

**INTEGRATED FISHERIES MANAGEMENT REPORT
ABALONE RESOURCE**

FISHERIES MANAGEMENT PAPER NO. 204

Prepared by
Department of Fisheries
168 St Georges Terrace

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EXECUTIVE SUMMARY

This report is the second in a series of Integrated Fisheries Management (IFM) reports required under the Government Policy on IFM. Under this policy, the Executive Director of the Department of Fisheries is required to approve a sustainability report for each fishery, which includes a clear statement on the harvest level.

This report includes information on sustainability and sustainable harvest levels for Western Australian abalone stocks as required under the IFM policy. It also contains additional information on the current state of knowledge of the abalone resource, which provides a broader context for considering allocations. In particular, detailed information is provided on the Roe's abalone resource in the Perth metropolitan area (commercial Area 7/recreational West Coast Zone).

The IFM reports will assist in the process of allocating explicit shares in the use of Western Australia's fish resources and do not establish the initial allocations for use of fish resources. The reports are a statement of what is known about those resources and current use patterns. They will become a primary, but not exclusive, resource for the Integrated Fisheries Allocation Advisory Committee (IFAAC) when forming their recommendations to the Minister on allocations in each fishery.

The IFAAC was established by the Minister for Agriculture, Forestry and Fisheries in October 2004 specifically to advise him on these allocations. The Minister, on consideration of IFAAC's advice, will then make a determination on the allocations to each sector.

The commercial abalone fishery is one of Western Australia's most valuable fisheries with a gross value of production of approximately \$12 million in 2003-2004. Three species, greenlip abalone (*Haliotis laevis*), brownlip abalone (*Haliotis conicopora*) and Roe's abalone (*Haliotis roei*) are fished by commercial divers.

This fishery is regulated by a management plan, under which the fishery is divided into eight management areas. The fishery spans the entire WA coast, although fishing occurs only between the Western Australian/South Australian border and Shark Bay.

The primary management tool is allocated quotas for the commercial fishery. Total Allowable Commercial Catches (TACCs) are determined on an annual basis for each specific species taken in each area. The TACC is allocated to licensees in the form of transferable units of entitlement.

In addition, a number of input controls support the quota management regime, including minimum size limits (which apply to both commercial and recreational abalone fishers), area and seasonal closures. Commercial fishers also have higher size limits in some sectors of the fishery, to 'fine-tune' the fishing impacts on the stocks and enhance market value.

Recreational fishing for abalone occurs over three geographical zones (Southern, West Coast and Northern). Recreational fishing is concentrated in the Perth metropolitan area (within the recreational West Coast Zone), where Roe's abalone is the target species.

The catch and effort of recreational fishers is relatively well known from this area, based on field and telephone surveys. Access issues in this area have resulted in a season of nine hours over six consecutive Sundays, commencing on the first Sunday in November between the hours of 7.00 am and 8.30 am.

In the Northern and Southern Zones outside of the Perth metropolitan fishery, recreational fishing for abalone is less concentrated and catch estimates are less accurate, as surveys have been based on smaller sample sizes and have 'recall bias' as the survey is undertaken at the end of the season. In 2004/05 a phone diary survey has been used which should eliminate most of this bias and provide data of a quality suitable for allocation purposes.

In the areas south of the Perth metropolitan area, particularly between the south-west Capes and on the south coast, some recreational abalone fishing occurs, targeting greenlip and brownlip abalone in deeper waters and Roe's abalone in shallow areas. In these areas, fishing is largely focused around the major coastal towns with boating facilities.

Little is known about the level of customary fishing for abalone undertaken by Indigenous people. However, it is acknowledged that abalone may have significance to coastal Indigenous communities.

Sustainable Harvest Levels (SHLs) for Roe's abalone in the Perth metropolitan region are given in the table below, which includes the three sub-regions for this region. The SHLs are the current best estimates of the total quantity of Roe's abalone that may be taken by the commercial and recreational sectors.

Sub-region	SHL(Tonnes)
North Perth	36 (Range: 30 – 40)
Central Perth	23 (Range: 18 – 26)
South Perth	18 (Range: 15 – 20)
Total	77 (Range: 73 – 83)

The recreational proportion of the Roe's abalone catch taken in the Perth metropolitan region for each sub-region over the period 1997 to 2003 is given in the table below.

Year	Roe's Abalone			
	West Coast			
	North Perth %	Central Perth %	South Perth %	Metro average %
1997	-	-	-	45
1998	-	-	-	58
1999	57	61	6	49
2000	50	77	4	47
2001	56	75	13	56
2002	51	77	8	51
2003	60	73	13	56
2004	49	69	21	48

Data being collected on the recreational catch in 2004/05 is expected to enable the estimation of SHLs for abalone outside the metropolitan region.

INTRODUCTION

Integrated Fisheries Management (IFM) is a Government initiative aimed at making sure that Western Australia's fisheries continue to be managed in a sustainable way in the future. In essence, this new approach involves setting the total sustainable harvest level of fish from each fishery, and then sharing this potential harvest between the commercial, recreational (including charter boats) and customary fishers by means of an allocation process that meets community needs.

Each sector is then managed within the allocated share. A copy of the Government Policy on IFM is available from the Department of Fisheries' website at: www.fish.wa.gov.au

For each resource addressed through IFM, a report must be prepared to provide information on at least the following aspects of the resource and associated fishing activity:

- The current management practices within the fishery.
- Historical catch levels, or estimates of catch, by each sector.
- The biology of the fish species involved.
- The sustainable harvest level of the resource.
- Other relevant data, such as regional employment, economic and social/lifestyle issues.

The report is prepared primarily to provide the Integrated Fisheries Allocation Advisory Committee (IFAAC) with a factual account of the resource and current and historical trends in its exploitation – 'current' at the time the report is written. This report should be read in conjunction with the Department of Fisheries' annual *State of the Fisheries* report and the abalone sustainability report for commercial export fisheries prepared for the Australian Government Department of Environment and Heritage. These reports are also available on the Department of Fisheries' website.

Note it is not the purpose of this paper to set out which sector will get what share of the resource.

The Minister has established IFAAC to consider all the information on a resource and its users, and to consult widely in order to make recommendations on how the resource should be allocated. This process will be documented by IFAAC after its deliberations and submitted to the Minister to assist him in determining these initial allocations. The Minister may choose to release IFAAC's final report to him to the public.

The Government's priority for the introduction of IFM is the western rock lobster, abalone, West Coast demersal finfish and the Gascoyne demersal finfish resources. The IFM Western Rock Lobster resource report was published in March 2005 as Fisheries Management Paper No. 193 (Department of Fisheries, 2005).

SECTION 1 WESTERN AUSTRALIAN ABALONE

1.1 Distribution

Abalone are molluscs of the genus *Haliotis* (family Haliotidae).

1.1.1 Roe's abalone

Roe's abalone, *Haliotis roei* has a distribution from Shark Bay (WA) to western Victoria (Figure 1a). It inhabits areas of high wave action and is most abundant on intertidal and shallow subtidal limestone platforms on the west coast. This species is mainly found in depths of 0 to 3 metres and prefers water temperatures of 14 – 26°C.

1.1.2 Greenlip abalone

The greenlip abalone, *Haliotis laevigata* has been reported from Cape Naturaliste in WA to Cape Liptrap, Victoria, and northern Tasmania. This species is widely considered the best tasting of Australian abalone and targeted by commercial and recreational divers along the coasts of southern WA, South Australia, Victoria and northern Tasmania, providing about 20 per cent of the total Australian commercial abalone catch.

Greenlip abalone occurs primarily on granite rocks in depths of five to 40 metres, in areas with high wave action and water movement. Adults live on rock faces near the sand line where drift algae are readily available; juveniles usually reside in cracks, crevices and under rocks where they are protected from predators such as fish. The species prefers exposed areas on rocky reefs with water temperatures ranging from 12 – 22°C. The optimum growth temperature is 16°C.

1.1.3 Brownlip abalone

Brownlip abalone, *Haliotis conicopora*, may be a western subspecies of the eastern Australian blacklip abalone (*Haliotis rubra*). Many genetic characteristics of the western populations indicate that *H. conicopora* may be at the western end of the clinal variation¹ of *H. rubra*.

More powerful scientific methods may resolve this issue, but for the moment and for the purposes of this report, *H. conicopora* is regarded as separate from *H. rubra*. Therefore, this species is currently recorded as being distributed from Fremantle in WA to the South Australian border (Figure 1c).

Brownlip abalone are characterised as a 'cryptic' species, preferring areas of reduced wave action, including caves and fissures in rock crevices. Brownlip abalone occur in coastal waters to a depth of 30 metres mostly on granite (occasionally limestone) substrate and favours water temperatures ranging from 12 – 22°C.

¹ Clinal variation: genetically inherited traits often gradually change in frequency from one geographic region to another.



Figure 1a: *Distribution of Roe's abalone in Western Australia.*

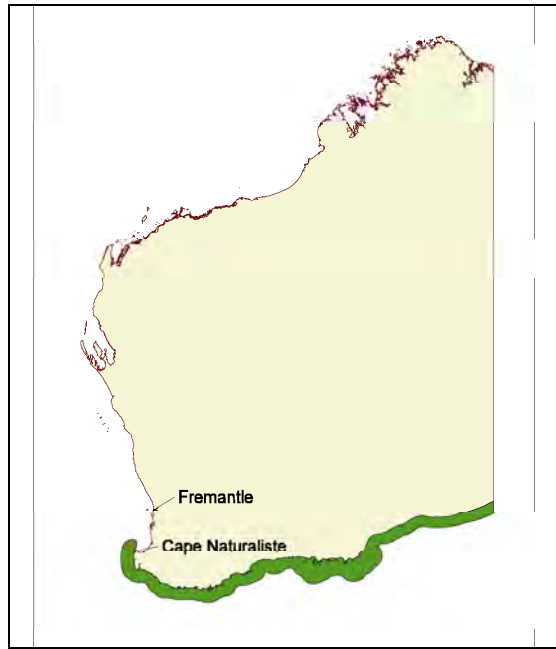


Figure 1b: *Distribution of greenlip abalone in Western Australia.*

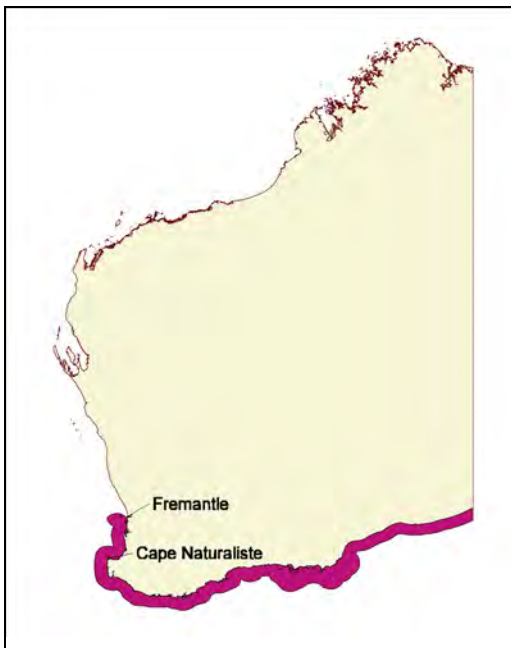


Figure 1c: *Distribution of brownlip abalone in Western Australia.*

1.2 Life history

1.2.1 General

All three commercial abalone species in Western Australia share similar life-history characteristics in that they are broadcast spawners, with separate sexes and external fertilisation. Fecundity increases with size for abalone.

Female abalone produce large numbers of eggs. For example, a single large individual greenlip abalone can produce millions of eggs each year.

After a larval life of between five to 10 days, depending on water temperature, the larvae metamorphose into small juveniles and settle onto rocks usually in association with crustose coralline algae (the same habitat as adult abalone). Post settlement juveniles feed on microscopic algae such as diatoms. When the juveniles reach about 5mm long they begin to feed on macro-algae and thereafter show a preference for drift red algae.

It is thought that the dispersal of some species of abalone is relatively localised, due to the short duration of the larval stage of their life cycle. This has led to the hypothesis that there is little intermixing of recruits amongst reefs and genetically distinct populations may occur within a few kilometers of each other.

1.2.2 *Roe's abalone*

Roe's abalone can grow to a maximum shell length of about 12cm but individuals larger than 10cm are rare. In the Perth metropolitan area, which is at the centre of the species' distribution, it attains 20mm shell length at the end of its first year, 35 to 40mm at age two and reaches legal minimum length (60mm) at four years of age. However, animals fished by the commercial fishery (70mm-plus) are at least five years of age.

Roe's abalone begin to become sexually mature at around 40mm, which occurs at two to three years of age. Thus, most females have at least two spawning seasons before they become vulnerable to the recreational and commercial fisheries.

The fecundity of each individual is relatively high with large individuals (over 90mm in size) producing in excess of three million eggs, but smaller individuals (near 40mm) only produce approximately 200,000. Spawning activity appears to occur at low levels throughout most of the year and peaks during the winter months of July and August.

