented in the "General Environment" Section 5.3. This has been completed through a formal risk assessment analysis of the issues and, where necessary, the development of suitable monitoring programs.

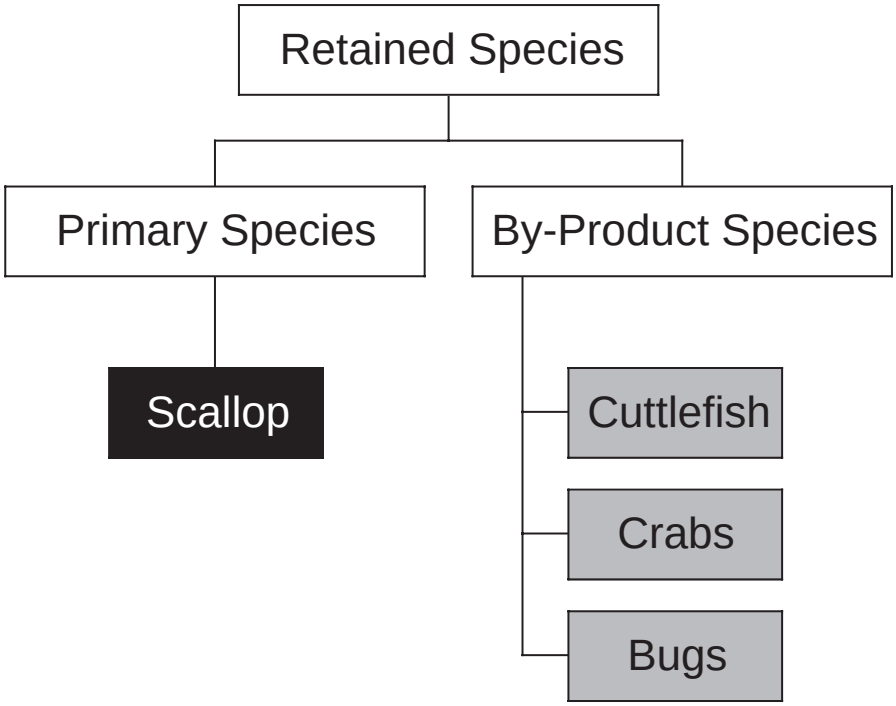
Require compliance with relevant threat abatement plans, recovery plans, the National Policy on Fisheries Bycatch, and bycatch action strategies developed under that policy

The management regime complies with all relevant threat abatement plans for species where there is an interaction. Details are provided in the 'non-retained species' Section of the ESD Report (Section 5.2) and a stand alone Bycatch Action plan based on this material will be circulated to all stakeholders once finalised.

PRINCIPLE 1 OF THE COMMONWEALTH GUIDELINES

OBJECTIVE 1. MAINTAIN VIABLE STOCK LEVELS OF TARGET SPECIES

A fishery shall be conducted at catch levels that maintain ecologically viable stock levels at an agreed point or range, with acceptable levels of probability



Component tree for the retained species.

Black boxes indicate that the issue was considered high enough risk at the June 2001 Risk Assessment workshop to warrant having a full report on performance. Grey boxes indicate the issue was rated as a low risk and no specific management is required – generally only the justification is presented.

The component tree detailing the retained species within the SBS fishery is shown above. The target species, saucer scallop (*Amusium balloti*) retained by this fishery has been assessed with an appropriately detailed report having been compiled. Only the saucer scallop was caught in sufficient quantities by this fishery to warrant detailed attention (Section 5.1.1.1). There are, however, reports for the other retained species including the 3 main by-product groups located in Section 5.1.

Assessments of the current performance demonstrate that scallops are being maintained above levels necessary to maintain ecologically viable stock levels. The annual biological survey is designed to measure the abundance of recruits to the Shark Bay scallop population, which results in an index of recruitment independent of fishery catch records. The mixture of residual and recruit abundance on the trawl grounds in this survey is used to determine the opening date of the fishery (see below for details) that ensures an adequate level of spawning stock. Due to the significant correlation between the abundance of recruits a residual stock in November and the following years catch, the annual management for this fishery can be tailored to the expected abundance of scallops.

Thus, in summary:

- The index of stock abundance of scallops must be above a level that would allow for adequate levels of spawning stock during the spawning season. In circumstances where stock levels are low, but not sufficiently low to not open the area to the fishery, a season of very limited duration may be provided for.
- The level of capture of other by-product species by this fishery is too small to have a significant impact on their dynamics.

Consequently, this fishery is meeting the requirements of Principle 1.

Information Requirements

1.1.1 There is a reliable data collection system in place appropriate to the scale of the fishery. The level of data collection should be based upon an appropriate degree of fishery independent as well as fishery dependent research and monitoring.

A substantial level of information is collected on the SBS fishery. Data are collected through a combination of fishery dependent and fishery independent systems, many of which have been in place for decades. These on-going monitoring programs are supported by a long history of research programs on the biology and ecology of scallops along the west coast of WA.

The specific data requirements needed to assess performance for each of the relevant objectives are detailed in the relevant sections of the ESD reports in Section 5.1 Retained Species. The requirements are summarised as follows:

Monitoring Program	Information Collected	Robustness[1]
Fishery independent recruit/ residual surveys	Annual biological survey that measures the abundance of recruits to the Shark Bay population and levels of residual stock	High
Voluntary daily logbooks	Hours fished, areas of operation, and estimated catch per trawl	High
CAESS returns	Monthly catch and days fished	Moderate
Processor unload records	Scallop landings	High
VMS	Location and speed of vessels – used by Department of Fisheries for managing compliance with closures	High
On-board observer program	Bycatch species and numbers	High
Climatic data	Monthly Fremantle Sea Level data- used to estimate strength of Leeuwin Current; Rainfall data; Wind data and Swell Height Conditions	High

[1] *The level of robustness of these measures is discussed in full within each of the relevant component reports in Section 5.*

Assessments

2.2.2 There is a robust assessment of the dynamics and status of the stock dynamics and status for the target species. Review should ideally take place every year, and no greater than three years should elapse between reviews.

