



**PRIMARY INDUSTRIES
AND RESOURCES SA**



SOUTH AUSTRALIAN FISHERIES MANAGEMENT SERIES

Ecological Assessment of the South Australian Sea Urchin Fishery

Assessment Report Prepared for Environment Australia, against the *Guidelines For
The Ecologically Sustainable Management Of Fisheries*

For the purposes of Part 13 and 13(A) of the *Environment Protection and Biodiversity
Conservation Act 1999*

August 2004

Prepared by the Agriculture, Food and Fisheries Division of Primary Industries &
Resources, South Australia

25 Grenfell Street, Adelaide
GPO Box 1625 ADELAIDE 5001

Ecological Assessment of the South Australian Sea Urchin Fishery

Assessment Report Prepared for Environment Australia, against the *Guidelines For The Ecologically Sustainable Management Of Fisheries*. For the purposes of Part 13 and 13(A) of the *Environment Protection and Biodiversity Conservation Act 1999*.

August 2004

Primary Industries and Resources South Australia
GPO Box 1625
ADELAIDE SA 5001
www.pir.sa.gov.au

ph (08) 8226 2316
fax (08) 8226 0434

FOREWORD

The marine, estuarine and freshwater fisheries resources of South Australia are community owned resources. The role of the Government, as custodian of these resources on behalf of the broader community and future generations, is to ensure that they are used in an ecologically sustainable and economically efficient manner, while at the same time maximising returns to the community.

Experience world-wide has demonstrated that where unrestricted use of fisheries resources is allowed, there is little incentive for individuals involved in harvesting to conserve fish stocks. The resulting competition among and between user groups often leads to reduced biological and economic productivity. Left unmanaged, the increase in fishing effort that results from competition is reflected in lower individual catches in the recreational fishing sector, and over-capitalisation and reduced financial returns in the commercial fishing sector. Loss of these resources to the community can result in significant regional economic problems.

In managing fisheries resources, Governments have the primary responsibility of ensuring long-term sustainability. Governments must also ensure that the basis for sharing fisheries resources among all users is clearly understood and accepted as equitable, and that the allocation of fisheries resources and their level of utilisation are consistent with the needs of present and future generations.

To facilitate better decision-making by the Government in managing South Australia's fisheries resources, a number of fishery-specific stakeholder-based fishery management committees have been established to provide expertise-based advice to the Minister for Agriculture, Food and Fisheries. These committees are comprised of Government managers, research scientists, commercial and recreational fishers, fish processors and members of the general community. Each of these committees is convened by an independent chairperson. Appointment of members and the terms of reference of the committees are embodied in the *Fisheries (Management Committees) Regulations 1995*.

Where there are considered to be threats of serious or irreversible damage to fisheries resources, or the environment upon which they depend, a lack of full scientific certainty or insufficient information will not prevent the Government from making a resource management decision. Where resource management decisions must be made in an environment of uncertainty the Government, in partnership with the fisheries management committee, will take a precautionary approach to the management of South Australia's fisheries resources.

Hon Rory McEwen MP
MINISTER FOR AGRICULTURE, FOOD AND FISHERIES
MINISTER FOR STATE/LOCAL GOVERNMENT RELATIONS
MINISTER FOR FORESTS

/ /2004

PURPOSE OF REPORT

Primary Industries and Resources South Australia (PIRSA) Fisheries, have prepared this report.

The purpose of this report is to provide Environment Australia with comprehensive detail of the management arrangements for the South Australian sea urchin fishery, against the *'Guidelines For The Ecologically Sustainable Management Of Fisheries'*, set out in the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act).

It is intended that this report serve as the first step in the process to have sea urchins taken from South Australian waters, placed on the list of exempt native species for export, under Part 13 and 13(A) of the EPBC Act, for the five year period from 1 January 2004 to the 31 December 2008.

CONTENTS

FOREWORD	3
PURPOSE OF REPORT	4
CONTENTS	5
A. INTRODUCTION	6
A.1 DESCRIPTION OF THE FISHERY	6
A.2 BACKGROUND	6
A.2.1 HARVESTING	8
A.2.2 EXPORT MARKETS.....	10
A.2.3 BIOLOGICAL CHARACTERISTICS OF THE SEA URCHIN SPECIES <i>HELIOCIDARIS</i> <i>ERYTHROGRAMMA</i>	10
A.3 MANAGEMENT OF THE FISHERY	12
A.3.1 REVIEW OF THE MANAGEMENT REGIME	12
A.3.2 CONTEXT OF THE MANAGEMENT PLAN.....	12
ESD ASSESSMENT OF THE MANAGEMENT REGIME AGAINST PRINCIPLES 1 AND 2	16
PRINCIPLE 1	16
1.1. OBJECTIVE 1	16
1.2. OBJECTIVE 2	23
PRINCIPLE 2	24
2.1. OBJECTIVE 1	24
2.2. OBJECTIVE 2	24
2.3. OBJECTIVE 3.....	25
REFERENCES	26

A. INTRODUCTION

A.1 Description of the fishery

In South Australia (SA) the harvesting of sea urchins is a relatively small, but growing industry. Interest in harvesting has resulted from an ever-increasing demand for quality sea urchin roe delivered into well-established international markets. The exploitation of a natural marine resource for financial gain is regarded as a commercial activity under the terms of the *Fisheries Act 1982* ('the Act'). Accordingly, the harvesting of sea urchins from any marine waters of the State is under the care, control and management of the Fisheries Group of Primary Industries and Resources South Australia (PIRSA).