Abalone larvae are known to settle out onto encrusting coralline algae. The juveniles (smaller than 10 mm in size) of *H. roei* are mainly found on areas of encrusting coralline algae, which are most abundant on the seaward edge of intertidal platform reefs. They remain on top of these platforms for the first two years of their life and move to the deeper subtidal areas or shallow platform habitats where the food availability is higher.

H. roei consumes a variety of macroalgae by trapping drift algae which is mostly done at night. They do not appear to be active grazers of surface algae on the rock surfaces. The most widespread algae found in their guts is *Sargassum* but the diet for *H. roei* varies both amongst sites and amongst seasons, presumably due to the relative availability. Consequently, measurements of feeding have shown that the volumes of algae in the guts were lowest in January and highest in the winter months, which corresponds to the seasonal abundance of drift algae that accumulate during winter storms.

1.2.3 *Greenlip abalone*

In WA this species can grow to a maximum shell length of about 240mm but are most commonly found in the 140mm to 170mm range. "Stunted" populations of this species have been recognised at some locations on the south coast. The gonad begins to develop at a shell length of about 70mm in both "normal" and "stunted" areas. *H.*

laevigata become mature at three years of age around a size of 80-110mm shell length, depending on the growth.

In WA, greenlip abalone attain the minimum legal size (140mm) at around three years of age at the fastest growing sites, and between four to six years at normal growing sites. At “stunted” sites, many individuals do not attain the minimum legal length. Thus, depending on the area, they have none or at least three or more spawning seasons before they become vulnerable to the fishery. This wide variability in growth has led to the voluntary imposition of higher size limits in many areas.

The main spawning period of greenlip abalone occurs in late spring and early autumn, peaking in December. This species appears to be largely dependent upon drift algae for food and rarely moves to graze on attached algae.

1.2.4 Brownlip abalone

This species can grow to a maximum shell length of about 220mm but are commonly about 160mm to 180mm. Brownlip abalone are thought to become mature at three to four years of age, at shell lengths of between 110mm and 130mm and reach the legal size (140mm) at around four to six years of age, which is at least a year after reaching maturity. However, growth studies are yet to be done on this species to confirm these growth rates.

The main spawning season for brownlip abalone occurs in late spring and early autumn, peaking in December. Mature brownlip abalone feed mainly on drift algae and graze on seagrass in areas where drift algae is scarce.

1.3 Recruitment and mortality

There can be a high degree of variability of recruitment success both within and between years and regions (McShane, 1995). The natural mortality rates of abalone are highly size dependent.

Mortality is very high for larvae and juvenile but decreases as the animals grow. Predators of large-sized individuals include stingrays, fish, octopus, rock lobsters, starfish and predatory whelks. Natural mortality rates for adult abalone are thought to vary between 0.2 and 0.3.

1.4 Physical environment and external inputs

Abalone only live on hard rocky reef structures in relatively shallow clean marine waters. The specific types of reefs inhabited vary amongst the species, dependent upon their individual preferences for level of exposure and substrate complexity.

In recent years, concern has been mounting over habitat degradation, as the Perth metropolitan human population spreads north towards Lancelin and south past Mandurah. Although most abalone are found on reefs well away from areas of human activity that do not normally suffer problems of environmental degradation, there is still a need to address these concerns, particularly in the Perth metropolitan area where Roe’s abalone occurs on the ‘doorstep’ of the suburban environment.

Habitat modification, such as coastal development (construction of quays) and changes in riverine outflows, can also make an area unsuitable for abalone, as any reduction in salinity through river outflow is generally fatal for members of the Western Australian species of abalone.

SECTION 2 THE ABALONE FISHERY

2.1 The commercial fishery

2.1.1 Boundaries

The legal area of the commercial abalone fishery includes all coastal waters of the Southern Ocean, Indian Ocean and Timor Sea between the Western Australian/Northern Territory Border and the Western Australian/South Australian border (i.e. all the waters of the state).



Figure 2a: The boundaries of commercial greenlip/brownlip areas

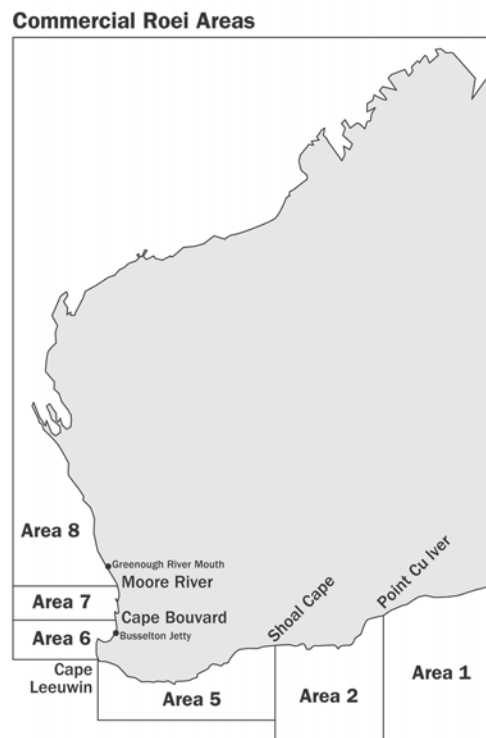


Figure 2b: The boundaries of commercial Roei areas

The commercial fishery for abalone is divided into eight areas: Areas 1 to 4 (Figure 2a) are boundaries for the commercial greenlip and brownlip fishery and Areas 1, 2, 5, 6, 7 and 8 (Figure 2b) are boundaries for the commercial Roei fishery. The details of these boundaries are:

- Area 1: SA/WA border to Point Culver.
- Area 2: Point Culver to Shoal Cape.
- Area 3: Shoal Cape to Busselton Jetty.
- Area 4: Busselton Jetty to NT/WA border.
- Area 5: Shoal Cape to Cape Leeuwin.
- Area 6: Cape Leeuwin to Cape Bouvard.
- Area 7: Cape Bouvard to Moore River.
- Area 8: Moore River to the NT/WA border.

Although the existing area description of the commercial abalone fishery gives the impression of an extensive fishery, only a small portion forms the functional fishery. In practice, abalone are only commercially harvested from a patch network of reefs. For example, about 50 per cent of the state-wide catch of Roe's comes from a 20km stretch along Perth's metropolitan beaches.

2.1.2 Main fishing method

The only method of fishing used in the Abalone Managed Fishery is hand collection involving wading or diving. Fishing operations are heavily weather-dependent, due to the small vessels used and the potentially hazardous conditions (waves, swells etc) encountered, particularly off the south coast.

Off the west coast of Western Australia, Roe's abalone generally live in very shallow areas with high wave action, therefore access to these animals is also highly weather-dependent.

Fishing is largely confined to daylight hours and is usually undertaken close to shore (or offshore islands) as abalone tend to inhabit relatively shallow water (one to twenty metres deep). Typically, fishers will travel up to 20 nautical miles in a day, and return to a land-based camp at night. Fishers do not remain overnight on board a vessel, as each day's catch must be weighed and recorded in a catch and disposal record.

2.1.4 Fishing season

The quota year and licensing period runs from 1 April to 31 March of the following year.

2.2 The recreational fishery

2.2.1 Boundaries

The recreational fishery for abalone is divided into three zones (Figures 3a and 3b):

Southern Zone:	South Australian border to Busselton Jetty.
West Coast Zone:	Busselton Jetty to Greenough River mouth.
Northern Zone:	Greenough River mouth to the Northern Territory border.

2.2.2 Main fishing method

Recreational fishing for Roe's abalone is carried out while wading or snorkelling in high density (30 to 90 legal size animals per square metre) populations on reef platforms and sub-tidal reefs, using a screwdriver or similar implement to lever abalone from the reef.

Greenlip and brownlip abalone are usually taken while free diving or diving on compressed air.

2.2.3 Fishing season

Separate seasonal fishing times apply to the West Coast Zone (Perth metropolitan area) and the combined Northern and Southern Zones. The open season for the West Coast Zone operates for a total of nine hours over six consecutive Sundays, commencing on the first Sunday in November between the hours of 7.00am and 8.30am only.

Abalone fishing is permitted in the Northern and Southern Zones from 1 October to 15 May. When the season is open, fishing is allowed at any time during the day.

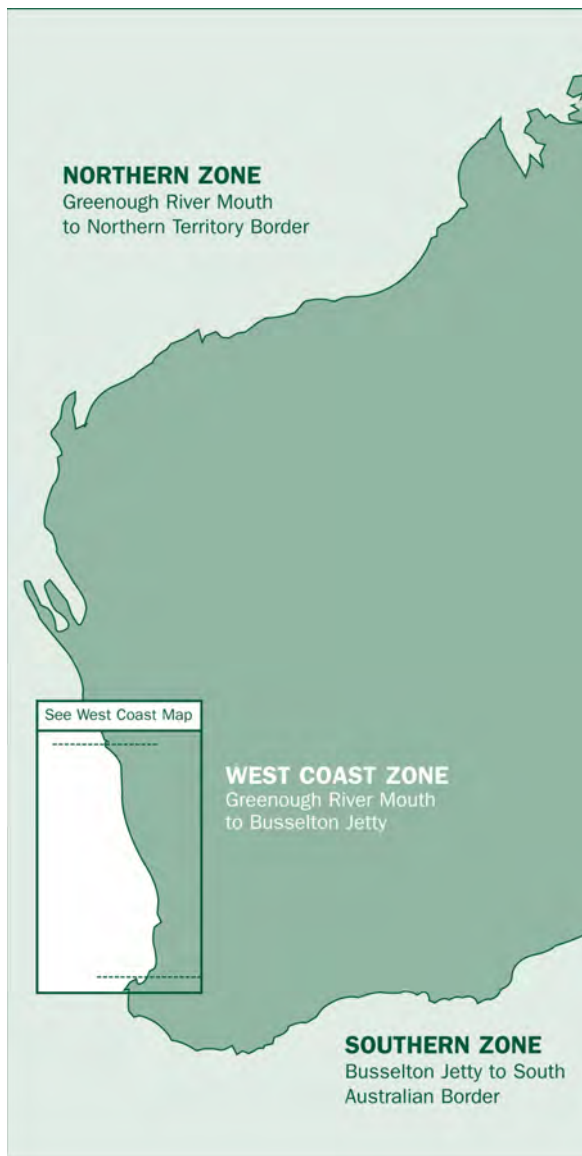


Figure 3a: Recreational fishing boundaries for abalone



Figure 3b: Recreational West Coast Zone, showing conservation areas within the zone

2.3 Indigenous fishing

Indigenous people engage in commercial, recreational and customary fishing. It is only in recent times that customary fishing has begun to be identified as a separate activity to recreational and commercial fishing.

Customary fishing applies to persons of Aboriginal descent; fishing in accordance with the traditional law and custom of the area being fished; and fishing for the purpose of satisfying non-commercial personal, domestic, ceremonial, educational or communal needs.

Indigenous people fishing commercially for abalone would be bound by the rules of the Abalone Management Plan.

Indigenous people engaged in either recreational or customary fishing are currently bound by the recreational fishing rules because the *Fish Resource Management Act 1994* does not provide a definition for customary fishing, and the definition of recreational fishing includes everything that is not commercial fishing.

However, an Indigenous recreational or customary fisher is not required to hold a recreational fishing licence. Specific management arrangements (including different rules) may be applied to customary fishing for abalone, pending outcomes of the draft Aboriginal Fishing Strategy.

Greater clarification on the application of customary fishing in policy and practice will continue to evolve as Government continues to develop its position in response to the draft Aboriginal Fishing Strategy.

SECTION 3 SUMMARY OF MANAGEMENT ARRANGEMENTS

3.1 Commercial management

3.1.1 *Management objectives*

The Minister and the Department of Fisheries have a statutory obligation under section 3 of the *Fish Resource Management Act 1994* (FRMA) to conserve, develop and share fish resources of the State for the benefit of present and future generations.

The current management objectives for the commercial Abalone Managed Fishery are [WA Fisheries Overview No.1. (FWA, 1998)]:

- Maintain sustainability of the State's abalone stocks through maintenance of the breeding stock and habitat.
- Maximise the economic return from the abalone resource to the community while maintaining sustainability of the stock and the habitat.
- Ensure cost-effective management of the fishery, with special reference to developing systems in collaboration with clients to fully identify all costs of running the sub-program for cost recovery.
- Encourage maximum commercial flexibility and administrative simplicity from industry participants.

3.1.2 *Historical development of management*

A summary of the management arrangements for the commercial abalone sector prior to 1998 was published in the WA Fisheries Overview No. 1 (FWA, 1998).

The fishery for abalone in WA began in the 1960s when Roe's abalone made up the majority of abalone harvested in WA. Since 1970, the catch composition for the Abalone Managed Fishery has expanded to include greenlip and brownlip abalone.

Although it started with a low level of fishing, the commercial abalone fishery experienced a rapid expansion in 1969 when an influx of divers moved from other states to WA. In 1971 the fishery was subjected to limited entry management and 36 non-transferable licences were issued. By 1975 this number had been reduced to 26.