The status of the stock is determined annually from a pre-season (November-December) fishery-independent survey of recruit and residual stock levels. This survey provides the data on the relative abundance of these 2 classes of scallops for the decision making process on the start date of the fishery which allows for proper management of spawning stock levels (see Table 5). The variable starting date, which is determined by the results of these surveys, ensures that there will always be sufficient spawning irrespective of the level of recruitment.

As an example, the recruitment of juvenile scallops to the stock in 1998 was found to be low to moderate with the residual stock also relatively low (as measured by the November scallop survey). These data resulted in a start date of May 5, which is 6 weeks after the earliest possible start date and about a month after spawning had commenced. This level of recruitment recorded in November 1998 was reflected in the catch taken in 1999 (1,700 tonnes whole weight), which was in the middle of the range projected for the season (Figure 11).

Full details of the current evaluation and a discussion of the robustness of the analyses used are located in 5.1.1.1. These assessments are reported annually within the State of the Fisheries Report.

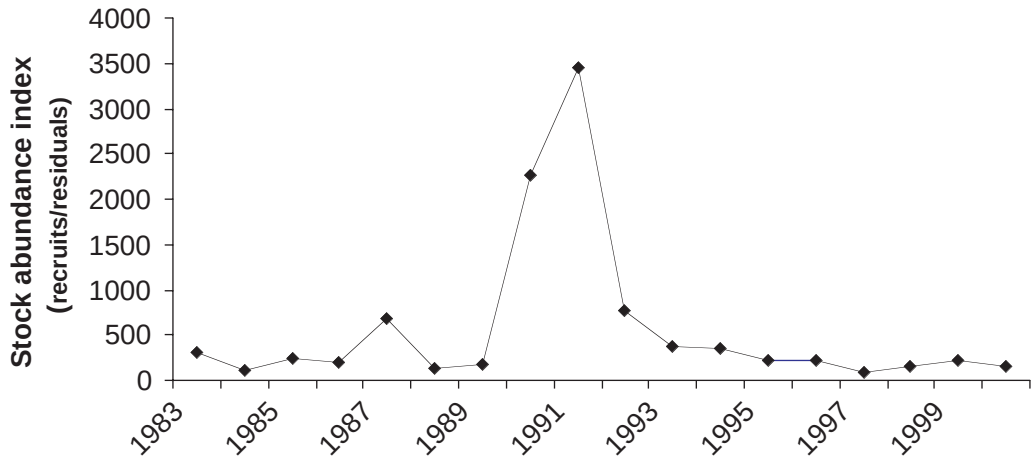


Figure 10. Stock abundance index (recruits and residuals) for the SBS fishery.

2.2.3 The distribution and spatial structure of the stock(s) has been established.

The distribution of this species of scallop has been well documented, occurring from Esperance to Broome with a number of locations where there are commercial abundances in Western Australia (see also Figure 6 located in the Background Section). Additionally, *Amusium balloti* occurs from Queensland to New South Wales in eastern Australia. It is also commercially harvested in the eastern states but the distribution of the east and west populations of the saucer scallops are separated across the northern Australian waters (see Section 2.1 for more information).

2.2.4 There are reliable estimates of all removals, including commercial (including discards), recreational and indigenous, from the fished stock. These estimates have been factored into stock assessments and target species catch levels.

Within the list of monitoring programs outlined above for the SBS fishery, data covering each of these sources of removal are outlined. Given the nature of this fishery, only the estimates of removals by the commercial sector are required and these are collected on a daily to monthly basis during the fishing season. There are no recreational or indigenous fisheries for scallops in Shark Bay. Furthermore, there is a minimal likelihood of a significant level of illegal capture of scallops by the commercial fleet.

Sector	Catch Data Collected	Frequency
Commercial	Fishers monthly returns, Processor unload records, Voluntary daily logbooks, On-board observer data	Daily or monthly during the season
Recreational	N/A	N/A
Indigenous	N/A	N/A
Illegal	N/A	N/A

2.2.5 There is a sound estimate of the potential productivity (maximum safe long term yield) of the fished stock/s.

The status of the stock is determined from a pre-season survey of recruitment and residual stock conducted between November and December. This survey provides the data for the decision making on the start date of the fishery and allows for the management and presence of the spawning stock from year to year. The level of recruitment of this species (as with all species of scallops) is highly variable and as a result the catch varies greatly from year to year (Figure 11).

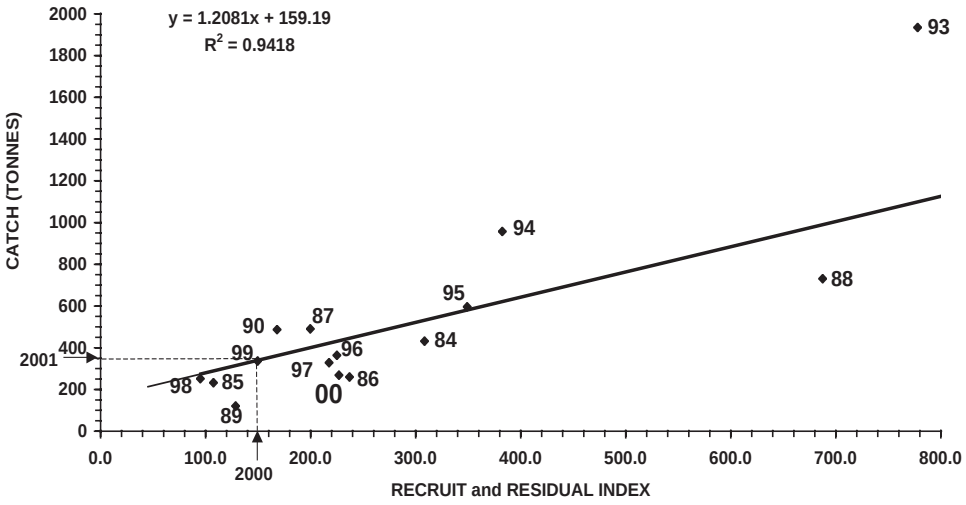


Figure 11. Relationship between recruit/residual index (stock abundance) and the commercial catch the following year.