The ecology and biology of sea urchin species from around the world has been extensively explored over the past few decades, however the information available on the status of sea urchin fisheries, their sustainability and their impacts on the surrounding marine ecosystem is very limited, and almost non-existent for the South Australian commercial sea urchin fishery. However, the limited development of sea urchin harvesting previously in South Australia and lessons learnt from the collapse of some of the world's largest sea urchin fisheries from other parts of the world, has driven the potential development of a sustainable sea urchin fishery in South Australia.

A.2 Background

Sea urchin gonads (roe) have been consumed by humans since pre-historic times and can constitute up to 10% of an urchin's total body weight (Lawrence 2001). The USA, Chile and Japan are currently the world's major producers of sea urchin roe, considered a delicacy in many countries (Keesing and Hall 1998). The majority of world sea urchin production is imported into Japan, where sea urchin roe is regarded as a premium seafood product and consequently has a strong demand.

In 1996 Japan imported over \$360 million worth of sea urchin roe from a world fishery in marked decline. These fisheries, principally in the US and Chile developed largely unregulated after the collapse of the Japanese urchin fishery and are now themselves in decline with little prospect for recovery (Keesing and Hall 1998).

The unexplained decline of Japan's local urchin populations and subsequent decrease in local production has been a major contributor to increased demand for imported roe (Keesing and Hall 1998). The growing demand for sea urchin roe has increased pressure on urchin populations around the world, with catches either declining or reaching their peak in most producing

countries. The general decline of natural sea urchin populations in major producing countries has led to an exploration of alternative production methods including sea urchin aquaculture and roe enhancement practices (Keesing and Hall 1998).

In 1982 the world sea urchin harvest was predicted to be 48,000 tonnes. By 1998, world harvest had increased to an estimated 117,000 tonnes (Australia contributed approximately 93 tonnes – whole weight) (Keesing and Hall 1998).

There are at least 16 species of sea urchin harvested for human consumption around the world, however in Australia only three species have been commercially exploited; *Heliocidaris erythrogramma* in Tasmania, Victoria and South Australia, *Centrostephanus rodgersii* in NSW and eastern Victoria and *Heliocidaris tuberculata* in NSW and Eastern Victoria (Worthington and Blount 2003). The sea urchin fishery in Australia is largely unexploited due to varying product quality, high production costs and a failure to establish regular export markets. Although there is potential for expansion, these factors limit Australia's ability to become a major producer such as the USA, Chile or Japan (Keesing and Hall 1998).

Sea urchin stocks in Australia are extensive, but largely unexploited due to low rates of recovery (amount of roe per urchin), variation in roe quality (colour and texture) and variation in rate of recovery (in any batch of urchins there will be a wide range of recovery rates). All these factors together with the propensity of sea urchin fisheries to collapse through over harvesting, affect marketability and economic feasibility and therefore the viability of a traditional fishery. In 1996 Australia exported only 700 kg of urchin roe to Japan with a total value of \$60,000 or \$85 per kg (includes both A and B grade roe). Over the same period the USA received on average only \$67 per kg. Peak prices paid for Tasmanian A grade *Heliocidaris erythrogramma* sea urchin roe in Japan in 1995 were \$250 per kg. South Australia, Victoria and Tasmania have divers licensed to collect urchins. Viability has been marginal due to low recovery rates, with profitability limited to a narrow window for collection.

To develop this fishery the following is required:

1. Increase the recovery rate for A grade roe
2. Increase the period for harvesting.

In South Australia, the only species currently commercially exploited is *Heliocidaris erythrogramma*, commonly known as the purple sea urchin (Rodriguez 2002). Harvesting of this species has been a sporadic activity for many decades in South Australia. The development of the commercial fishery began in early 1999, when five exemptions were granted for commercial harvesting in five zones across the state. These zones were referred to as the West Coast, Eyre, Central, Kangaroo Island and Southern zones. Over the years, the number of exemptions has reduced to two, who are able to harvest urchins throughout South Australia. Harvesting now takes place mainly along the coastlines of Eyre Peninsula and Spencer Gulf. The permits

were initially issued for the purpose of market research and development, to identify potential markets for sea urchin products and to determine if the industry could be viable. Exemptions are reviewed on an annual basis, with no guarantee of renewal from year to year. Currently the South Australian commercial sea urchin fishery is still considered a developmental fishery.

Development of urchin fisheries in Australia is currently limited by economic viability due to low recovery rates. This fishery has an opportunity to expand given:

1. There is a potentially large sea urchin resource
2. The high price urchin roe fetches
3. Low cost of fishing (relatively shallow water).

The opportunity to develop this fishery into a highly profitable one is dependent on the development of innovative solutions such as enhancing recovery rates using supplementary feeding for short periods. If this can be done cost effectively it opens the opportunity to dramatically increase the profitability and size of this fishery. Without this technology the urchin fishery will not fully develop. With this technology the fishery has the potential for growth.

In the absence of scientific data, and through concerns regarding the possibility of over harvesting sea urchin populations and/or significantly impacting on the surrounding marine environment, PIRSA has always adopted a 'precautionary approach' to the harvesting of sea urchins.