At this time, the fishery was divided into three zones - two (Zones 1 and 2) on the south coast (greenlip/brownlip fishery) and one (Zone 3) on the west coast (Roe's fishery). There were six, eight and 12 divers respectively in these zones.

Size and weight limits were imposed for each of the abalone species, which in some cases also varied among zones. In addition, individual transferable quotas (ITQs) were introduced in 1985-86 at the request of the commercial fishing industry to reduce competition amongst divers. These quotas were progressively reduced until 1990; after which time they have been relatively stable.

Since 1985, licensees in Zone 3 have also had access to Roe's abalone resources on the south coast (Zones 1 and 2). Licensees in Zones 1 and 2 had access to Roe's abalone in these zones prior to 1985 but harvested very little of the available stock during that period.

In March 1999, management changes resulted in the State being divided into eight specific areas for abalone fishing and in the separation of licences into specific Roe's

abalone and greenlip/brownlip abalone licences. These changes allowed better monitoring and management of the specific abalone stocks found along the coast of WA.

3.1.3 Current commercial fishery management arrangements

The current management plan for the Abalone Managed Fishery is a formal statutory document - the *Abalone Fishery Management Plan 1992* (the Abalone Plan) that specifies the management measures for the fishery. These include: limited entry licensing, minimum legal shell sizes, seasonal and area closures and individual quotas for each licence holder generated from the total allowable commercial catch for each area.

The significant elements of the Abalone Plan are as follows.

- *Limited number of licences*

To gain/retain a licence, a person must hold a minimum number of units for a particular species. In the Roe's abalone fishery, the minimum number of units is 800, while in the greenlip/brownlip fishery the minimum number of units is 450.

Currently there are 42 managed fishery licences in the Abalone Managed Fishery (26 licences endorsed to take Roe's abalone and 16 licences endorsed to take greenlip/brownlip abalone) in one or more of the eight specific areas. Twenty-three people hold the 42 licences.

- *TACCs for an area*

Separate total allowable commercial catches (TACCs) are set for each species in each area on an annual basis. Each Abalone Managed Fishery Licence has attached to it transferable units of entitlement (Table 1).

Each unit is given a value by dividing the TACC for a given area and species by the total number of units allocated for that area and species. The TACCs for each area of the fishery are given in Table 2. Note there is currently no TACC for brownlip in Area 1, hence the 60 units have no value attached to them.

- *Stock partitioning*

Whilst recreational fishers taking Roe's abalone must abide by a minimum legal size of 60mm, commercial abalone fishers must ensure that Roe's abalone taken in the Perth metropolitan area (Area 7) are at least 70mm in length and, in Area 1, are at least 75mm in length.

The difference in the size limits amongst sectors within the Perth metropolitan area (which is also the West Coast Zone of the recreational fishery) suits the commercial fishery because larger-sized abalone attract a higher price and recreational fishers because it assists in enabling them to collect sufficient sized abalone during their nine-hour yearly season. The increased minimum size in Area 1 was implemented at the request of industry members fishing for Roe's abalone in that area.

- *Seasonal closures*

Commercial divers fishing in the Area 7 must cease fishing two weeks prior to the opening of the West Coast recreational fishery (November) and must not fish at all during the six weeks of the recreational fishing season. Commercial fishing can recommence on the Monday following the closure of the recreational fishing season. Fishing on weekends and public holidays in the Area 7 is prohibited all year.

- *Area closures*

Commercial divers for Roe’s abalone must not, when operating in the waters on the west coast of the State lying between the northern sea wall of Hillarys Boat Harbour and Cape Bouvard:

- (a) stand or remain on any reef top while fishing for abalone; or
- (b) fish for abalone other than from a boat authorised to be used in the fishery.

This is to ensure that stock levels on the shallow reef tops, which are the main areas fished by the recreational fishers, are not depleted in a way that would disadvantage recreational fishers. Specifically, between Hillarys Boat Harbour and Cape Bouvard, commercial fishers are not permitted to stand or remain on the reef top while fishing for abalone; they must only fish from a boat.

Commercial fishing for Roe’s abalone is not permitted between the North Mole at Fremantle and Trigg Island at any time.

At times, there have been spatial closures in other regions to mitigate short term, small-scale issues. See also section 3.5 of this paper for a list of conservation areas.

Area	Greenlip Units	Licences	Brownlip Units	Licences	Roei Units	Licences
1	600	6	60	6	1980	14
2	6000	8	1440	8	3600	13
3	7200	8	800	8	-	
4					-	
5	-		-		4000	21
6	-		-		2400	10
7	-		-		7200	13
8	-		-		6000	12
Total	13,800	16	2,300	16	25,180	26

Table 1: *The total number of units and Managed Fishery Licences for each area of the commercial fishery 2005-06*

Area	Greenlip Meat weight (t)	Brownlip Meat weight (t)	Roes Whole weight (t)
1	1.2	0	9.9
2	31.2	7.9	19.8
3	37.45	7.5	
4	0	0	-
5	-	-	20
6	-	-	12
7	-	-	36
8	-	-	15
Total	69.85	15.4	112.7

Table 2: TACCs for greenlip, brownlip and Roe's abalone by area for 2005-06

3.1.4 Managing for sustainability

The primary management tool that is used to ensure that the biological objective for the commercial fishery is met is the total allowable commercial catch (TACC). The TACC is assessed annually in December, following a stock assessment and discussions with industry.

Changes to the TACC affect 'individual transferable quotas' (ITQs) equally. No formal decision making rules for altering TACCs are currently in place, but in 2003, a series of preliminary performance indicators of stock status were implemented (see Appendix 1), in line with reporting requirements to the Department of Environment and Heritage.

If the indicators for each assessment year fall outside the nominated range, a potential suite of management actions may ensue, including altering the TACC.

The research and monitoring methods that underpin the TACC setting process are described in detail in Section 7 of this report.

Table 1 and 2 in Appendix 1 describe the TACC and current performance indicators for the greenlip, brownlip and Roe's abalone stocks respectively. Most of these were developed during the Department of Fisheries' application for accreditation of the abalone fishery for export approval under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC), and are continually updated.

A more substantial suite of performance indicators are currently under development, and future work will focus on using these performance indicators to develop strategic 'decision rules' for both stock maintenance and stock re-building where necessary.

Other management rules that are adjusted less frequently but also make a contribution to ensuring the biological objective is met are minimum size limits and seasonal and area closures.

3.2 Management of recreational fishing

3.2.1 Management objectives

The two management objectives for the recreational fishery are:

- To maintain and improve the sustainability and quality of recreational fishing for abalone.
- To improve individual and community support for sustainable recreational abalone fishing.

Management objectives for recreational fishing may differ from those of commercial fisheries. In addition to sustainability, which remains a fundamental principle that underpins fisheries management, recreational fishers value the “fishing experience”.

The “fishing experience” varies between fishers, and includes factors such as the diversity of opportunities available (i.e. the size of the abalone taken) and social aspects. In general, the value to the individual and the community of the fishing experience are key goals for recreational fisheries management.

3.2.2 Management history

During the 1980s and early 1990s, abalone, in particular Roe’s abalone, was subject to increasing recreational fishing pressure, due to a growing population and increasing popularity of abalone as a delicacy.

In 1979 a seasonal closure which ran from mid-December to mid-October and a state-wide size limit for Roe’s abalone of 60 mm were introduced.

In 1988 a permitted fishing time within the open season was introduced for the Perth metropolitan and mid-west coast part of the fishery. The permitted time was 6:00 am to 10:00 am on weekends and public holidays.

In 1992 a recreational abalone licence was introduced, fishing times were reduced from 6:00 am to 10:00 am to 7:00 am to 9:00 am and a minimum size limit of 140mm set for greenlip and brownlip abalone.

In 1994 bag limits were introduced for recreational abalone fishers. The Roe’s abalone limit was 20 per person per day and greenlip and brownlip abalone limit was 10 per person per day with a boat limit of 30.

In 1997 in response to further recreational fishing pressure, principally on the reef-top abalone stocks in the Metropolitan area, the season was further reduced to the period between early November and early December and the permitted fishing time reduced to one and a half hours (from 7:00 am to 8:30 am) on Sundays only.

The last review of recreational abalone fishing resulted in the management arrangements listed in section 3.2.3 applying from 2003 onwards.

3.2.3 Current management arrangements

Management arrangements for recreational fishing complement the commercial fishery management plan. They aim to manage the proportional impact on abalone of recreational fishing, as well as protecting other molluscs and reef species.

Recreational fishers are required to take out either a dedicated abalone recreational fishing licence, or an umbrella licence (which covers all licensed recreational fishing activities). These licences are not restricted in numbers, and the following conditions are attached to them.

- The fishery is divided into three zones (see section 2.2.1) with fishing seasons as described in section 2.2.3 of this report.
- The daily bag/possession limit for Roe's abalone is 20 per fisher, while the maximum number of this species that may be stored at a person's permanent place of residence is 80. The minimum size limit is 60mm across the widest part of the shell.
- The daily bag limit for greenlip and brownlip abalone combined is five per fisher. The possession limit for these species is 10 while the maximum number of this species that may be stored at a person's permanent place of residence is 20. The minimum size limit for these species is 140mm across the widest point of the shell.
- The boat limit for greenlip/brown lip is five per day or 10 where there are two or more fishers aboard the boat.

The management controls for the recreational fishing of Roe's abalone in the west coast zone constitute the most restrictive management regime for a recreational fishery in Australia.

3.2.4 Managing for sustainability

The management arrangements described in the previous section are primarily aimed at ensuring that management objectives for the recreational abalone fishing sector are met. Biological research for sustainability for the recreational sector is focused on the Perth metropolitan area, where recreational fishing is concentrated.

This research, involves sampling eight sites in the Perth metropolitan region annually - see *State of the Fisheries 2003/04 Report* (page 59) for a detailed description of the stock assessment for the Perth metropolitan fishery.

3.3 Management of abalone harvested for aquaculture

3.3.1 Requirements

The Department of Fisheries receives requests for the collection of a limited amount of abalone stock from the wild to enable aquaculturists to conduct basic commercial research on the species being farmed.

The quantity of broodstock required each year is dependent on the number of licensees. Currently, five companies hold a Ministerial exemption for the collection of abalone broodstock for aquaculture.

3.3.2 Current access

Broodstock for aquaculture purposes must be purchased from commercial fishers or retail outlets, or taken under authority of a Ministerial Exemption. As aquaculturists prefer to collect broodstock themselves, they can apply for a Ministerial Exemption

under Section 7 of the *Fish Resources Management Act 1994*, which if approved gives them the authority to take abalone specific to their needs.

The methods and conditions which abalone may be taken under an exemption include:

- Collection of legal-sized adults (species-specific).
- Collection by diving.
- A cap on the number allowed to be taken of between 25 to 300 of each species.
- All licensed abalone hatcheries in WA are required to keep accurate records of all broodstock obtained and juveniles produced. A consignment note must accompany any juveniles sold by a hatchery.
- Stringent reporting/disposal/notification and compliance conditions are in place in order to protect resource and abalone fishers.

The Department of Fisheries has a draft policy paper on the collection of broodstock for aquaculture purposes, and this draft paper is being amended for incorporation into a Hatchery Policy Paper.

In the longer term, the Department is proposing to draft the appropriate legislation that will allow aquaculture licence holders to apply for an 'authority' to take small numbers of fish for breeding purposes.

3.4 Stock enhancement and re- seeding

The commercial abalone industry has shown an interest in abalone re-seeding/stock enhancement. A pilot greenlip abalone re-seeding trial is currently in progress off the south coast. Results have been promising and it is possible that a larger-scale trial will commence in the coming months.

Implications of this type of activity for the sustainable harvest level and allocation process is likely to depend on the nature of the tenure held over re-seeded abalone – that is, whether one sector has exclusive access either in legal or practical terms to these abalone.

3.5 The Indigenous fishery

Indigenous people involved in commercial fishing for abalone would be required to comply with the legislation associated with commercial fishing – the *Fish Resources Management Act 1994*, the *Fish Resources Management Regulations 1995* and the Abalone Managed Fishery Management Plan. Similarly, Indigenous people recreationally fishing for abalone must comply with all regulations, but are not required to hold a recreational fishing licence.

Management arrangements for customary fishing (see section 2.3 of this document) are being developed through the Aboriginal Fishing Strategy, which is currently under consideration by Government.

3.6 Conservation areas

A number of abalone populations are managed within conservation areas. These are summarised in Table 3.