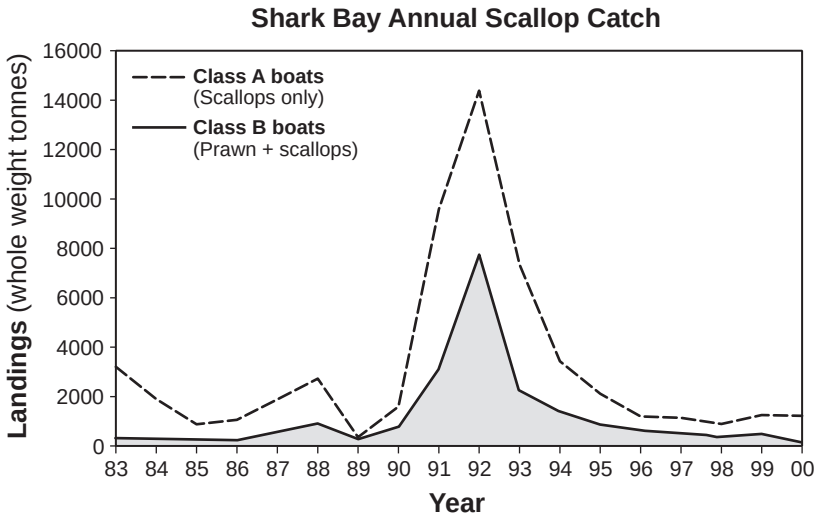


Figure 12. Annual scallop landings by fleet for the SBS fishery, 1983-2000.

Over the last 18 years, scallop landings have varied greatly in this fishery from around 605 to 22,070 whole weight tonnes (121 to 4,414 meat weight tonnes) (Figure 12). Scallop landings have depended primarily on the strength of recruitment in the previous years, which is largely environmentally driven (see external drivers in Section 5.1.1.1) and the spawning stock size has not been a significant factor at the levels of spawning stock so far experienced.

Management Responses

2.2.6 There is a limit reference point, which is the biological and/or effort bottom line beyond, which the stock should not be taken.

Due to the significant correlation that has been determined between the abundance of recruits and the following year's catch (Joll and Caputi, 1995a), annual management arrangements can be tailored to the expected abundance of scallops. The approach taken is to ensure an adequate level of spawning occurs irrespective of the recruitment levels. Thus, the lower the predicted catch level, derived from the stock abundance index (level of recruit plus residuals stock) the later the starting time is for the fishery. With spawning beginning in April, most scallops would have had the opportunity to spawn by the latest start time, which is in mid-May. As stated above, the majority of recruits appear to result from spawning which occurs in this early period of the spawning season.

The relevant levels for stock abundance/predicted catch abundance with the corresponding opening date for the fishery are outlined in Table 8. However, the opening date determined from the estimated catch is adjusted by the composition of the stock (recruits/residuals) therefore when the stock is dominated by recruits (i.e. a high or medium relative abundance) a later start date is selected to ensure that the stock has grown to an appropriate meat size for harvest. As a result, the process of setting an opening date for the season balances the stock abundance and composition levels and the seasonal decline in meat condition associated with spawning. This approach has been generally successful in maintaining spawning stocks at adequate levels for recruitment and annual variations in recruitment are dominated by environmental factors that are inversely correlated with the strength of the Leeuwin Current. Consequently, during the past 20 years, the SBS fishery has seen no significant relationship between the level of spawning stock and subsequent recruitment. For example, the high levels of recruitment seen in 1990 and fished in 1991 and 1992 resulted from one of the lowest spawning stocks. Therefore, a biological limit reference point has not been able to be determined at current effort levels and economic catching thresholds.

While there isn't a biological limit reference point at which fishing is halted, there is an economic bottom line, which determines when fishing is ceased. Therefore the closing date for the SBS fishery is economically driven with A class license fishers usually ceasing when the catch rates drop to around 6 to 7 kg/hr (120 – 150 kg/day). B-class license fishers continue to fish scallops at lower catch rates, but this low catch rate continuation of fishing is in the latter part of the spawning season and therefore does not impact significantly on spawning stock levels. The Department of Fisheries will be looking into developing a more explicit lower reference point for the SBS fishery within the near future.

The full justification for selecting these reference points and the current performance against these measures are described in Section 5.1.1.1.

Table 8. Opening date schedule for the SBS fishery.