A.2.1 Harvesting

The majority of sea urchin harvesting in South Australia, occurs along the Western Coast of the Eyre Peninsula. The main locations of harvest include the Streaky Bay and Coffin Bay areas.

Harvesting of sea urchins usually occurs prior to sea urchins spawning as the quality of the roe is poor during spawning. As a result, the majority of harvesting takes place during May or June to December when peak roe quality and abundance occur. This also corresponds with higher prices and demand in Asia. Spawning usually corresponds with higher water temperatures between January and April.

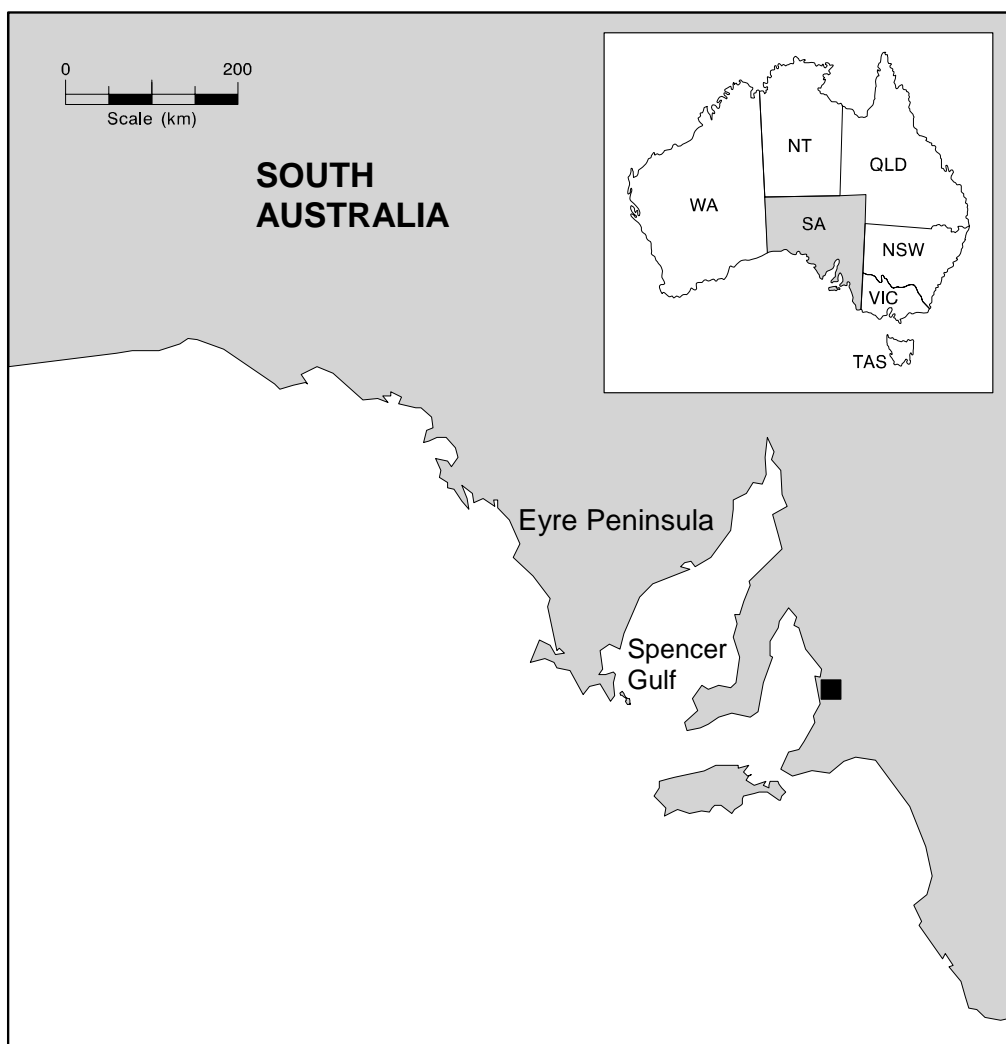


Figure 1: South Australian sea urchin fishing area.

Harvesting occurs from small vessels of approximately 20 feet in length in inshore waters. Sea urchins are hand harvested by divers operating on hookah (compressed air). Whole sea urchins are transported live to Adelaide and are processed by hand.

Harvesters remove approximately 40% of any sea urchins from an area, and only harvest when yield is a minimum of 6.5 – 7%.

Monthly catch data is supplied to SARDI and PIRSA (refer to table 1).

Table 1: Sea Urchin catch and effort data and main fishing area per year since the development of the South Australian commercial sea urchin fishery.

Financial Year	Sea Urchin harvest (kg, live weight)	Fishing Effort		
		Boat Days	Searching Time (hrs)	Fishing Time (hrs)
1996/97	1164	35	N/a	N/a
1997/98	515	9	N/a	N/a
1998/99	170	11	16	3.3
1999/00	12770	118	N/a	N/a
2000/01	1219	77	8.8	40.7
2001/02	1593	34	2.3	22.2
2002/03	1490	58	1.2	25
2003/04	7660	57	7.1	97.8