Area	Restriction
Cottesloe Groyne to Rous Head	The taking of abalone is prohibited between the main Cottesloe Groyne and Rous Head.
Cottesloe Reef	All commercial fishing is prohibited.
Jurien Marine Park	Fishing for abalone is not permitted in some restricted (special purpose and sanctuary) zones within the Jurien Marine Park.
Waterman's Reef Observation Area	This area surrounds the WA Marine Research Laboratories at Waterman's and all reef life is protected in this area at all times. Fishing for abalone is prohibited.
Rottnest Island	All commercial fishing is prohibited. All marine life is protected in two conservation areas near the island. These are near Pocillopora Reef, and part of the Transit Reefs.
Yallingup Reef Protected Area	Recreational fishing for abalone is not permitted inside the Yallingup Reef Protected Area.

Table 3: Conservation areas that impact on the taking of abalone

SECTION 4 FACTORS THAT INFLUENCE NET BENEFIT FROM USE OF THE RESOURCE

4.1 Economic environment

4.1.1 Commercial fishery environment

In the past five years, the gross value of production (GVP) from the commercial abalone fishery has varied between \$12 million and \$19 million (see Table 4). In 2003 the GVP value of the Roe's abalone harvest was \$2.6 million, whereas the value of greenlip and brownlip abalone harvest was much higher at \$9.7 million.

4.1.2 Market environment

More than 95 per cent of the abalone taken by commercial operators is exported. The major markets for all three abalone species are Hong Kong, Singapore, and Taiwan. There are lesser markets in Japan, other Asian countries and Australia. Some product imported into Hong Kong is re-exported to China (WA Fisheries Overview No 1, FWA 1998).

The highest prices for greenlip abalone are gained in China, Hong Kong and Singapore because it is the preferred abalone species in these places.

Nearly all greenlip and some brownlip are exported as frozen meat. Roe's abalone is nearly all canned, as is part of the brownlip catch.

About 40 per cent of the abalone sold for canning is processed in WA, with the remainder being shipped to South Australia or Victoria for processing.

Abalone shell is sold to Korea for buttons, jewelry and inlay work. However, demand has weakened in recent years.

Year	Average wholesale price \$/kg meat weight		Average wholesale price \$/kg whole weight	Greenlip + brownlip value (\$ million)	Roe's Value (\$ million)	Total value (\$ million)
	<i>Greenlip</i>	<i>Brownlip</i>	<i>Roe's</i>			
1999	120	110	35	9.1	3.8	13.0
2000	163	133	55	13.4	5.9	19.3
2001	146	119	41	11.7	4.1	15.8
2002	146	119	41	10.4	4.0	14.4
2003	126	93	27	9.7	2.6	12.3

Table 4: Average prices obtained for abalone and the associated value of the fishery for 1999 to 2003 seasons.

The estimated average price received by fishers in 2003 was \$126/kg meat weight for greenlip and \$93/kg meat weight for brownlip abalone, resulting in a fishery valued at approximately \$9.7 million. These prices were considerably lower than 2002 when the

average price received by fishers was \$146/kg meat weight for greenlip and \$119/kg meat weight for brownlip abalone, and substantially lower than the high values of \$163/kg meat weight for greenlip and \$132.50/kg meat weight for brownlip abalone received in 2000 (see Table 4).

The estimated average price for Roe's abalone in 2003 was \$27/kg whole weight, compared to \$41/kg whole weight in 2002. On the basis of the average price, the fishery was worth approximately \$2.6 million - a substantial drop from \$4 million in 2002.

Overall, the price of Roe's abalone has dropped more than 50 per cent since 2000, when it was \$55/kg whole weight (see Table 4). The small size of Roe's abalone means, that, as a fishery product, it is likely to be in direct competition with small, hatchery-produced greenlip abalone, which are now being released onto the market.

4.1.3 Recreational fishing environment

A survey undertaken by Economic Research Associates (Lindner and McLeod, 1991) estimated that recreational fishing activity across the State had a direct expenditure of \$205 million in 1989/90, and an indirect impact of \$184 million, giving an aggregate impact of \$389 million and an employment impact of 5,700 full-time jobs.

A repeat survey in 1998 estimated direct expenditure at \$299 million in 1995/96, with an aggregate impact of \$569 million and an employment impact of 7,000 full time jobs.

Although it is of interest to know how much is spent by recreational fishers, expenditure on recreational fishing and the gross value of commercial fisheries are not appropriate economic values to use to properly compare allocation options between these sectors (see McLeod and Nicholls, 2004 and Hundloe, 2002 for an explanation of appropriate economic values).

McLeod and Nicholls (McLeod and Nicholls, 2004) demonstrate the application of appropriate socio-economic valuation methodologies that should be used for evaluating resource allocation options between commercial and recreational users, using three case studies. One of these case studies was the Perth Abalone Fishery (see section 7.3).

4.2 Social Environment

4.2.1 Commercial fishing participation

There are approximately 35 divers and deck hands employed by the greenlip and brownlip abalone fishers, and 50 by the Roe's abalone fishers. In addition, due to the dispersed nature of the abalone species fished, small coastal towns from Kalbarri to Eucla receive income from the activity of abalone divers.

4.2.2 Recreational fishing participation

Persons wishing to take abalone are required to hold a recreational fishing licence. They may buy an abalone recreational licence for \$36 or an 'umbrella' licence for \$72, which entitles them to engage in all licensed recreational activities, i.e. abalone, rock lobster, marron, net fishing and freshwater angling.

The total number of recreational licences to take abalone has increased from approximately 7,000 in 1992 to 20,000 in 2004 (Figure 4). Overall, licence numbers have been relatively stable since 2001, with a slight decrease in the number of abalone-only licences and an increase in the number of ‘umbrella’ licences.

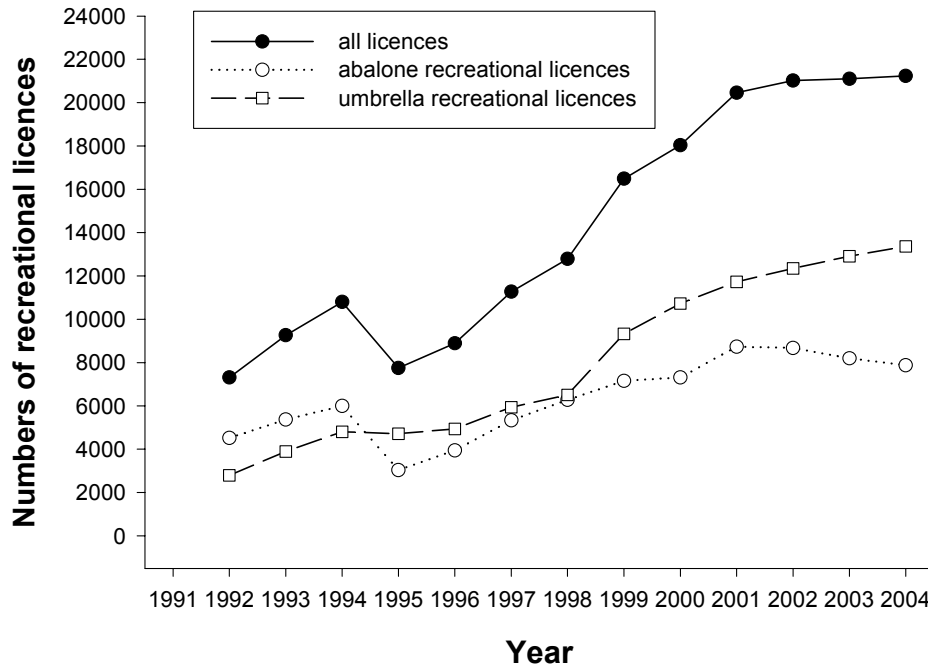


Figure 4: The number of licences issued in the recreational abalone fishery, by licence type, for the period 1992 to 2003.

Data from the 2001 season indicates that not all holders of recreational abalone licences fish for abalone eg 75 per cent of recreational abalone licence holders in the metropolitan area fished in the metropolitan area. For eligible ‘umbrella’ licence holders, the participation rates were 28 per cent for those located in the Perth area.

Determining the relationship between the number of abalone licensees and recreational fishing effort is not straight forward because the abalone fishing experience varies between licensees. For example a survey of recreational licensees (McLeod and Nicholls 2004) found that 43 per cent of respondents fished the six Sundays permitted in the Metropolitan area, and one quarter fished three times or less.

This could be partly attributed to the adverse ocean conditions on three of the six days fishing was permitted. Only 38 per cent of the respondents took their bag limit of 20 abalone per trip for the season and the average catch per trip was around 18 abalone. The importance of the number of abalone caught varied between respondents, with about half regarding it as important and half not.

The authors concluded that the constraints on recreational fishing were not universally binding on respondents as many chose to fish less than the allowed days and caught less than the allowed daily catch.

As recreational licences use is an important consideration in the evaluation of management changes for the recreational sector, it will be important to undertake similar surveys in the future.

4.3 Key socio-economic statistics

Table 5 sets out recent movements in key socio-economic indicators for each of the regions of Western Australia where abalone is taken. These provide a limited framework within which to view commercial and recreational fishing and the socio-economic trends that may influence participation in these fishing activities in a particular region.

Region	Population (10-year trend)	Employment (4-year trend)	Unemployment (4-year trend)	Average taxable income (from 1998/99 to 1999/00) (5-year trend)	Overnight domestic visitor expenditure (4-year trend)
Mid west	-0.3% (↑)	+6.4% (↑)	-2.3% to 5.8% (↓)	-5.3% (↔)	+56.1% (↑)
Perth metro	+1.5% (↑)	+2.1% (↑)	-0.1% to 6.1% (↓)	+4.6% (↑)	+1.8% (↓)
Peel	+3.2% (↑)	+0.4% (↑)	+1.5% to 8.1% (↓)	+4.3% (↑)	-4.3% (↓)
South west	+2.0% (↑)	+1.8% (↑)	+1.0% to 6.0% (↑)	+4.3% (↑)	+0.5% (↔)
Great Southern	+0.4% (↑)	-9.0% (↔)	+1.6% to 6.8% (↑)	+2.5% (↑)	-13.2% (↓)

Table 5: Change in indicators over the 12 months to June 2003 for main regions associated with abalone fishing (DoLGandRD, 2003)

SECTION 5 INDIRECT FISHERY MANAGEMENT INFLUENCES ON FISHING

There are a number of external influences that affect why, how and where commercial and recreational fishers fish and hence have relevance to any decision on allocation of access to fish resources.

5.1 Marine planning

Marine planning has the potential to impact on access for both commercial and recreational fishers to abalone stocks and therefore is a factor to consider in resource allocation decisions.

5.1.1 National marine planning

Marine planning at the national level under the Australian Government's 'Oceans Policy' involves two major marine planning initiatives:

- National Oceans Office regional marine planning; and
- Department of Environment and Heritage's 'National Representative System of Marine Protected Areas' (NRSMPA).

The National Oceans Office was established to, among other things:

- Coordinate the development of Regional Marine Plans.
- Coordinate the overall implementation and further development of Australia's Oceans Policy.

The primary objective of the National Oceans Office is to maintain marine biological diversity and health of ocean ecosystems. One of the programs the National Oceans Office has put in place to support this objective involves the identification and allocation of components of ocean resources specifically for the conservation of marine biological diversity and ocean ecosystem processes.

The primary mechanism for implementing this strategy is the development of Regional Marine Plans for areas based on large marine ecosystems (see Figure 5). Regional Marine Plans will incorporate economic, environmental, social and cultural objectives. The plans are intended to be a focus for coordination between existing and developing ocean uses and the range of sectoral and administrative agencies with responsibilities for marine systems (CoA, 1998).

To date, the bioregional marine planning process has been completed for the south-east region and the northern gulf. A south-west bioregional marine planning process (extending from St Vincent's Gulf, South Australia to approximately Lancelin, Western Australia) is due to commence within the next three to six months.

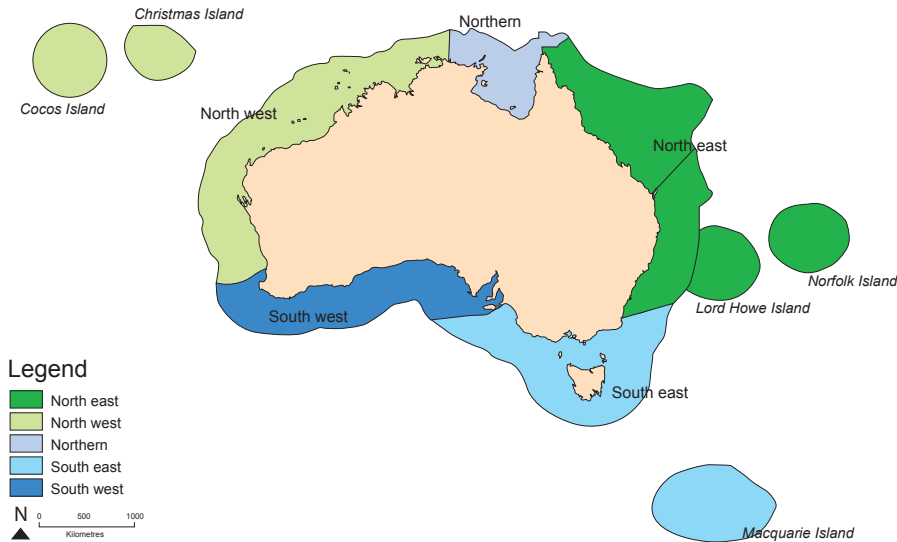


Figure 5: Key areas for regional marine planning established by the National Oceans Office

A National Representative System of Marine Protected Areas (NRSMPA) program is being coordinated by the Department of Environment and Heritage. The primary goal of the NRSMPA is “to establish and manage a comprehensive, adequate and representative system of marine protected areas to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia's biological diversity at all levels” (DEH, 2004).