ESTIMATED CATCH* (meat wt.)	RELATIVE ABUNDANCE RECRUITS	RELATIVE ABUNDANCE RESIDUALS	OPENING DATE* (*or nearest suitable day)
Low (<300t)	Low	Low	15 May
Med (300 - 600t)	Moderate	Low	1 May
	Low	Moderate	15 April
High (600 - 1500t)	High	Low	15 April
	Moderate	Moderate	15 April
	Low	High	1 April
Very high (>1500t)	High	Low	1 April
	Low	High	15 March

*****Estiimated catch derived from stock abundance index to catch relationship (see Figure 11).

2.2.7 There are management strategies in place capable of controlling the level of take.

A full description of the management arrangements for the commercial fishery is located in the attached management plan. A full discussion of the main regulations and their justifications are located in Section 2.2. In summary, these arrangements include:

- Limited number of vessels operating in fishery.
- Two sets of licences (Class A and Class B) with different limits on crew number, gear and time closures.
- Closed season between November and around April (see opening date table).
- 24 hour trawling allowed for Class A licensees.
- Temporary or permanent area closures, which relate to important prawn nursery grounds or no marketable product in the area.
- Gear controls that include restrictions on the mesh size (Class A 100mm; Class B < 60mm) and the number of nets (2), the length of trawl net head rope (Class A 7 fathoms; Class B 8 fathoms), and the size of the trawl otter boards and ground chains.
- Extensive “unfished” licence area resulting in approximately 30% of licensed area actually fished.
- Requirement for VMS on all fishing vessels.

Significant effort is put into ensuring adequate compliance with these regulations. This includes at-sea patrols to ensure restrictions on gear and other operational rules are being adhered to while closed seasons and areas are maintained by both VMS and at-sea patrols.

2.2.2 Fishing is conducted in a manner that does not threaten stocks of by-product species.

The relatively small area of operation of this fishery (over sand habitat) combined with the short time the fishery operates (only a few months per year), the large mesh size used and the slow speed

of trawling results in this fishery only catching relatively small amounts of by-product species. Full descriptions of the information available and the levels of risk of impact on these by-product species from the SBS fishery are located in sections 5.1.2.1, 5.1.2.2 and 5.1.2.3. None of the by-product species were rated as having sufficient risk to require specific ongoing monitoring except for the monthly return information on landed catches.

Cuttlefish - Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

In terms of impact on breeding stock levels of cuttlefish, the consequence of the SBS fishery is considered "negligible". This is due to the small and isolated catch in comparison to the extensive population size and distribution of cuttlefish along the WA coastline. For further information see Section 5.1.2.1.

Blue Swimmer Crabs - Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

Since 1995, the catch of crabs has been less than 1 tonne, except between 1996 and 1998 when the catch ranged between 2 and 12 tonne. The risk assessment determined that it was 'likely' that the fishery would only be having a 'negligible' impact on the breeding stock levels of blue swimmer crabs, resulting in an overall 'negligible' risk ranking (see Section 5.1.2.2).

Bugs - Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

The fishery catches less than 1 tonne of bugs per year, which is minimal compared to the extensive population size and wide geographical range of this species. For further information see Section 5.1.2.3.

In summary, (relating to objectives 1.1–1.6), a number of the monitoring programs that are currently in place for the SBS fishery also provide relevant information on the by-product species.

2.2.3 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

The management responses that are currently in place for the SBS fishery are very detailed, both for current actions, future actions and if the performance limits are reached/approached (see Section 5.1.1.1). Management actions taken over the past 15-20 years have been extremely effective and there is, therefore, an extremely high probability that they will continue to achieve the main objective of maintaining the spawning biomass of the SBS.

The ability to directly monitor stock abundance levels through a survey provides the data for the decision making on the opening date of the fishery. This allows for the annual management arrangements to be tailored to the expected abundance of scallops which ensures that adequate levels of breeding stock are present during the spawning period as well as ensuring the sustainability of this fishery. Continued monitoring of the level of stock abundance will be undertaken and if there is a reasonable likelihood that the performance limit will be reached, increased management arrangements would be implemented.

Strategies, which are readily available to offer further protection to the breeding stock if required include:

a. Changes to the timing of the start of the fishing season.
b. Reduction in the length of the fishing season.
c. Area closures.

OBJECTIVE 2. RECOVERY OF STOCKS

Where the fished stocks are below a defined reference point, the fishery will be managed to promote recovery to ecologically viable stock levels within nominated timeframes

There are no stocks within the SBS fishery that are currently below defined reference points/limits. However, the management arrangements are such that the fishery could be managed in a way, which would promote recovery in the event of the fishery falling below a defined reference point.

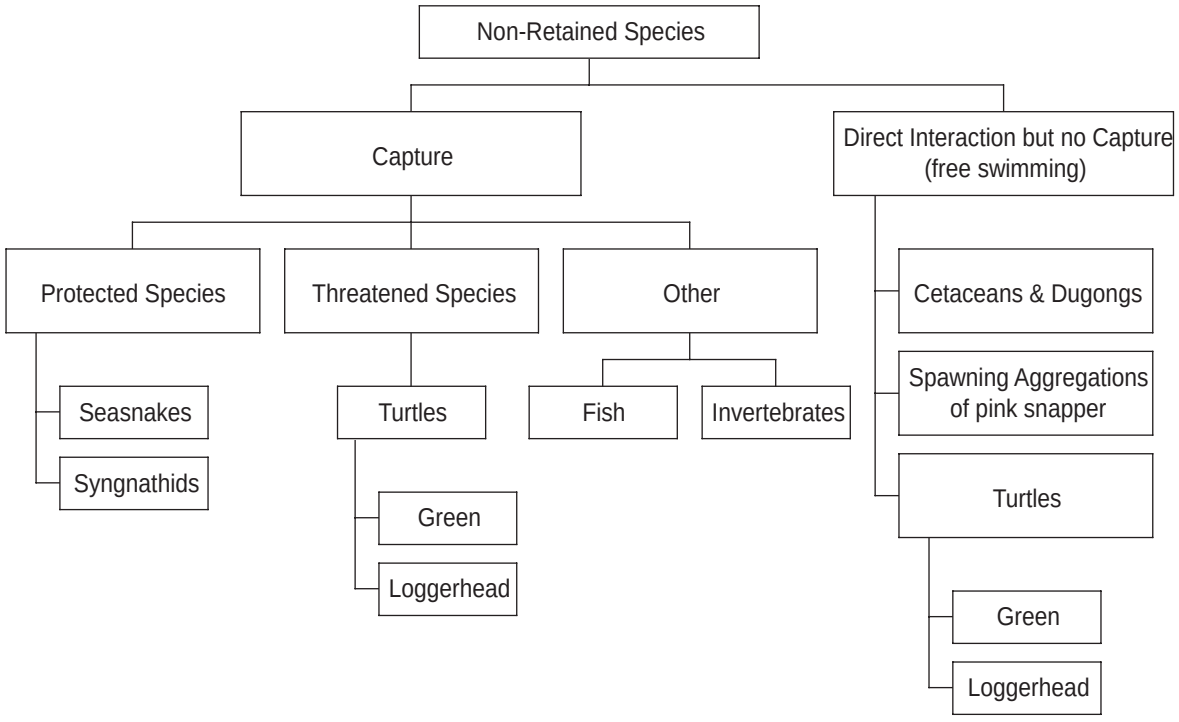
PRINCIPLE 2 OF THE COMMONWEALTH GUIDELINES