A.2.2 Export Markets

The apparently large populations of sea urchins throughout southern Australian waters were thought to be sufficient to create a viable and lucrative export industry focusing on whole sea urchins and sea urchin roe delivered to well-established overseas markets (Blount *et al.* 2001). Despite several attempts to expand, there is only limited demand for sea urchin roe in local domestic markets. Until 1999, when the Australian product fetched one of the highest prices on the Japanese market, due to its high quality, there was limited success from numerous attempts to develop an export industry of Australian sea urchin roe (Blount *et al.* 2001). In top Japanese restaurants, individual servings of raw roe (20gm) can reach as much as 5000 Japanese Yen, the equivalent of ~AUD\$4000 per kg (Blount *et al.* 2001). Traditionally, sea urchin roe has been popular in sushi restaurants with most retailers/consumers preferring locally sourced roe over imported products. Today, sea urchin products can be found in local supermarkets, which is much cheaper to buy than from a sushi restaurant, thus opening a market for lower grade imported roe. The USA, Mexico, Chile and Canada export the most roe. However most imports fail to compete with local product at the premium end of the market. The colour, size and texture of the roe is generally used to determine the value of the product on the Japanese market. However, preference for local roe often influences the market price of imported product (Reynolds and Wilen 2000).

A.2.3 Biological characteristics of the sea urchin species *Heliocidaris erythrogramma*

Sea urchins are marine benthic invertebrates and a member of the Phylum *Echinodermata* and class *Echinoidea*. They possess a hard globular exoskeleton, comprised of hundreds of interlocked calcareous plates, numerous protruding sharp spines, tube feet and a mouth located on the underside of the body (Edgar 2001).



Figure 2: Purple sea urchin – *Heliocidaris erythrogramma*

Heliocidaris erythrogramma is the most common sea urchin found in southern Australian waters. Limited studies on the biology and ecology of *H. erythrogramma* have been undertaken (Lawrence 2001). This species is endemic to Australia and inhabits the intertidal rocky reefs down to depths of 35 metres along southern Australian coasts. *H. erythrogramma* is usually 60 to 90 millimetres in diameter, however has been known to reach 125 millimetres in Tasmania. They can be found inhabiting reef crevices in high energy sites, aggregating on rocks or on the muddy benthic communities of seagrass meadows. In South Australia they are commonly found amongst rocks, boulders or crevices of shallow subtidal limestone and granite reefs. *H. erythrogramma* occurs in a broad range of colours including white, green and violet. Colour expression varies between populations and habitats and is considered to be determined either environmentally and/or genetically (Lawrence 2001).

Sea urchins are free-spawners, with both males and females releasing their gametes into the water column, triggered by environmental cues. Previous studies on *H. erythrogramma* have shown that fertilisation success is significantly higher when female and male sea urchins are located within a couple of metres of one another (Lawrence 2001). Generally, spawning occurs during early summer to late autumn. However, reproductive periodicity in South Australia has not been studied. *H. erythrogramma* mature at a diameter of 23 millimetres, however may not spawn until they reach a diameter of 40-50 millimetres. Population replacement in this species has not been studied.

H. erythrogramma mainly moves at night, positioning itself on sites favourable for feeding. Sea urchins feed by grazing on filamentous and encrusting algae found on the substrate, or capturing drift algae and is considered a dominant herbivore in the southern Australian region (Lawrence 2001). Despite many attempts to determine the growth rate and age of individual *H. erythrogramma*, the results of each study were inconclusive.

A.3 Management of the fishery

The potential of developing a commercial sea urchin fishery in South Australia was explored in 1998, when PIRSA sought expressions of interest from fishers interested in an exemption permit to harvest wild sea urchins. In May 1999 five sea urchin exemption permits were allocated after a detailed tender process, one permit per sea urchin zone in South Australia. Despite growing interest from numerous parties for an increase in the number of permits, the experimental nature of the fishery led to it being limited to five exemption holders for a two year trial period. Even though the trial development period ended in March of 2002, PIRSA Fisheries have continued to manage the sea urchin fishery as a limited entry fishery. There are currently only two harvesters operating under exemption.

In addition to the two dedicated sea urchin harvesters, scallop divers (currently five) have access to sea urchins. However, in the past year no scallop divers have reported harvest levels of sea urchin. This may be a reflection of the difficulty in processing the sea urchins and the currently small market for the roe.

A.3.1 Review of the Management Regime

The *Fisheries Act 1982* provides the broad statutory framework to ensure the management and ecologically sustainable development of South Australia's marine and freshwater fisheries resources.

A formal fishery management plan or similar voluntary management program has not yet been developed for the South Australian sea urchin fishery due to its low harvest levels and experimental nature. Instead, the regulations that govern the management of the South Australian sea urchin fishery is established in the *Scheme of Management (Miscellaneous Fisheries) Regulations 1991* and through exemption conditions.

A.3.2 Context of the Management Plan

A 'fish' is defined in Section 5 of the *Fisheries Act*, as: "***an aquatic organism of any species and includes the eggs, spat or spawn, or the body or part of the body (including the shell) of such an organism***".

The taking of all, or any part of, a 'fish', is conducted under the provisions of the Act, which is administered by PIRSA. The *Fisheries Act 1982* endeavors to ensure the sustainable development of the living aquatic resources of the State. The Management Plan is a policy document that is used as a guide in the management of the fishery. The legislative regime supporting this process is as follows:

In the administration of the Fisheries Act, the Minister for Agriculture, Food and Fisheries, the Director of Fisheries and the established fisheries

management committees must pursue the following objectives, outlined in Section 20 of the Act:

Section 20 of the Fisheries Act 1982 states:

20. In the administration of this Act, the Minister, the Director and management committees have as their principal objectives:

(a) ensuring, through proper conservation, preservation and fisheries management measures, that the living resources of the waters to which this Act applies are not endangered or overexploited; and

(b) achieving the optimum utilisation and equitable distribution of those resources.