The planning framework for NRSMPA is based on the ‘Interim Marine and Coastal Regionalisation for Australia’ (IMCRA) ecosystem classification.

In line with this objective, 60 bioregions have been identified to cover Australia’s waters, 16 of which are within Western Australia coastal waters. A bioregion is defined by a combination of biological, social and geographic criteria, rather than by geopolitical considerations and is, generally, a system of related interconnected ecosystems.

The intention is that each State would identify at least one marine protected area in each bioregion towards the development of the NRSMPA (DEH, 2004).

5.1.1 State Marine Planning

- *Marine Conservation Reserves*

Multiple-use Marine Conservation Reserves may be created under the provisions of the *Conservation and Land Management Act 1984*. The lead agency for implementing this legislation is the Department of Conservation and Land Management.

A key element of this process is the establishment and management of a state wide system of Marine Conservation Reserves, which have the ability to restrict fishing activity to varying degrees in accordance with a zoning scheme outlined within the plan of management for a particular area. Because abalone do not migrate after settlement, the introduction of sanctuaries under this legislation, or Fish Habitat Protection Areas (see below) under the *Fish Resources Management Act 1994*, directly reduces the

access to abalone stocks, effectively providing a reallocation of stocks for conservation purposes.

Existing marine conservation reserves in WA include Hamelin Pool Marine Nature Reserve, Jurien Bay Marine Park, Marmion Marine Park, Ningaloo Marine Park, Rowley Shoals Marine Park, Shark Bay Marine Park, Shoalwater Islands Marine Park, Swan Estuary Marine Park and the Montebello-Barrow Islands. Further marine conservation reserves are planned for Capes Leeuwin and Naturaliste, Dampier Archipelago-Cape Preston, and Walpole-Nornalup Inlets (CALM, 2004).

- *Fish Habitat Protection Areas*

There is provision to establish Fish Habitat Protection Areas (FHPAs) under the *Fish Resources Management Act 1994* to meet a number of objectives, some of which are non-fishery related (FWA, 2001).

FHPAs are most commonly community-initiated proposals to protect relatively small areas of the aquatic environment, and rely on community stewardship for on-going management. Fishing activities within an FHPA may be restricted to varying degrees.

FHPAs currently exist at the Abrolhos Islands, Cottesloe Reef, Lancelin Island Lagoon, Miaboolya Beach and Point Quobba.

- *Regional marine planning*

The Department of Premier and Cabinet is currently coordinating a multi-sectoral approach to the marine planning process, with a focus on a regional scale. This is anticipated to run independently of the existing CALM and Department of Fisheries marine planning exercises and address strategic rather than operational issues. It is intended to compliment and facilitate existing state marine planning legislation.

Details of this process are currently being finalised, and it is likely that it will be trialled in the south coast, to compliment current National Oceans Office initiatives in the southwest bioregion.

5.2 Coastal development

Over 80 per cent of the State's population lives within 30km of the coast (WAPC, 2003). The implications of this for coastal development are significant – residential sprawl and demand for coastal recreational facilities, which may in turn put pressure on available fishing grounds.

Although there is also demand for maintenance of some wilderness coastal areas, those areas may not be ones of significance to fishery ecosystems, such as breeding grounds or nursery areas.

The Western Australian Planning Commission administers the State Coastal Planning Policy, gazetted in June 2003 (WAPC, 2003), which is intended to provide an integrated approach to coastal planning.

5.3 The world economy

5.3.1 Exchange rates

Australian seafood producers represent a small percentage of the world market in seafood products.

As Australia's exchange rate has increased against the rates of exchange of its key trading partners (e.g. Japanese yen, Korean won, US dollar, Chinese yuan), Australian seafood producers have had to accept lower prices when they are converted into Australian dollars.

Normally, an increase in the Australian dollar would be partially offset by a reduction in the cost of imported (or internationally traded) 'inputs' such as fuel. However, despite the increased strength of the Australian dollar, fuel prices have continued to escalate because of other supply and demand issues in world oil markets.

Since 2002, the Australian dollar has appreciated by up to 30 per cent against the exchange rates of a number of key trading partners – meaning there has been downwards pressure on local prices, although there has been some buffering provided to Australian seafood exporters by the relative strength of the Euro and the English pound and by the relative economic buoyancy of some key importing markets.

5.3.2 Trade barriers

The US -Australia free trade agreement will have little impact, if any, on the marketing of Australian abalone. Trade barriers into China are still up to 40% however these may be improved through the free trade agreement being negotiated between Australia and China.

5.4 National and international reporting requirements

5.4.1 Environmental Protection and Biodiversity Conservation (EPBC) Act 1999

The *EPBC Act 1999* promotes the conservation of biodiversity by providing strong protection for listed species and communities in Commonwealth areas, Commonwealth waters and waters around our External Territories. Species and communities listed for protection include threatened species, marine species, migratory species and threatened ecological communities.

The *EPBC Act 1999* requires a fishery management regime to be assessed against the Australian Government's *Guidelines for the Ecologically Sustainable Management of Fisheries* – Part 13 and Part 13A.

In 2004, the Commonwealth's Department of Environment and Heritage finalised its assessment of the Department's application for accreditation of the Abalone Managed Fishery for export approval under the *EPBC Act 1999* and found the fishery to be sustainably managed. Export approval was given, subject to certain requirements.

Information on the *EPBC Act 1999* can be found at:
<http://www.environment.gov.au/epbc>

5.4.2 National Competition Policy

The method and level of restriction on commercial fisheries have an impact on the environment, the fishing industry and consumers.

The National Competition Policy legislation review process involves governments reviewing and, where appropriate, reforming legislation that restricts competition. However, governments may retain restrictions if they show that these are in the public interest.

More information about National Competition Policy can be found at:

www.ncc.gov.au

SECTION 6 INSTITUTIONAL ARRANGEMENTS

6.1 Governing legislation/fishing entitlement

Both commercial and recreational fishing are administered through the provisions of the *Fish Resources Management Act 1994* and the *Fish Resources Management Regulations 1995*. This legislation provides for the gazettal of management plans for fisheries and the issuing and management of entitlements to facilitate commercial and recreational fishing.

The Department of Fisheries carries out management of the commercial Abalone Managed Fishery in accordance with the *Abalone Management Plan 1992*, Ministerial Policy Guideline No. 10 (which guides the Executive Director on specific matters associated with management of the fishery), and associated operational policies. Fishers have to hold an Abalone Managed Fishery Licence.

Recreational fishing for abalone requires either an abalone recreational fishing licence or an umbrella licence permitting access to all licensed recreational fishing activities. There is no limit on the number of licences that could be issued. The rules governing recreational fishing are found in the *Fish Resources Management Regulations 1995*.

In addition, both commercial and recreational sectors contribute financially towards the management of their respective fisheries.

The Abalone Managed Fishery is fully cost recovered, that is, the licensees cover all of the Department of Fisheries' operating costs associated with the management of this fishery. In addition, licensees contribute to the Development and Better Interests Fund. The business rules for operation of this fund are derived from an industry/government agreement (called the "Cole/House" agreement) made in 1995.

The government funds the management of recreational fishing for abalone, although recreational fishers pay a user contribution through licence and administrative fees. These fees contribute to the research, management and compliance of the fishery.

6.2 Consultation Processes

The primary source of advice to the Minister on the management of abalone in Western Australia comes from the Abalone Management Advisory Committee (AbMAC). AbMAC is a multi-sector committee that regularly considers strategic management issues, along with other matters that affect the management of the State's abalone fishery. The commercial abalone sector also has a strong industry association, with which the Department of Fisheries liaises on day-to-day management issues.

There is a recreational member on AbMAC who provides a recreational fishing perspective on management direction in the Abalone Managed Fishery. The Recreational Fishing Advisory Committee (RFAC), which is the committee appointed by the Minister to advise him on matters pertaining to recreational fishing, provides advice on the management of recreational abalone fishing.

In addition to the main RFAC, there are 12 Regional Recreational Fishing Advisory Committees, providing more effective two-way communication with 'grass roots' fishers and regional perspectives on management issues.

Recreational fishing consultative processes are currently under review and may need to be considered in the context of Integrated Fisheries Management.

SECTION 7 RESEARCH AND MONITORING

7.1 Stock assessment

Abalone stock assessment methods perform two separate, but related tasks. First, a long-term ‘total allowable commercial catch’ (TACC) for the commercial fishery is estimated. This is generally fixed, with the annual TACC allowed to vary (usually ± 10 per cent) around this level, according to environmental fluctuations. Only rarely is the long-term TACC altered.

Second, annual harvest levels are examined using a suite of performance indicators to determine whether the long-term TACC is being compromised. The performance indicators vary according to the nature and quality of the data, usually in response to technological reasons (e.g. improved fishing efficiency of abalone divers) or methodological reasons (e.g. the development of fishery independent monitoring sites or more accurate recreational catch surveys), and are reviewed annually as part of the assessment process.

Data are summarised spatially and temporarily and are the basis of existing performance indicators for the abalone stocks (see Appendix 1). A summary of the performance of the fishery by area is provided in Appendix 2.

Stock indicator variables include catch, effort, daily and hourly catch rates, spatial distribution of fishing, average meat weights and average lengths. The catch rate per diver day has been historically used as the indicator of abundance, although consideration is being given to using the catch rate per hour in the future.

However, recent changes in technology, such as accurate swell prediction via the Internet, use of global positioning systems, nitrox diving, and occupational health and safety ‘drivers’, has resulted in considerable increases in efficiency. As a result, performance indicators will need to be modified. In future years, environmental information (swell, temperature) will also be taken into account in the assessment of performance indicators.

7.1.1 Harvest strategy assessment model

To date, estimation of TACCs in the abalone fisheries has primarily relied on known historical catch ranges derived mostly from commercial catch and effort data, coupled with biological knowledge of growth, mortality, fecundity and current stock levels.

In the future, a National Abalone Population Dynamics model, developed with Fisheries Research and Development Corporation (FRDC) funding, will formalise the estimation of Sustainable Harvest Levels (SHLs). The model will integrate all known biological information with all sources of catch information (commercial, Indigenous, recreational, illegal) in order to examine, by mathematical simulation, the effects of a range of SHLs on breeding capacity, stock abundance, and other sustainability indicators.

This model is currently being ‘fitted’ to Western Australia’s abalone stocks, and preliminary outputs will be available for the 2005/06 assessment season. If successful, the model will be utilised for ongoing SHL assessment into the future.

7.2 Biological research projects

During any given year, specific research projects are undertaken to complement and enhance overall fisheries assessment and sustainability research. In the 2004/05 fishing season (April 1 to March 30), the following research projects were undertaken.

- Fishery independent monitoring sites were implemented in both Roei and greenlip/brownlip fisheries. Currently there are eight Roei sites in the Perth metropolitan region surveyed annually, which provide good indices of stock density and size-structure, from which performance indicators have been developed. In the greenlip/brownlip fishery, 42 new sites were implemented in 'normal stocks', and 36 sites in 'stunted stocks'. These will be surveyed every two years, and performance indicators developed from this data. The location of the greenlip monitoring sites for 'normal stocks' in Area 3 are: Augusta - 20 sites, Hopetoun - 12 sites and in Area 2: West of Esperance - 7 sites, Town of Esperance - 6 sites, and Duke of Orleans Bay - 12 sites. The location of the greenlip monitoring sites for 'stunted stocks' in Area 3 are: Masons/2Mile - 12 sites, and Oldfields - 12 sites. In Area 2, there are 12 greenlip monitoring sites for 'stunted stocks' at Point Malcolm.
- The Fisheries Research and Development Corporation (FRDC) has funded a study entitled "Digital video techniques for assessing population size structure and habitat of greenlip and Roe's abalone". This project has the objective of training industry divers to monitor survey sites on an annual basis using underwater video technology. Once implemented, the data from this program will be used to set performance indicators for the stocks.
- A greenlip/brownlip morphometry (shell-shape) and length-frequency monitoring program was initiated for the commercial catch, with three objectives: a) to obtain sufficient morphological data from the main stocks to enable effective comparisons with 'stunted' populations; b) to obtain length-frequency data to enable estimation of total mortality and fishing mortality; and c) to provide a robust dataset for fitting of the national abalone population dynamics model, which is due to be implemented in 2005/2006.
- Stunted greenlip stock evaluation. Data on catch, effort, and morphometry (shell shape) at various spatial scales were analysed and used to establish harvesting protocols for stunted animals. This work is still in progress and will be reported on in future years. However, it has led to a specific management protocol for harvesting stunted stocks that is now being implemented through the various Department of Fisheries' regional and district offices.
- Yield-per-recruit and egg-per-recruit analysis. This analysis uses known estimates of growth, mortality (both fishing and natural), and fecundity to determine whether stocks are being fished at an adequate legal minimum length to maintain sufficient egg production (50 per cent of virgin levels for greenlip/brownlip; 40 per cent for Roei). These levels of egg production have proved capable of sustaining abalone populations elsewhere (e.g. Victoria, South Australia). Performance indicators are currently being developed from this for annual fishing mortality.
- An FRDC project proposal entitled "Abalone habitat categorization and standardization of abundance measures for stock enhancement and monitoring programs". This project has the objective to develop a method to accurately quantify abalone habitat, both for its effects on survival in re-seeded abalone and

on estimates of stocks density. Ultimately it will result in the refinement and improvement of the performance indicators for stock density.