OBJECTIVE 1. BYCATCH

The fishery is conducted in a manner that does not threaten bycatch species

There is limited information regarding the historical level and nature of bycatch in the SBS since the fishery's inception. Researcher observations are that the bycatch numbers are relatively low in this trawling fishery due to the larger mesh size nets used, clumped distribution of the scallops and lower trawling speeds. All the bycatch species identified by the component tree were ranked as either negligible or low risks. Three of these are not actually captured in the net but on rare occasions interact with the trawling operations. The threatened and protected species components of this group (e.g. turtles, syngnathids, seasnakes) are covered in objective 2.2; the remaining non-retained (bycatch) species are covered under objective 2.1.

Comprehensive reports on each of these bycatch (non-retained) species are presented in Section 5.2 NON-RETAINED SPECIES. These assessments indicate that the performance of the SBS fishery is currently adequate in not threatening any of the bycatch (non-retained) species and is therefore meeting objectives 1 and 2 of Principle 2.



Information Requirements

1.1.1 Reliable information, appropriate to the scale of the fishery, is collected on the composition and abundance of bycatch.

In July 2000, a two-year FRDC funded research program on the implementation of bycatch reduction devices began. This included an observer program designed to record, identify and quantify bycatch in the SBS fishery.

Assessments

1.1.2 There is a risk analysis of the bycatch with respect to its vulnerability to fishing.

A formal risk assessment for each of the identified non-retained/bycatch species (including those with direct interaction but no capture) was completed (see Section 3.4 for details). In the capture category for non-retained species, this assessment concluded that the SBS fishery was a negligible risk to discarded fish and invertebrates.

Discarded Fish – Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

Since scallop trawling is a non-selective form of fishing other species such as adult small species and juveniles of other larger fish are caught. Since these fish are generally not of commercial value, they are discarded overboard. Generally, a low amount of discards is generated from this fishery (of the order of 20 individuals per tow) given the large mesh size (100mm) that is used. Consequently, the Risk Assessment concluded that the SBS fishery would only have a negligible impact on each of these species. For full details see 5.2.1.5.

Invertebrates – Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

The configuration of the trawl gear and the mesh size largely precludes the capture of invertebrate species living on or in the substrate. This design minimises the capture of invertebrates other than scallops. Consequently, the Risk Assessment concluded that the SBS fishery would only have a negligible impact on each of these species. For full details see 5.2.1.6.

Management Responses

1.1.3 Measures are in place to avoid capture and mortality of bycatch species unless it is determined that the level of catch is sustainable (except in relation to endangered, threatened or protected species). Steps must be taken to develop suitable technology if none is available.

As a result of the introduction of at least one BRD on one side of each licensed boat in 2002 and with two BRDs per boat required in 2003 by this fishery, it is expected that the quantity and likelihood of bycatch captures will be further minimised. During the 2002 season, observer programs will be conducted to monitor bycatch. Following the observer program, data will be collected by fishery dependent means.

1.1.4 An indicator group of bycatch species is monitored.

The minimal risks associated with this group of non-retained species, results in it being unnecessary to monitor any of these species on a regular basis.

1.1.5 There are decision rules that trigger additional management measures when there are significant perturbations in the indicator species numbers.

The risks associated with this group of species will be reassessed at the next major review of this fishery. This will occur within five years as a requirement of the WA ESD policy.

1.1.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Given the relatively low levels of interactions of the SBS fishery with non-retained species and the introduction of BRDs within the next two seasons makes it likely that there will continue to be only minimal and acceptable levels of impact on this group of non-threatened/not protected species by the SBS fishery.

OBJECTIVE 2.

The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities

Information Requirements

1.1.1 Reliable information is collected on the interaction with endangered, threatened or protected species and threatened ecological communities.

Monitoring programs, based upon the information collected by the on-board observers, are now in place for cetaceans, dugongs, turtles, syngnathids and seasnakes. The logbooks also contain the ability to record interactions with each of these species. Previously the only information available was from the sparse data collected by CALM, which has the legislative responsibility for these species within WA waters.

Asssessments

1.1.2 There is an assessment of the impact of the fishery on endangered, threatened or protected species.

A formal risk assessment for each of the identified non-retained/bycatch species (including those with direct interaction but no capture) was completed (see Section 3.4 for details). In the capture category for non-retained species, this assessment concluded that the SBS fishery was a negligible risk to green turtles; and low risk to seasnakes, syngnathids and loggerhead turtles. For the direct interaction but no capture category for non-retained species, this assessment concluded that the fishery was of low risk to cetaceans, dugongs, loggerhead and green turtles.