PIRSA achieves these objectives, in part by:

- *the development of management arrangements for aquatic resources in consultation with stakeholders; and*
- *monitoring and promoting community compliance with legislation and regulations.*

From 1999 the Director of Fisheries began issuing Ministerial exemptions from the *Fisheries Act 1982*, under Section 59 as an interim measure. Permit conditions specify methods of access and harvesting and any relevant restrictions on harvesting activities considered necessary by PIRSA are developed in consultation with other agencies such as Department for Environment and Heritage (DEH) and the Department of State Aboriginal Affairs (DOSAA).

The following conditions regulate the exemption permit holders in the fishery:

Schedule 1:

1. Fish may only be taken from coastal waters of the State including (or excluding – depends on the exclusion holder) the waters of Coffin Bay.
2. The exemption holder may authorise a person to act on his behalf in conducting the exempted activity (the 'nominated person'). Before the nominated person undertakes fishing activity pursuant to this notice, the exemption holder must contact PIRSA Fishwatch 1800 065 522 and provide the following information:
 - The full name of the nominated person; and
 - The residential address of the nominated person.

3. The nominated person may undertake fishing activity pursuant to this exemption for a maximum of 21 days within the period 1 October to 30 June 2004.
4. The exemption holder or the nominated person must be present at all times during which fishing activity is undertaken pursuant to this exemption.
5. The exemption holder (or the nominated person) may have two other persons assisting them at any one time whilst undertaking the exempted activity. The persons assisting the exemption holder must, at all times whilst conducting the exempted activity, remain within 50 metres of the exemption holder.
6. Sea urchins may only be taken by hand.
7. The exemption holder must provide the Director of Fisheries statistical catch and effort information (including zero returns if no fishing operation have been conducted), in the form of a daily log, within 15 days of the completion of each calendar month.
8. The exemption holder must notify PIRSA Fishwatch on 1800 065 522 at least one hour prior to conducting the exempted activity with the following information:
 - Details of the boat that will be used to engage in the exempted activity
 - The intended area of conducting the exempted activity
 - The intended place and time of launching and retrieval of the nominated boat for that day; and
 - The name of the assistants (if any) who will be assisting the exemption holder or the nominated person.
9. The exemption holder or nominated person must allow a PIRSA Fisheries departmental officer to accompany them at any time whilst conducting the exempted activity.
10. The exemption holder or his assistants must not conduct any other fishing activity whilst undertaking the exempted activity.
11. While engaged in the exempted activity the exemption holder (or the nominated person) must carry or have about or near his person a copy of this notice. Such notice must be produced to a PIRSA Fisheries Officer upon request.
12. The exemption holder must not contravene or fail to comply with the Fisheries Act 1982 or any regulations made under that Act, except where specifically exempted by this notice.

The following table outlines the licence conditions for scallop harvesters.

Table 2: Licence Conditions for scallop harvesters

MISCELLANEOUS	
80	Only fish of the following species may be taken pursuant to the licence: SCALLOPS (Family <i>Pectinidae</i>) SEA URCHINS (<i>Heliocidaris erythrogramma</i>)
92	A maximum of only two persons may engage in fishing activities from the registered boat at any one time being any combination of the licence holder, a registered master other than the licence holder, and an agent of the licence holder.
229	The taking of scallops is not permitted from the waters of Coffin Bay southerly of the parallel of latitude 34.30.3'S.
285	The licence holder must not use more than one registered boat at any one time.
293	Fish may only be taken by hand and only by diving from the registered boat.
309	The licence holder may only take scallops from the waters of Coffin Bay in the period between 1 April and 30 November in any year
310	The licence holder must not take scallops in Coffin Bay that are less than 80 mm in size, measured in accordance with the defined method of measurement set out in Clause 8 of Schedule 6 of the <i>Fisheries (General) Regulations 2000</i> .
311	The licence holder must not take more than 500 kilograms of scallops wholeweight from the waters of Coffin Bay in a day
312	The licence holder must not take scallops from the waters of Coffin Bay for more than 2 days in any week
313	In these conditions "Coffin Bay" means the waters of Coffin Bay southerly of the parallel of latitude 34.30.3' S. "day" means a 24 hour period commencing at 0000 hrs, and "week" means 7 consecutive days starting on a Monday and ending on a Sunday

ESD ASSESSMENT OF THE MANAGEMENT REGIME AGAINST PRINCIPLES 1 AND 2

The following sections of this assessment report are presented to address “Guidelines for assessing the ecological sustainability of fisheries management regimes” approved by the Federal Minister for the Environment in August 2000.

PRINCIPLE 1

A fishery must be conducted in a manner that does not lead to over-fishing, or for those stocks that are over-fished, the fishery must be conducted such that there is a high degree of probability the stock(s) will recover.

1.1. OBJECTIVE 1

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

Information Requirements

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

As part of the fishery assessment process administered by SARDI, fishery dependent and independent research data are collected.