7.3 Socio-economic research

The Metropolitan Abalone Fishery was a case study in the Economic Research Associates research project “*A Socio-Economic Valuation of Resource Allocation Options between Commercial and Recreational Use*” (McLeod and Nicholls, 2004).

The analysis was based on certain assumptions, i.e:

1. The combined existing commercial and recreational catch is all that is sustainable and available for inter-sectoral allocation.
2. All recreational participants are subject to binding constraints (catch limits, fishing days and fishing times, etc) that is there is no unused or spare capacity.
3. For all commercial operators it is optimal to take the current total allowable catch, that is, there is no spare capacity.
4. All commercial operators are internally structured to maximise producer surpluses from Roe’s abalone catches in the Perth fishery.

The model showed that if there was a sustainable catch of 76 tonnes and all the assumptions (listed above) were met, a reallocation of up to 4.5 tonne to the recreational sector could improve the overall net economic benefit from the combined use of the resource. However, the authors gave a number of reasons why the results should not be relied upon for determining resource allocations at this stage including:

- There were clear indications that the assumption (2 above) relating to the recreational fishery did not hold. For example, a more flexible management system that allowed recreational fishers more choice about when and how they fished could increase economic benefits to the recreational sector within existing catch constraints.
- The results from the study were indicative only and, if the approach were to be used for resource allocation decision-making purposes, it would be necessary to recalibrate the model to revalidate and/or update the data used. The report also suggested that this should be done after the intra-sectoral allocation issues in the recreational sector are resolved and after there had been sufficient time for the recreational sector to adjust to any changes.

Notwithstanding, the fact that the results from applying the static model were not definitive at this stage, in the longer term increasing population growth and downward pressure on Roe’s abalone prices (particularly from the growth in abalone aquaculture production) are likely to favour a gradual shift in resource use to the recreational sector, if net economic benefits are to be maximised.

7.4 Compliance and education

7.4.1 Compliance

The impact of illegal and unlicensed operators on abalone stocks is of great concern. A major part of the work of the Department of Fisheries’ Serious Offences Unit is concerned with the detection and prosecution of individuals and organisations involved with the illegal ‘take’ and sale of abalone.

The Abalone Fishery has a compliance program, which involves:

- a) Inspections of commercial operators when landing catches.
- b) Covert surveillance of targeted commercial operators.
- c) Checking that abalone catch and disposal records have been completed correctly and accurately.
- d) Inspections of processing facilities.
- e) Inspections of recreational activity for adherence to size limits and bag limits, etc.
- f) Covert surveillance to detect and apprehend illegal operators.

Abalone fishery compliance is also a national concern. The Department of Fisheries is currently attempting to implement a National Docketing System for abalone that will bring the monitoring of the abalone trade in WA under the same level of scrutiny as that in other states.

7.4.2 Education

Fisheries and Marine Officers conduct a wide variety of education and extension services, formally and informally, to commercial fishers, fishing organisations, schools and general community members.

When recreational fishers purchase an abalone licence, they also receive a comprehensive brochure setting out the rules for the fishery. The brochures are updated annually and will show any rule changes that may have taken place since the previous season.

Each season is preceded by a media release, newspaper advertisements and radio and television coverage announcing the opening and closing dates, reiterating the rules and informing the public about any rule changes.

The degree of community stewardship – community support for the sustainability of fish resources - is a crucial factor in successful recreational fisheries management. Community education is the key process for the development of effective community stewardship.

To this end, the Department of Fisheries' Volunteer Fisheries Liaison Officer (VFLO) program is a structured process of peer education and a key long-term management strategy for recreational fisheries. The volunteer program involves recreational fishers themselves encouraging a change in the knowledge, values and attitudes of other recreational fishers, that in combination influences fishing behaviour.

As a result, the VFLO program works beyond the conventional law enforcement and compliance model. VFLOs have been used extensively to make 'beach contact' with recreational abalone fishers in the Perth metropolitan area during each abalone season, handing out brochures on the rules, carrying out surveys and talking to participants not just about the fishing rules but the reasons behind them.

SECTION 8 CATCH AND EFFORT

8.1 Commercial

Catch statistics have been collected since 1964 for the commercial abalone fishery. Records since 1976, when the exploratory phase finished, show that the catches during this period have ranged from 115 to 260 tonnes for greenlip abalone, 75 to 150 tonnes for Roe's abalone and (since the mid 1980s) 10 to 40 tonnes for brownlip abalone.

Consequently, the catch history in the commercial fishery indicates that the yield levels for each of the three species has been relatively stable over the past 25 years and mostly vary according to the effort levels expended towards these species.

For each day's fishing, commercial divers record estimates of catch (in kg), effort (in hours or minutes) spent diving for abalone, and location fished within a 10 x 10 nautical mile grid system. The data is stored on a daily 'Catch and Disposal Record' that accompanies each daily catch.

The catch is formally weighed at a licensed processor, and the resulting data entered into the Abalone Catch and Effort (ACE) database at Department of Fisheries' regional offices. In the greenlip and brownlip fisheries, the number of abalone caught, the meat weight and mean meat weight are recorded.

Secondary information is collected from compulsory monthly catch returns and stored in the Department of Fisheries' Catch And Effort Statistical System (CAESS). This system encompasses all fisheries in WA and the data is divided up into larger grid systems (60 x 60 nautical mile). Although CAESS is not as detailed as the ACE database, catch data has been entered in this system since the late 1970s, and it is a good source of archival information.

8.1.1 *Roe's abalone*

The annual Roe's abalone commercial catch has varied between 122 and 95 tonnes since 1990. Note the 86 tonnes recorded for 1998 was taken over a six-month season (see note 5 below). An overall summary of catch, effort, and catch rate is given in Table 6.

Quota period ²	Roe's TACC (kg whole weight ³)	Roe's caught (kg whole weight)	Diver days ⁴ (Roe's divers only)	Kg whole weight per diver day (Roe's divers only)
1990	105,000 ⁸	117,558	881	120
1991	101,000 ⁸	110,334	758	130
1992	105,000 ⁸	112,275	644	155
1993	128,000	116,390	735	139
1994	125,960	119,849	804	128
1995	125,960	115,218	975	106
1996	125,960	122,065	950	117
1997	126,790	119,080	750	137
1998	93,960 ⁵	86,530	608	123
1999	119,900 ⁶	108,278	849	116
2000	115,900 ⁶	107,683	759 ⁷	120
2001	107,900 ⁶	99,173	681	127
2002	107,900	97,660	655	131
2003	110,900	95,057	714	120
2004	110,900	107,593	740	126

Table 6: Roe's abalone catch and effort¹ by quota period.

Notes

1. Data source: quota returns.
2. The length of quota period has varied with management changes, and for simplicity has been recorded against the nearest calendar year.
3. Standard conversion factors for meat weight to whole weight for Roe's abalone were 2.5 prior to 2000 and 3.0 from 2000.
4. Effort (diver days) for dedicated Roe's abalone divers only. This year, database improvements allowed a better estimate, and consequently, figures vary from last year. A standardisation multiplier (2.3) was applied to 1999–2002 diver days estimates from Area 7, to account for the increase in catch rates arising from the lifting of the daily catch limit of 100kg.
5. Reduced quota for a six-month season.
6. Industry-instigated voluntary six tonne reduction in quota for 1999, voluntary four tonne reduction in 2000 and a two tonne reduction in 2001 in response to concerns over the low abundance of legal-sized abalone in Area 8.
7. Prior to 2000, effort estimates (diver days) extracted from days when catch was processed; from 2000 onwards, effort estimates extracted from daily CDR counts.
8. The TACC does not include the optional nine tonne quota that Roe's only operators could take east of Point Culver. There was no TACC set for the take of Roe's abalone for Zone 2 licensees.

• *Roe's abalone – Metropolitan region*

Within Area 7 (Perth Metropolitan area) catch and effort and catch rates of the commercial fishery were as shown in Table 7. A description of the areas where these catches were taken is provided by Hancock and Caputi (Hancock and Caputi *in press*).

Quota period	Roe's TACC (kg whole weight)	Roe's total catch (kg whole weight)	Total diver days, Roe's	Roe's catch rate kg/diver day	Total diver hours, Roe's	Catch rate kg/hour
1997	*	36,455	372	98	950	38
1998	*	24,123	254	95	634	37
1999	36,000	36,091	184	196	776	45
2000	36,000	36,509	169	216	682	47
2001	36,000	35,406	195	182	784	43
2002	36,000	35,965	208	173	867	39
2003	36,000	36,007	207	174	894	40

Table 7: Summary of TACC, catch, effort and CPUE for the Area 7 (Perth metropolitan) commercial Roe's abalone fishery.

8.1.2 Greenlip/brownlip

The greenlip and brownlip abalone commercial catch has varied between 179 and 273 tonnes since 1989 (Table 8). In more recent times (since 1995), it has been more consistent, varying between 180 and 223 tonnes. An overall summary of catch, effort, and catch rate is given in Table 8.

Quota period ²	Greenlip TACC (kg whole weight)	Greenlip caught (kg whole weight) - all stocks	Greenlip caught (kg whole weight) - stunted stocks	Brownlip TACC (kg whole weight)	Brownlip caught (kg whole weight)	Combined catch (kg whole weight)	Diver days (main stocks only) ³	Greenlip kg whole (meat) weight ⁴ per diver day (main stocks only)
1989	-	236,145	22,058	-	36,943	273,088	1,319	157 (59)
1990	126,500	114,414		-	18,768	133,182	670	162 (60)
1991	148,500	131,266		-	14,660	145,926	800	148 (56)
1992	192,500	175,054		-	30,285	205,339	1,110	152 (57)
1993	197,450	178,794		-	31,155	209,949	1,216	139 (52)
1994	200,750	177,166		-	32,223	209,389	1,328	129 (48)
1995	187,264	151,863		-	27,263	179,126	1,082	134 (50)
1996	189,750	176,668	11,517	-	21,933	198,601	896	178 (67)
1997	207,350	187,993		-	26,298	214,291	1,052	173 (65)
1998	200,750	187,644	7,884	-	22,198	209,842	1,040	167 (63)
1999	189,750	180,620	8,024	28,000 ⁵	27,673	208,293	920	182 (68)
2000	194,669	189,846	4,307	34,875	33,531	223,377	1,028	178 (67)
2001	194,669	187,459	21,243	34,875	31,089	218,548	992	167 (62)
2002	202,521 ⁶	166,721	29,931	35,893	27,451	194,172	1,035	132 (50)
2003	202,521	180,018	24,164	37,400	32,260	212,278	1,104	141 (53)

Table 8: Commercial greenlip and brownlip abalone catch and effort¹ by quota period.

Notes

1. Data source: quota returns.
2. The length of quota period has varied with management changes and, for simplicity, has been recorded against the nearest calendar years.
3. Effort (diver days): main stocks are separated from stunted stocks, which are subject to controlled fishing regimes and not directly comparable. The new data differs from previous years and impacts on the effort range provided in the Fishery Governance section
4. In prior years, conversion factors for meat weight to whole weight for greenlip abalone were 2.75 prior to 2000 and 2.667 for 2000+. To standardise comparison, we used one conversion factor of 2.667 across all years. The brownlip abalone conversion factor for meat weight to whole weight is 2.5.
5. Brownlip allocations not fixed across Areas 2 and 3 (ex-Zone 1 and 2) prior to 1999. Brownlip TACCs were fixed for the first year in 1999.
6. 2002 greenlip/brownlip TACC raised by four per cent mid-season in accordance with changes in weight processing, but does not represent an increase in actual allowed catch.

8.2 Recreational

8.2.1 Recreational survey techniques

Two surveys have been used to obtain estimates of the recreational abalone catch from the major fishery in the metropolitan area, namely a field survey (since 1997) and a telephone survey (since 1999). The field survey is a more comprehensive survey involving Department of Fisheries' researchers and a large number of Voluntary Fisheries Liaison Officers, distributed along the metropolitan reef fishing areas on each fishing day.

While focused on the major Perth metropolitan area, the telephone survey has also enabled some preliminary estimates of catches elsewhere in the State.