Capture

Loggerhead Turtles – Summary

ERA Risk Rating (C1 L3 LOW)

A relatively small number of Loggerhead turtles have been incidentally caught in the SBS fishery with nearly all released alive due to the short durations of the tows. A full management report has been prepared for this issue that canvases an approach and management response for this issue (Section 5.2.1.1). As BRDs have been installed in this fishery, these will effectively eliminate the capture of loggerhead turtles as a potential problem.

Green Turtles - Summary

ERA Risk Rating (C0 L5 NEGLIGIBLE)

There have been few reports of green turtles being caught in a trawl net through the fishery's duration. This is probably due to the fact that green turtles prefer to reside in seagrass habitats from which trawlers are excluded from and/or avoid. For full details see 5.2.1.2.

Syngnathids – Summary

ERA Risk Rating (C1 L2 LOW)

Syngnathids are occasionally incidentally caught in the SBS fishery and are generally discarded, presumed to be dead. Results from an observer program for the prawn trawling fisheries suggests that very low numbers of syngnathids are caught in the order of 1 per night across the entire fleet. The number caught by the scallop fleet is likely to be lower than this, given the larger mesh sizes and slower speeds used by the fleet. A full rationale for the minor risk rating for syngnathids is documented in section 5.2.1.3.

Seasnakes – Summary

ERA Risk Rating (C1 L2 LOW)

Seasnakes are regularly caught in low numbers in the fishery but are generally returned to the water in a live state and have relatively good survival following their return to the water. The full rationale for the minor risk rating for seasnakes is documented in section 5.2.1.4.

Direct Interaction but no Capture

Green and Loggerhead Turtles – Summary

ERA Risk Rating (C1 L4 LOW)

The Draft Turtle Recovery Plan developed by the Commonwealth government states that there has been no evidence of any additional impact (besides occasional capture) between trawl fleets and turtle populations. Additionally, due to the slow speeds at which the vessels trawl it is unlikely that any interaction between the turtle and the vessel hull would occur since the animal can move from its path. The full rationale for the minor risk rating for green and loggerhead turtles is documented in section 5.2.2.1.

Cetaceans & Dugongs – Summary

ERA Risk Rating (C1 L3 LOW)

There has been no evidence or record of a dugong capture or interaction over the period of the fishery, which is in excess of 30 years. For full details see 5.2.2.2.

1.1.3 There is an assessment of the impact of the fishery on threatened ecological communities.

There are no threatened ecological communities associated with the SBS fishery.

Management Responses

1.1.4 There are measures in place to avoid capture and/or mortality of endangered, threatened or protected species.

As previously mentioned above in 2.1.3, with the introduction of at least one BRD in 2002 and two in 2003 by this fishery, it is expected that the quantity and likelihood of bycatch captures will be minimised. Since the 2002 season, observer programs have been conducted to monitor bycatch. Following the observer program, data will be collected by fishery dependent means.

1.1.5 There are measures in place to avoid impact on threatened ecological communities.

Not applicable.

1.1.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

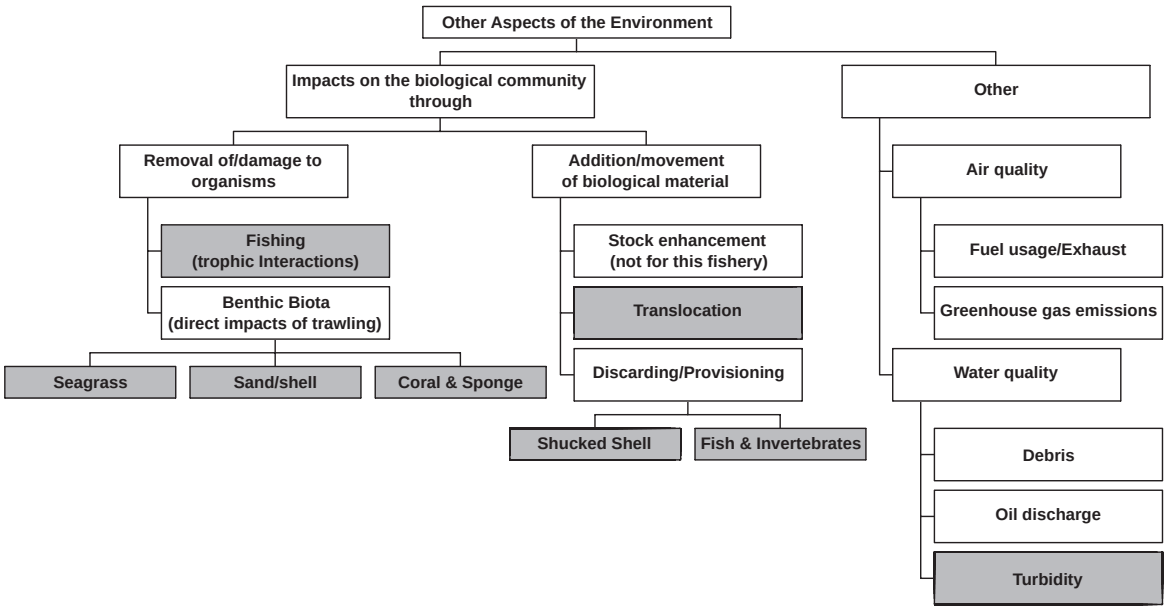
Given the relatively low levels of interactions of the SBS fishery with non-retained species and the introduction of BRDs , it is likely that the current situation of only having minimal and acceptable levels of impact on these threatened species by the SBS fishery will continue or diminish further. Nonetheless, as monitoring data becomes more available, the suitability of the current performance limits may need to be reviewed. If they are inappropriate and/or the level of interactions increases, appropriate alterations to practices will be taken.