Fishery-Dependent Data

Section 46 of the *Fisheries Act 1982* requires the five scallop harvesters, operating under a Miscellaneous Licence and two exemption permit holders, to submit catch and effort return information to the Chief Executive of PIRSA. This information is treated confidentially. The following information is requested from the licence holder:

- The date the fishing activity took place;
- The Port of Landing of the vessel involved in the fishing activity;
- The area fished;
- The species targeted;

- The name and number of each species taken;
- The method used to process the resource; and
- The use made of the resource.

A copy of the monthly log form for sea urchin permit holders is attached as Appendix 1.

Fishery Dependent information should be submitted every month of the life of the licence/permit to:

Chief Executive, PIRSA
C/- PO Box 120
HENLEY BEACH SA 5022

If the sea urchin harvester fails to submit catch and effort information, the Director of Fisheries may recommend the imposition of a substantial fine or term of imprisonment under Section 46 of the *Fisheries Act 1982*.

There have been no reports on sea urchin harvests reported by scallop divers in the past 12 months.

Fishery-Independent Data

Currently, there is no ongoing independent monitoring of the fishery, due to its experimental nature. SARDI have however completed a major project on the post harvest enhancement of sea urchin roe using controlled conditions and supplementary manufactured diets. This project explored the potential of controlling the quality and consistency of roe. In doing so the project also explored the possibility of developing a more sustainable fishery by making it unnecessary to waste sea urchins that do not meet the premium A grade standard, reducing harvest levels.

A project has recently been conducted by the South Australian Research and Development Institute, with the purpose of enhancing the rate of recovery and quality of urchin roe and to reduce variability by holding and feeding post-harvest. The advantage of this approach is that it will control quality and consistency of product and ensure sustainability by making it unnecessary to harvest large quantities of urchins simply to waste the majority that do not meet A grade standard. This project had the following objectives:

- Determine the environmental conditions (time and temperature) under which the roe enhancement can be manipulated.
- Investigate the gonadal growth of sea urchins in response to diets differing in protein:energy content for each of the three reproductive phases - gametogenesis, spent and regeneration.
- Evaluate photoperiod manipulation of the gametogenic cycle as a method of increasing the availability of the highest quality roe.

- Evaluate the best commercial growout options by assessing the technical and relative economic feasibility of both land based (eg abalone) and in-water sub-tidal cage (eg. polyculture with Pacific oysters).
- Determine future research needs for the industry.

The results of this project will be made available upon its completion.

An approach such as that outlined above will allow harvesters to remove poor quality urchins from areas of high density and allow growth of those urchins left un-harvested. This will ensure maximum economic performance of the fishery (ie low quality urchin roe is enhanced and the product is not wasted) and the urchins that remain suffer less competition and are able to breed and grow more efficiently.

Assessment

1.1.2. There is a robust assessment of the dynamics and status of the species/fishery and periodic review of the process and the data collected. Assessment should include a process to identify any reduction in biological diversity and/or reproductive capacity. Review should take place at regular intervals but at least every three years.

There is currently no research basis from which to determine ecologically sustainable sea urchin fishing effort. There is also limited historical records of catch and effort data for the fishery due to its infancy and experimental nature. Given the lack of quantitative scientific data from which to establish a sustainable harvest level, there are good commercial and conservation motives for adopting a precautionary and structured approach to harvesting sea urchins and avoiding a rapid development of the fishery before the wider and more long-term impacts of this activity on dependent coastal ecosystem processes have received some scientific attention.

1.1.3. The distribution and spatial structure of the stock(s) has been established and factored into management responses.

The documented information of sea urchin *H. erythrogramma* population dynamics in South Australia is virtually non-existent. However it can be expected that they exhibit similar behavior and structure characteristics of this species and similar species in NSW and Victoria, on which numerous studies have been completed. Studies in Victoria and NSW have shown that densities of *H. erythrogramma* vary at a range of spatial scales, with the density of small individuals considered low. *H. erythrogramma* larvae have a limited ability to disperse and fertilization success requires males and females to be located in close proximity of one another, making recruitment and replenishment of depleted stock from another location limited (Worthington and Blount 2003 and Lawrence 2001).

High density aggregations of sea urchins have caused devastating impacts on important ecological communities by creating urchin barrens (experienced in

Victoria, NSW and Tasmania). The extreme level of this is when high density feeding fronts (experienced in Victoria and NSW) are created, where sea urchins have literally devastated large areas of seagrass meadows, over a short period of time (Lawrence 2001). The South Australian commercial fishery could be potentially helping to prevent these instances occurring in South Australia. However there is still a requirement to keep sea urchin populations at a sustainable level.

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

Although some studies have attempted to quantify the amount of sea urchin biomass available to harvest in NSW and Victoria, no such studies have been completed for South Australia. As a result it is felt that the most appropriate approach is to apply a precautionary principle and ensure the level of harvest is contained at low levels until there is sufficient evidence to support a sustainable increase in harvest. On this basis, the management approach to regulating the fishery is through the use of input controls, such as limiting the number of entrants to the fishery, their harvesting operations and to some degree the area they can fish. It is an objective that through proposed monitoring programs, a data basis upon which to determine ecologically sustainable sea urchin levels be determined.

Commercial Harvest

Since 1999, South Australian commercial sea urchin harvesters have provided data on their fishing activities each month to SARDI Aquatic Sciences (refer to table 1). Fishers are required to provide information on species harvested, weight of each species harvested and the exact location of the harvesting activity in order to maintain their exemption permit.