The use of two different and relatively independent survey methods has been undertaken to provide cross-validation of the Perth metropolitan catch and effort estimates and to assess cost-benefit issues. The extension of the relatively low-cost telephone recall survey to regional areas has been undertaken, but has produced highly variable results, which have not been able to be validated with field observations.

As a consequence, a potentially more reliable but expensive telephone diary system was commenced in 2004/05 to obtain more accurate estimates of recreational abalone catch, particularly of greenlip and brownlip. It is anticipated that this phone/diary survey will be undertaken every two years. The data from this survey should be available at the end of 2005.

- *Metropolitan field survey methods*

A field survey is undertaken each Perth metropolitan abalone season (November to mid-December) to estimate the catch, effort, catch rate, and catch weight of Roe's abalone. The sampling employs a stratified effort survey (counts of number fishers from 20 vantage points across the high useage zones) of the fishery, combined with substantial interviews of fishers (1,000+ interviews per year) to obtain catch weights and catch rates.

Estimates of fishers from low useage zones are achieved by two aerial surveys each year. This survey enables accurate estimates of recreational catch and effort from the Northern, Central, and Southern sub-zones of the Perth metropolitan fishery that can be compared with the commercial catch from the same areas.

- *Historical telephone survey methods*

A telephone survey has been conducted annually to estimate catch, effort, and catch rate for Roe's abalone in the Perth metropolitan area, and has been extended to cover greenlip, brownlip, and Roe's abalone taken in the West and South Coast bioregions.

The method involves surveying 800 abalone licensees each year - 400 licensees (200 umbrella and 200 abalone) from the Perth metropolitan area and 400 licensees (200 umbrella and 200 abalone) from outside the Perth metropolitan area. The survey is conducted once a year in February. Licensees are selected randomly, contacted by phone and asked to provide information on their catch from the previous year.

- *Perth metropolitan telephone survey catch estimates*

The telephone survey results for the Perth metropolitan area are considered to be accurate and precise (95 per cent confidence limits of less than 10 per cent of the mean). The recall bias is considered to be low because the survey is conducted close to the period licensees are fishing (within two to three months of the season) and they only need to recall their catch from a very limited fishing season (nine hours).

- *Regional telephone survey catch estimates*

The regional telephone-based catch and effort results, i.e. for areas outside of the Perth metropolitan area, are not considered reliable at this stage, but are included as preliminary estimates. The lower statistical accuracy is due to fewer people being surveyed and spread over a much greater area, and the problems of recalling catches over a full 12-month fishing period.

In addition, there are separate sources of error related to species identification which have the potential to severely distort the catch estimates for greenlip and brownlip abalone, owing to the necessary assumption of standard weights.

Some of these sources of error, particularly recall bias, will be reduced by the new telephone/diary survey, but the species identification and species weight issues require comprehensive field survey data. Because of the dispersed nature of this sector of the fishery, this validation data may take a number of years to collect.

8.2.2 *Roe's abalone – Perth metropolitan region*

Both the telephone and field surveys are considered to give accurate estimates of the recreational take in the Perth metropolitan area since 1999 although the field survey gives a slightly lower estimate of the recreational catch (around three tonnes) than the telephone survey.

The estimated Roe's abalone recreational catch from the Perth metropolitan fishery has varied between 30 and 48 tonnes since 1999 (Figure 6). An overall summary of catch, effort, and catch rate is given in Table 9 separately for the telephone and field surveys. A description of the areas where these catches were taken is provided by Hancock and Caputi (Hancock and Caputi *in press*).

Year	Telephone Survey					Field Survey				
	Effort (days)	Catch (rate)	Catch (number)	Catch (tonnes)	95% Confidence Limits	Effort (days)	Catch (rate)	Catch (number)	Catch (tonnes)	Mean weight (kg)
1997						16,990	18.9	323,200	29.5	-
1998						20,820	17.5	369,900	33.8	-
1999	23,300	17.6	410,000	37.7*	33.8 – 41.6	22,070	17.4	383,600	35.3*	0.092*
2000	21,800	17.0	369,000	33.7	29.5 - 36.8	19,800	16.7	330,300	30.2	0.0913
2001	29,600	17.6	521,500	47.8	43.3 – 52.3	25,590	18.8	481,300	44.1	0.0917
2002	26,300	16.7	438,500	39.3	35.4 – 43.2	22,450	17.9	401,500	36.0	0.0897
2003	28,700	17.1	489,800	47.2	43.0 – 51.4	23,700	18.6	442,405	42.6	0.096
2004						18,661	19.0	354,800	32.8	0.0925

Note: * Updated mean weight of 1999 based on five-year (2000-2004) average has lowered the previously reported catch (tonnes) estimate for 1999 from 45.8 to 35.3 tonnes for the field surveys, and from 48.8 to 37.7 tonnes for the telephone surveys.

Table 9: Summary of effort (fisher days), catch rate (abalone per fisher day), catch (number of abalone and tonnes whole weight) and mean whole weight (kg) for the Perth recreational Roe’s abalone fishery, from telephone and field surveys (SoF, 2004).

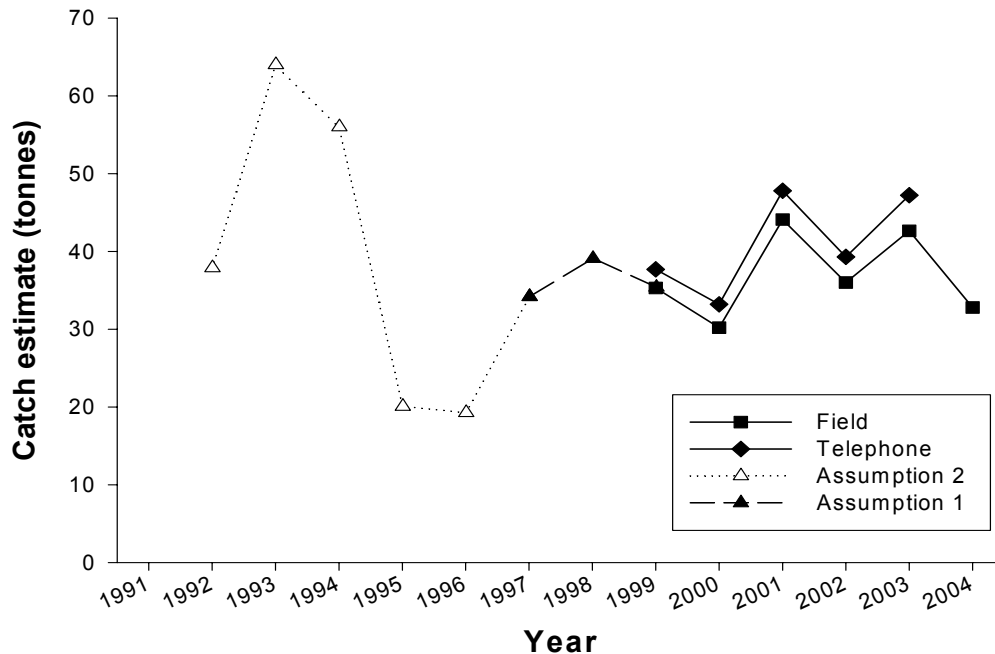


Figure 6: Catch estimates for the Perth recreational abalone fishery for the period 1992 to 2001, including backwards projections through time based on two assumptions.

Notes: Assumption 1 assumes that the mean weight of abalone taken during 1997 and 1998 is equal to the average of the two mean weight values measured for 1999 and 2000 (i.e. 105.4 g, averaged from 119.5 g in 1999 and 91.3 g in 2000). Numbers caught are estimated using the field survey technique.

Assumption 2 assumes that effort from 1992 to 1996 is the average percentage of the potential effort utilised for the years 1997 to 2000; that the catch rate for the years 1992 to 1996 is the average of the annual catch rates for the years 1997 to 2000; and that the mean weight of abalone taken from 1992 to 1996 is the same as applied to 1997 and 1998 in Assumption 1.

Note that the recreational season totalled 16 days in 1993, 12 days in 1992 and 1994, five days in 1996 and six days in 1995 and 1997–2003. In 1992–1994 fishing was permitted for two hours per season day (7.00 to 9.00 a.m., Saturdays and Sundays). Since 1995, permissible fishing time per season day has been 1.5 hours (7.00 to 8.30 a.m., Sundays only).

8.2.3 All species – Outside the Perth metropolitan region

Preliminary data from the telephone survey of fishing outside of the Perth metropolitan area is summarised in Table 11.

- *Data limitations*

Although the estimates in Table 11 have been recorded previously in the *State of the Fisheries Report* they have yet to be validated. They are included for completeness and may be able to be further improved when field data become available.

In considering the data in Table 10, it is notable that there is a high degree of variation in both the annual catch and catch rate estimates, particularly for the two larger abalone species. This reflects the various sources of bias and error in 8.2.2 and 8.6.

Given that the survey methodology used did not target regions outside the Perth metropolitan region, the resultant variation in individual estimates suggests that they should not be relied upon as an accurate estimate of the recreational catch for resource sharing purposes.

The more reliable telephone/diary survey now underway (2004/05) is expected to provide improved estimates with less recall bias. Field data currently being collected will further validate the estimates.

These estimates, which will become available when the data is analysed towards the end of 2005, will provide the first reasonably reliable information for resource allocation purposes. It is also anticipated that the historical catches will be able to be re-estimated, utilising the relationship between the improved survey data and the time series of numbers of abalone licences on issue in regional areas.

This process of back-calculation will improve, as more years of phone/diary survey data are added.

Year	Effort ¹ (days)	Roe's abalone			Greenlip abalone			Brownlip abalone		
		Catch rate	Catch ² (tonnes)	Confidence limits	Catch rate	Catch ³ (tonnes)	Confidence limits	Catch rate	Catch ⁴ (tonnes)	Confidence limits
West Coast										
1999	10,300	12.4	11.8	8.5–14.6	1.9	13.5	8.1–18.9	1.2	8.1	4.8–11.3
2000	9,800	12.7	11.2	8.4–13.7	2.3	15.5	10.2–20.8	0.6	4.6	2.9–6.3
2001	18,400	13.1	21.6	17.3–25.9	1.9	23.6	16.1–31.0	0.9	11.0	7.4–14.5
2002	17,500	14.3	22.5	17.1–27.9	1.6	18.4	12.4–24.5	0.4	4.6	3.1–6.2
2003	13,600	12.5	15.2	11.6–18.8	0.5	4.4	1.2–7.5	0.3	2.4	0.3–4.5
South Coast										
1999	16,300	11.0	17.0	11.5–22.1	3.0	22.6	16.1–29.2	0.7	7.1	5.0–9.2
2000	13,000	7.3	8.3	6.1–10.2	5.0	31.5	22.0–41.0	0.8	7.4	4.8–10.0
2001	9,600	7.1	6.1	4.1–8.1	5.1	22.7	12.2–33.3	1.1	6.6	4.1–9.1
2002	6,900	7.9	4.9	3.1–6.7	3.5	11.4	6.5–16.2	1.1	4.7	2.1–7.4
2003	9,500	11.3	9.6	5.4–13.8	2.6	11.7	5.6–17.8	0.5	3.2	1.2–5.1

Table 10: Preliminary summary of effort (fisher days), catch rate (abalone per fisher day) and catch (number of abalone and *t* whole weight) for the west coast (excluding Perth) and south coast recreational abalone fisheries, from telephone surveys.

Notes

1. Effort is estimated for all species combined.
2. Mean whole weight for Roe's abalone is assumed to be 90 g (mean weight measured from the Perth fishery for 2000).
3. Mean whole weight for greenlip is assumed to be 661 g for the west coast and 467 g for the south coast.
4. Mean whole weight for brownlip is assumed to be 0.675 kg for the west coast and 0.650 kg for the south coast.
5. West Coast includes the area from Shark Bay to Black Point (East of Augusta) excluding the Perth metropolitan area.
6. South Coast is the area East of Black Point to the WA/SA border.

8.3 Indigenous

Although the Department of Fisheries has no quantitative information available on the catch of abalone by Indigenous people, there is evidence available that indicates Indigenous people have traditionally taken abalone for food and continue to do so.

For example, the National Native Title Tribunal in a research report on Indigenous fisheries on the west and south coasts of WA (Wright, 2005) refer to evidence from an archeological study of coastal middens that south-western Aboriginal people ate marine molluscs including abalone.

More recently, evidence has been given in a South Coast Native Title Claim that abalone were collected by Aboriginal people from reefs tops and rocks (Dimer v State of Western Australia 1998). Department of Fisheries licensing records show that on the 30 June 2005, 1,133 recreational umbrella² licences were held by Aboriginal people,

² A licence to engage in all recreational activities ie abalone, rock lobster, marron, netting and freshwater angling, see also section 8.2

notwithstanding the fact that Aboriginal people are not required to hold a recreational licence.