OBJECTIVE 3. GENERAL ECOSYSTEM

The fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally

The issues that relate to the broader ecosystem identified for the SBS fishery are shown in the following component tree. A formal risk assessment process subsequently assessed each of these issues with the information relating to each issue detailed in Section 5.3.

Of the seven issues identified for the SBS fishery, two (impacts on sand/shell and coral/sponge habitat) were rated as moderate risk, two (impact of taking retained and non-retained species and discarding fish) were rated as a low risk and three (discarded shell, translocation and turbidity) were rated as negligible. Consequently, the SBS fishery's current performance is meeting Objective 3 and this acceptable performance is likely to at least continue or improve in the future.



Information Requirements

1.1.1 Information appropriate for the analysis in 2.3.2 is collected and/or collected covering the fisheries impact on the ecosystem and environment generally.

Appropriate levels of information have been obtained for most of the issues identified, which has allowed for a sensible assessment of the level of risk to be determined. This information includes data directly related to the SBS fishery in terms of the stock assessment and status of scallop stocks, levels of catch and effort, gear designs, area swept by the fleet and understanding of spatial and temporal closures. There are a number of research publications that provide valuable evidence on the effects of otter-trawling on sand, seagrass and coral communities, and trophic structures in similar fisheries/ environments in other parts of Australia and elsewhere.

In cases where the level of information was insufficient, processes are already in place to remedy this situation to enable a more informed decision to be made (e.g. distribution of different environments in Shark Bay, distribution of fish species within and outside trawled grounds, and composition and abundance of fish and invertebrate species within various habitats in trawled and untrawled areas). Consequently, the levels of information available for most issues identified allowed a sensible assessment of the level of risk to be determined.

Assessments

1.1.2 Information is collected and a risk analysis, appropriate to the scale of the fishery and its potential impacts, is conducted into the susceptibility of each of the following ecosystem components to the fishery.

A formal risk assessment was completed (see Section 5.3 for details) on each of the identified issues relevant to the SBS fishery (see component tree for issues). The identified issues that were assessed and a summary of the outcomes are located in Table 5 – complete justifications are located in the performance reports in Section 5.3.

Table 5. Summary of risk assessment outcomes for environmental issues related to the SBS fishery.

ISSUE	RISK	SUMMARY JUSTIFICATION	FULL DETAILS
TROPHIC INTERACTIONS			
Impact of taking retained and non-retained species from the environment	LOW	Hardly any material is taken by the scallop fleet. None of the species taken are known to be an exclusive food source for a predator.	5.3.1.1
IMPACTS ON BENTHIC BIOTA:			
Sand/shell	LOW	The area open to trawling by the scallop fleet is only 27% of the Shark Bay region. A GIS analysis of the areas actually trawled indicate that less than 12% of the area is subject to trawling and in the last 5 years this has only occurred for less than a 2 month period. Thus there are many areas that are protected from any impact. Studies elsewhere have shown only minor and short-lived damage from this type of trawling in sandy areas.	5.3.1.2
Coral/sponge	LOW	Scallop trawlers do not operate in coral/ sponge habitats.	5.3.1.3
ADDING OR MOVING MATERIAL			
Discarding fish (provisioning)	LOW	The low number of fish discards combined with the large area over which the organisms are discarded results in any impacts being diffused. Introduction of BRDs will reduce the amount of bycatch generated by this fishery, which in turn reduces amount of discards.	5.3.2.1

ISSUE	RISK	SUMMARY JUSTIFICATION	FULL DETAILS
Translocation	NEGLIGIBLE	Vessels in Shark Bay have limited interaction with fisheries in other biogeographic regions. Although most vessels do move to Fremantle for seasonal maintenance, the Leeuwin Current provides a natural connection between Fremantle and the trawl grounds. Most vessel hulls undergo refit (which includes cleaning of the hull) at the commencement of each season before movement to the trawling grounds. So there is negligible chance of moving material into the Shark Bay region.	5.3.3.2
Discarding Scallop Shells	NEGLIGIBLE	In Shark Bay boats are large so shucking is undertaken continually and shells are widely distributed, i.e. merely adding back to environment what would have been there anyway.	5.3.2.2
Turbidity	NEGLIGIBLE	Turbidity caused by trawling is insignificant compared to that caused by the natural water movements due to the strong currents and tides in Shark Bay and relatively coarse sands in trawl grounds (Hall and Penn, 1979).	5.3.3.1

Thus, all of these issues were rated as NEGLIGIBLE or LOW risk.

Management Responses

1.1.3 Management actions are in place to ensure significant damage to ecosystems does not arise from the impacts described in 2.3.1.

The most important management action that ensures there is minimal impact on the broader ecosystem is to ensure that there is an adequate level of spawning stock to ensure recruitment is not affected by spawning stock abundance. Furthermore, while scallops are filter feeders, removing small organic material and particulates from the surrounding water they are only one of a large number of such feeders in this region. Furthermore, they are not the sole prey for any species. It should also be noted that recruitment and stock abundance are highly variable from year to year and therefore the ecosystem does not depend on relatively static levels of scallop stock abundance. Consequently, by ensuring adequate levels of spawning stock serves to achieve two objectives (e.g. a sustainable fishery and minimising impacts on any trophic interactions). Other management measures such as gear restrictions, spatial and seasonal closures and limiting the number of operating vessels also further minimise the potential for

impacts on bycatch species and other indirect impacts. In addition, planned future research will help to further minimise the potential for impacts in the future by expanding our knowledge of the broader ecosystem.

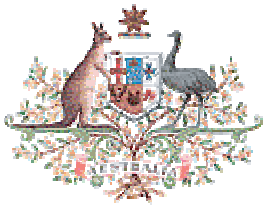
1.1.4 There are decision rules that trigger further management responses when monitoring detects impacts on selected ecosystem indicators beyond a predetermined level, or where action is indicated by application of the precautionary approach.