Recreational and Indigenous

The recreational and indigenous take of sea urchins for human consumption in South Australia is currently not studied and there are no size, bag or boat limits set for any species of sea urchin. However it is considered to be quite low, due to the limited demand for sea urchin products on the local domestic market with a corresponding low interest in recreational harvest. Additionally, the requirement of a boat and diving apparatus to access and obtain a significant amount of catch from most sea urchin populations would be a further limiting factor on recreational harvest.

The National Recreational and Indigenous Fishing Survey reported extremely low recreational harvest and total catch estimates for sea urchins for South Australia. In South Australia there was estimated to be a total annual catch of 147 (numbers) sea urchins across South Australia, with only 45% retained (Jones, unpublished data).

In addition to removals by commercial harvesters and recreational/indigenous harvesters, the South Australian Museum and the Malacological Society are permitted, under exemption to harvest marine organisms, including sea urchins for scientific purposes.

The quantities removed are small and reports are submitted on the species, number harvested and the area of harvest. There is no record of any harvest of sea urchins under this exemption in the past 12 months.

1.1.5 There is a sound estimate of the potential productivity of the fished stock/s and the proportion that could be harvested.

In light of the difficulties in quantifying the amount of sea urchins available to harvest, it is felt that the most appropriate approach is to apply the precautionary principle and ensure the level of harvest is contained by limiting the numbers of entitlements to the fishery and restricting the take through input controls. As PIRSA Fisheries moves the management of the sea urchin fishery toward a Miscellaneous licence rather than under exemption, a management plan with associated research strategies will be developed. This will include the development of research to estimate fishery productivity, biomass and other biological factors.

Management Responses

1.1.6. There are reference points (target and/or limit) that trigger management actions including a biological bottom line and/or a catch or effort upper limit beyond which the stock should not be taken.

Performance indicators, reference points and management responses have not been developed for the South Australian sea urchin fishery. Sea urchin populations in South Australia have only been opened to commercial exploitation since early 1999 and since then commercial harvest is usually sporadic with low levels of catch obtained. The fishery is still going through a developmental phase and as such no structured management arrangements have been developed since the fishery first opened. The management arrangements have so far been developed on an *ad hoc* basis, incorporating a precautionary approach through the use of input controls such as limited access to manage the fishery. This will continue until sufficient information is obtained (through dependent data collection from the two exemption holders and five Miscellaneous Fishery Licence holders and results of independent research and monitoring of other sea urchin fisheries) to make an informed decision on the fishery's future and management regime.

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

The market for sea urchins currently places many restrictions on the fishery. For instance, there is a peak season of demand in Asia for sea urchin roe. Additionally, the market dictates that they want high quality roe and thus

harvesters have an economic incentive to harvest only when yield levels are high. By harvesting at times of high yield also reduces transport costs compared with transporting large quantities of low quality urchins long distances to processing factories. These factors therefore reduce the need for closed seasons. A more appropriate strategy may be to have regular sampling/survey periods (ie small amount collected monthly) and there must be a minimum recovery rate before fishing occurs.

Input controls such as limiting the number of entitlements, harvesting operations and accessible areas are currently used to manage the fishery, however there is no bag or boat limit currently set to control the level of take from one site. It is important at this time of limited scientific data to maintain limited entry.

Due to the limited dispersal of larvae, proximity dependent fertilisation success and the unlikelihood of replenishment of exploited areas from other locations, there is the potential for over exploitation of sea urchins on a local scale if sufficient densities of sea urchins are not left on exploited sites. This will be especially important for areas with sea urchins which continually produce high quality roe. Currently there are no conditions limiting the amount of sea urchins a diver can remove from one site, however anecdotal evidence suggests divers maintain high diversity levels by using a system of removing approximately 40% of urchins present on the site, to ensure recruitment for the following season. Other strategies used to promote the production of high quality roe includes the removal/translocation of old/large urchins from dense populations and translocating young/small urchins to areas of lower density. These techniques have been shown to be successful in increasing roe quality and yield (Worthington and Blount 2003). However the effects of this on sea urchin populations and the surrounding marine ecosystem has not been explored.

The harvesting and removal of sea urchins is prohibited from:

- All Aquatic Reserves proclaimed under the *Fisheries Act 1982*.
- Foreshore adjacent to land under the care, control and management of the Minister of Environment, Heritage and Aboriginal Affairs and gazetted as a reserve under the *National Parks and Wildlife Act 1972*, *Wilderness Act 1992*, *Crown Lands Act 1929* or the *Coast Protection Act 1972*.
- Areas adjacent to lands under the management of the Department of Defence.
- Foreshore restricted by Local and/or District Councils for the purpose of non- development, recreation or conservation reserves.

Commercial fishing

Commercial harvest is managed under the *Scheme of Management (miscellaneous Fisheries Regulations 1991)* and Ministerial exemptions from the *Fisheries Act 1982*, under Section 59.

Recreational Fishing

The recreational and indigenous take of sea urchins for human consumption in South Australia is currently not studied and there are no size, bag or boat limits set for any species of sea urchin. However it is considered to be quite low, due to the limited demand for sea urchin products on the local domestic market and the requirement of a boat and diving apparatus to access and obtain a significant amount of catch from most sea urchin populations.

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

Each licence or exemption permit, contains specific regulations outlining the methods of harvesting allowed (type and number of items of harvesting apparatus, exclusion zones). The South Australian sea urchin fishery is target-specific (i.e. hand selected harvesting), with negligible bycatch and therefore is not believed to threaten any stocks of species inhabiting the same area.