None of the issues was found to be of sufficient risk to require specific target levels as they are effectively covered by the other management arrangements and trigger points (e.g. recruitment level of scallops). However, the management arrangements are sufficiently flexible and dynamic to be capable of responding to a future problem.

1.1.5 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Given the risk assessment identified that under current management arrangements there have been minimal or negligible impacts from the SBS fishery on the broader ecosystem even after around 30 years of fishing, it is highly likely that the fishery will continue to meet the objectives of having acceptable levels of impact. If future studies indicate that further management is required for various habitat types and the composition and abundance of by-product and/or bycatch species, then appropriate actions will be developed.

APPENDIX 8. APPROVAL AND RECOMMENDATIONS FROM EA



THE HON. DR. DAVID KEMP MP
MINISTER FOR THE ENVIRONMENT AND HERITAGE

The Hon Kim Chance MLC
Minister for Agriculture, Forestry and Fisheries
11th Floor, Dumas House
2 Havelock Street
WEST PERTH WA 6005

Dear Minister

In November 2001 the Western Australian Department of Fisheries (WADF) submitted the document *Application to Environment Australia for the Shark Bay Scallop Fishery Against the Guidelines for the Ecologically Sustainable Management of Fisheries for Continued Listing on Section 303DB of the Environmental Protection and Biodiversity Conservation Act 1999* for assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The submission has been assessed in accordance with the protected species provisions of Part 13 and the wildlife trade provisions of Part 13A of the EPBC Act.

I am pleased to advise that assessment of the fishery is now complete. The assessment report will be available on the EA website at: http://www.ea.gov.au/coasts/fisheries/index.html.

I am satisfied that it is unlikely that fishing operations conducted in accordance with the management arrangements will adversely affect the conservation status of protected species, or affect the survival and recovery of threatened species. The *Shark Bay Scallop Management Plan 1994* requires that all reasonable steps are taken to ensure that protected species are not injured or killed and the level of interactions with such species in the fishery is not likely to adversely affect the conservation status of protected species or the survival and recovery of listed threatened species. Hence, the management arrangements for the Shark Bay Scallop (SBS) fishery meet the requirements of Part 13 of the Act and I propose to accredit the plan accordingly. Accreditation will ensure that individual fishers operating in accordance with the plan are not required to seek permits in relation to interactions with protected species in Commonwealth Waters.

I am satisfied that for the purposes of the wildlife trade provisions in part 13A of the EPBC Act, the management arrangements provide the basis for the fishery to be managed in an ecologically sustainable way. I therefore propose to amend the list of exempt native specimens to include all specimens taken in the SBS fishery for a period of five years. Such listing will serve to exempt the fishery from other export controls of the Act and exempt exporters from requiring export permits under the Act.

The SBS management arrangements meet the Commonwealth *Guidelines for the Ecologically Sustainable Management of Fisheries*. The fishery is managed under a comprehensive, adaptable, precautionary and ecologically based regime capable of controlling, monitoring and enforcing the level

of take from the fishery. The combination of management arrangements, data gathering and proposed research provides confidence in the fishery's ability to manage impacts on the wider ecosystem.

While there are some environmental risks associated with this fishery, I believe that DFWA is taking a proactive approach to mitigating these risks and addressing them adequately. Officers from our two departments have discussed some key areas requiring ongoing attention. I understand that they have agreed to a number of recommended actions, focussed on ensuring the continuation of good management practices. The recommendations for the SBS fishery are attached to this letter. I look forward to receiving your agreement in relation to the implementation of these recommendations.

I would like to thank you for the constructive way in which your officials have approached this task and I look forward to reviewing the remainder of the Western Australian managed fisheries.

Yours sincerely

Signed on 11 February 2003

DAVID KEMP

Recommendations to the Western Australian Department of Fisheries on the ecologically sustainable management of the Shark Bay Scallop Fishery

1. Opportunity should be provided to conservation, community, recreational fishing and world heritage area management interests to participate in the processes of the main advisory body to the WA Fisheries Minister for this fishery. DFWA should also ensure that any relevant indigenous interests are considered through appropriate consultative mechanisms.

2. The ESD report, including all performance measures, responses and information requirements, should be formally incorporated into the management regime and decision making process within one year, with a clear timeframe for implementation.

3. EA should be informed of any changes to the management plan or managerial commitments in the ESD report.

4. The ESD report should be amended to incorporate time frames for all management responses to breaches of performance measures.

5. The implementation of a decision rule to close the fishery or prevent commencement of the fishing season, when recruitment of scallops is sufficiently low, should be pursued as a priority.

6. Permitted byproduct should be limited to species currently harvested, with a robust system developed to add or remove species as appropriate. Suitable catch triggers should be developed to ensure any change in targeting behaviour can be detected and addressed as it occurs. Management responses should be clarified, with timeframes for implementation, to address such changes, so that the management arrangements are able to minimise threats to byproduct species.

7. DFWA should participate in any cross-jurisdictional activities regarding relevant target and byproduct species, including squid.

8. Ongoing monitoring should be implemented sufficient to identify long-term trends in bycatch between fished and unfished areas to ensure that information used in the risk assessment for the fishery remains based on accurate and current data.

9. The importance of specific areas and habitats to applicable bycatch species during all stages of their life cycle should be considered when applying the results of biodiversity research to management arrangements.

10. A mechanism should be developed to enable the amendment of management arrangements to respond to new information or future Government plans and policies.

11. All protected species interactions by commercial operations should be reported and coupled with an education program to ensure industry has the capacity to make accurate reports.