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

Continued monitoring and assessment as the fishery develops and continued use of management controls including input controls supported by licensing and exemptions, will ensure that this fishery remains sustainable in the long-term. However, uncertainties in the biomass available for harvesting give reason to be particularly cautious at this early stage of development. Thus, PIRSA will continue to adopt a 'precautionary approach' to the harvesting of sea urchins by maintaining current licence and exemption conditions until sufficient evidence is available to determine the future of the fishery and its management regime, or until catch levels of urchins become more structured or increase considerably, raising concerns of over exploitation of the fishery.

Additional management conditions and the development of a formal management plan for this fishery, will be undertaken as the fishery moves to management through a Miscellaneous Fishery licence.

1.2. OBJECTIVE 2

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

Management Responses

1.2.1 A precautionary recovery strategy is in place specifying management actions, or staged management responses, which are linked to reference points. The recovery strategy should apply until the stock recovers, and should aim to the biology of the stock;

A precautionary recovery strategy has not been developed for the South Australian sea urchin fishery. Sea urchin populations in South Australia have only been opened to commercial exploitation since May 1999. The fishery is still going through a developmental phase with a low level of operators and as such no structured management arrangements have been developed since the fishery first opened. The management arrangements have so far been developed on an *ad hoc* basis, using input controls such as limited access to manage the fishery. This will continue to be restricted until sufficient information has been collected and made available on all aspects of the fishery.

1.2.2 If the stock is estimated as being at or below the biological and/or effort bottom line, management responses such as a zero targeted catch, temporary fishery closure or a 'whole of fishery' effort or quota reduction are implemented

Management responses such as those outlined above are not applicable at this time due to the relatively short time frame and sporadic harvest effort of the current fishery.

PRINCIPLE 2

Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem.

2.1. OBJECTIVE 1

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

The South Australian sea urchin fishery is target-specific (i.e. hand selected harvesting) and therefore has no bycatch.

2.2. 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.

Diving and taking sea urchins by hand is the only method authorised to harvest sea urchins. This allows divers to be target specific, eliminating problems associated with non target species and benthic communities. A combination of using small fishing vessels, a restricted number of divers, limited time divers can remain submerged and low impact harvesting tools minimises the risk of damage to benthic communities, specifically reef, and interaction with endangered, threatened or protected species. As fishing effort to date has been minimal, and historically not specifically localised, benthic damage and possible interaction currently is and will remain at a minimum.

Currently, there is little to no information collected on the interaction between commercial sea urchin fishing and its effects on endangered, threatened or protected species and threatened ecological communities as the fishery is considered insignificant due to the extremely low catch and effort data recorded.

As it is PIRSA's intention to maintain current access restrictions to the sea urchin fishery until a reliable database of information is collected on all of its aspects, mortality of or injuries to endangered, threatened or protected species and ecological communities as a result of harvesting sea urchins will remain negligible.

2.3. OBJECTIVE 3

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

As previously mentioned in this report, extremely minor impacts could be seen in benthic communities through diving as the harvest technique utilised by the sea urchin fishery. In addition, minor impacts could be seen on localised communities e.g. reefs within the food web because of sea urchin harvesting and anchoring of vessels. There is also a belief that the disturbance and harvesting of sea urchin populations can cause a decrease in the biodiversity of the surrounding area. The only potential risk to water quality from sea urchin harvesting would be a spillage of fuel and oil from vessels. However due to the sporadic nature of the fishery, low catch levels, limit of one vessel per permit and historically, not being specifically localised, the impacts would be isolated and have limited consequences.

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

The precautionary nature of the input controls and access granted to this fishery ensures that the development of the fishery will prevent serious ecological impacts. PIRSA will continue to adopt a 'precautionary approach' to the harvesting of sea urchins by maintaining current licence and exemption conditions until sufficient evidence is available to determine the future of the fishery and its management regime, or until catch levels of urchins become more structured or increase considerably, raising concerns of increased ecological impacts or over exploitation of the fishery.

Additional management conditions or the development of a formal management plan for this fishery, will be required if the fishery is to be expanded.

REFERENCES

Blount, C., Worthington, D. and Bell, G. 2001. Japanese YEN for Australian Sea Urchin Roe. Centre for ChemoSensory Research, Sydney.

Edgar, G. J. 2001. Australian Marine Life (revised edition): The plants and Animals of Temperate waters. Reed New Holland, pp: 365

Keesing, J. K. and Hall, K. C. 1998. Review of status of world sea urchin fisheries points to opportunities for aquaculture. Journal of Shellfish Research. Volume 17 (5), pp 1597-1604

Lawrence, J. M. 2001. Edible sea urchins: Biology and ecology. Elsevier. New York

Reynolds, J. and Wilen, J. 2000. The Sea Urchin Fishery: Harvesting, Processing and the Market. Marine Resource Economics, Volume 15. pp 115-126

Rodriguez, J. 2002. Assessing techniques for the direct aging and tagging of the sea urchin, *Heliocidaris erythrogramma*. Honours Thesis. SARDI and Flinders University. SA.

Worthington, D. G. and Blount, C. 2003. Research to develop and manage the sea urchin fisheries of NSW and eastern Victoria. Final Report to Fisheries Research and Development Corporation. Project No. 1999/128