Recreational fishing surveys have not reported on the cultural background of those surveyed (although future surveys will now do so). However, the surveys only involve fishers who hold a recreational fishing licence. There are no surveys or formal data collection on customary fishing and indeed little on Indigenous fishing practices in general (with the exception of data collected from the Kimberley communities in conjunction with the national recreational and Indigenous fishing survey).

Specific data collection and consultation is required state-wide to gain a better understanding of Indigenous fishing patterns. Until such data is collected, a broad estimate of Indigenous fishing catch can be made by extrapolating census data on proportions of Indigenous to non-Indigenous people and relating this proportion to recreational catch data for the areas of Western Australia within which abalone occurs. This assumes that the Indigenous population in coastal areas are fishing at the same rate as the non-Indigenous population.

The weighted percentage of Indigenous people in the population in coastal areas (including Perth) from Kalbarri to Augusta is equal to approximately 1.7 per cent (2001 Census). On this basis, it can be anticipated that recreational Indigenous fishers would have taken about 1.7 per cent of the Roe's abalone in the west coast bioregion (south of Kalbarri), or about 1 tonne per year currently.

On the south coast the weighted percentage of Indigenous people in the coastal areas from Augusta to the South Australian border is equal to approximately 3.5 per cent (2001 Census). However, the applicability of this proportion to the south coast recreational catch is more complex, as the 'species mix' on the south coast generally requires access to scuba to take the two larger, deeper-water species of abalone.

This additional unknown, together with the uncertainty around the recreational catch estimates on the south coast, indicates that further dedicated surveys would be required to provide useful data for allocation purposes.

It is also important to note that the application of Indigenous proportion of the population to recreational catch estimates cannot provide any estimate of quantity of abalone taken for customary purposes.

8.4 Aquaculture

The companies that currently hold Ministerial exemptions for the collection of broodstock are listed in Table 11.

Company	Number granted by species				
	Greenlip	Brownlip	Roe's	Scalaris	Tropical
Mariculture Holdings T/A Great Southern Marine Hatcheries	300	100	100	-	-
Bayside Abalone Farms Pty Ltd	250	50	250	-	-
Challenger TAFE	200	200	200	200	-
Kimberley TAFE	-	-	-	-	50
MSH Pty Ltd T/A Manbana	-	-	-	-	50
TOTAL	750	350	550	200	100

Table 11: The number of abalone permitted to be taken as broodstock by aquaculture licensees in 2004

8.5 Illegal catch

There are no reliable estimates of the illegal and unreported catch of abalone. This illegal and unreported catch falls into five broad categories:

1. *Recreational fishers illegally taking abalone for their personal use contrary to the management rules.* This usually involves the taking of undersize abalone generally in small numbers to meet a recreational fisher's bag limit expectations, or opportunistically taking over the bag/possession limit for abalone when catch rates are high. Spatial variations in the availability of abalone can influence recreational attitudes to compliance.
2. *Commercially licensed operators illegally taking abalone for their personal use.* This form of non-compliant activity usually involves the illegal retention of small numbers of protected or unreported abalone for the purpose of food by a commercial fisher for their family and/or friends. This activity is generally socially and not profit driven.
3. *Commercial licensed operators illegally taking abalone for sale, gain or reward.* This practice involves the retention of protected and/or unreported abalone for sale that are taken in conjunction with legitimate commercial abalone fishing activity. In practice, there are two avenues for commercial operators to dispose of abalone illegally. They could under report the amount of abalone they deliver to a processing factory or sell abalone for cash, for example to the local restaurant trade.
4. *Licensed recreational fishers illegally selling abalone or both illegally taking and selling abalone.*

There are two basic types of illegal operations in this category:

- a. Those that fish legitimately within the rules but fish regularly and with a high degree of expertise to maximise the catch, which is later sold, or;
- b. Those that take excessive catches (above the bag limit) whenever the opportunity presents, whether protected or unprotected abalone.

5. *Unlicensed persons taking abalone for sale gain or reward.*

Persons in this category do not hold either a recreational fishing licence or one for the commercial managed fishery. They operate illegally in a semi-commercial manner, disposing of the abalone they take through a number of sources, i.e. retail or restaurant trade or personal networks.

When persons in categories 4 and 5 are caught with illegal catch, they are subject to severe mandatory penalties in keeping with their commercial-level activities.

This list does not attempt to cover all avenues of illegal activity or possible offences in the abalone fishery. The above classes of offender deals with fishing practices that result in the illegal taking of abalone that is unlikely to be accounted for in catch data relating to both the recreational and commercial abalone fisheries and, if significant, needs to be considered in determining sustainable harvest levels.

Historically, the quantity of abalone taken illegally has been implicitly taken into account in the TACC setting process. The amount of abalone taken by unlicensed illegal fishers for commercial gain is thought to be, by far, the most significant proportion of the illegal take. There is evidence to suggest that organised crime is occasionally involved in this type of activity.

Whilst this type of activity is contained through effective compliance programs, any significant growth in the activity will ultimately impact on the overall sustainable yields from the fishery. This threat continues to be a high risk for the fishery, but in setting relative catch shares for a fishery, it is not a factor that needs to be taken into account.

8.6 Comparison between commercial and recreational Roe's abalone catches

Overall, the historical commercial and recreational catch levels in the abalone fishery are considered sustainable. The following sections provided comparisons for the Perth metropolitan area, which is the focus of a significant commercial and recreational fishery for Roe's abalone.

Comparisons of catches are not provided outside the Perth metropolitan area because the recreational catch estimates are not considered to be accurate at this stage for this purpose for the following reasons.

1. Small sample sizes – surveys were aimed at the abalone fishing in the Perth area and sample sizes outside the Perth area were relatively small.
2. Recall bias - the estimates were made from data obtained via an annual telephone survey, in which fishers were asked to remember how many times they fished during a 12-month period, and what their average catch was. Such a technique is known to result in 'recall bias', in which estimates given are over-estimates. This was found to be the case in rock lobster surveys done with recall compared to those undertaken throughout the course of a year.
3. Species identification - there is concern over whether fishers were correctly distinguishing between the different abalone species.

To this end, a comprehensive phone/diary survey has been undertaken for the 2004-05 recreational fishing year, in which fishers have been supplied with diaries and photo

identification sheets, and are tracked for the whole year by telephone interviewers so that recall bias is reduced.

It is expected that this survey will provide more accurate estimates of recreational catch of abalone outside the Perth metropolitan area. However, the results are not expected to be available until December 2005.

8.6.1 *Roe's abalone by area*

- *Perth metropolitan area*

In Table 12 a comparison of the Roe's abalone catch between commercial and recreational areas in the Perth metropolitan area is provided. A graphical comparison is also given in Figure 7.

Year	Commercial Catch (kg)	Estimated Recreational Catch (kg)	Total Catch (kg)	Percent Recreational
1997	36,455	29,500	65,955	45
1998	24,123	33,800	57,923	58
1999	36,091	35,291	71,382	49
2000	36,509	31,950	68,459	47
2001	35,406	45,950	81,356	56
2002	35,965	37,650	73,615	51
2003	36,007	45,000	81,000	56
2004	35,889	32,800	67,889	48

Table 12: *Historical Roe's abalone catches from recreational and commercial fishing in the Perth metropolitan region (kg whole weight)*

Note: Commercial catch estimates obtained Area 7. Recreational catch estimates from the Metropolitan stratum reported in Recreational Abalone Table 2 of the 2004 *State of the Fisheries Report*, and are viewed as more accurate than those obtained from telephone surveys of the west and south coasts. Figures here are the average of two estimates produced from telephone and field surveys. The estimate for the recreational catch for 1997, 1998, 2004 are from the field surveys only.

- *Perth metropolitan area (North)*

In Table 13 a comparison of the Roe's abalone catch between commercial and recreational areas in the north Perth Metropolitan area is provided. This area extends from Moore River to Mullaloo Point, or more generally, north of Hillary's marina.

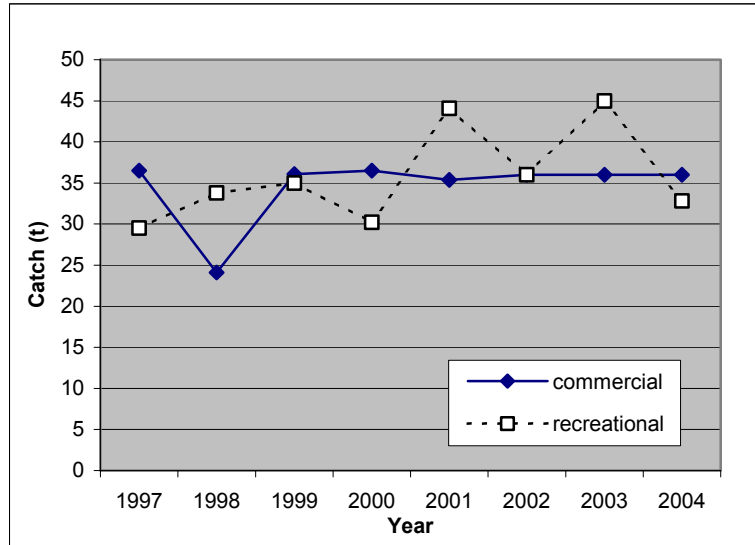


Figure 7: Comparison of Perth metropolitan abalone commercial and recreational catch field survey and commercial logbook returns

Year	Commercial Catch (kg)	Estimated Recreational Catch (kg)	Total Catch (kg)	Percent Recreational
1997	14,974	-	-	-
1998	12,249	-	-	-
1999	13,167	23,235	36,402	64
2000	12,607	12,790	25,397	50
2001	15,687	19,802	35,489	56
2002	16,528	17,026	33,554	51
2003	16,008	26,649	42,657	62
2004	15,763	15,000	30,763	49

Note: Commercial catch estimates obtained from Moore River to Mullaloo Point in Area 7. Recreational catch estimates from field survey data collected by the Mollusc Research Section.

Table 13: Historical Roe's abalone catches from recreational and commercial fishing in the North Perth metropolitan region (kg whole weight)

- Perth metropolitan area (Central)

In Table 14 a comparison of the Roe's abalone catch between commercial and recreational areas in the central Perth metropolitan area is provided. This area extends from Mullaloo Point to Woodman Point, or more generally, the stocks from Hillarys Marina to Trigg Island.

Year	Commercial Catch (kg)	Estimated Recreational Catch (kg)	Total Catch (kg)	Percent Recreational
1997	10,132	-	-	-
1998	5,483	-	-	-
1999	8,773	13,250	22,023	60
2000	3,989	13,178	17,117	77
2001	6,441	18,342	24,783	74
2002	5,066	14,550	19,616	74
2003	7,252	16,347	23,599	69
2004	6,393	14,100	20,493	69

Table 14: Historical Roe's abalone catches from recreational and commercial fishing in the central Perth metropolitan region (kg whole weight)

Note: Commercial catch estimates obtained from Mullaloo Point to Woodman Point t in Area 7. Recreational catch estimates from field survey data collected by the Mollusc Research Section.

- *Perth metropolitan area (South)*

In Table 15 a comparison of the Roe's abalone catch between commercial and recreational areas in the south Perth metropolitan area is provided. This area extends from Woodman Point to Cape Bouvard, and includes the Garden Island and Penguin Island reefs.

Year	Commercial Catch (kg)	Estimated Recreational Catch (kg)	Total Catch (kg)	Percent Recreational
1997	11,252	-	-	-
1998	6,392	-	-	-
1999	14,151	961	15,112	6
2000	19,914	760	20,674	4
2001	13,277	2,037	15,314	13
2002	14,370	1,337	15,707	9
2003	12,747	2,140	14,887	14
2004	13,733	3,600	17,333	21

Table 15: Historical Roe's abalone catches from recreational and commercial fishing in the south Perth metropolitan region (kg whole weight)

Note: Commercial catch estimates obtained from Woodman Pt to Cape Bouvard in Area 7. Recreational catch estimates from field survey data collected by the Mollusc Research Section.

- *Whole of the State*

As noted previously, data for recreational catches outside of the well-studied metropolitan area are not sufficiently reliable to estimate catch shares. Data being collected during 2004/05 will provide improved estimates and these will be used with the trends in abalone licence numbers to provide estimates for back years.

8.6.2 Summary of comparisons for Roe’s abalone

A summary of the percentage of Roe’s abalone taken by the recreational sector in each area of the metropolitan fishery over the period 1997 to 2003 is provided in Table 16.

Year	North Perth	Central Perth	South Perth	Metro average
1997	-	-	-	45
1998	-	-	-	58
1999	57	61	6	49
2000	50	77	4	47
2001	56	75	13	56
2002	51	77	8	51
2003	60	73	13	56
2004	49	69	21	48

Table 16: *Estimated percentage of Roe’s abalone taken by the recreational sector in each sub-area of the metropolitan fishery*

8.7 Sustainable Harvest Level for abalone

8.7.1 Roe’s abalone – metropolitan region

Sustainable harvest levels (SHLs) for Roe’s abalone in the Perth metropolitan area are given in Table 17, which includes data for the three sub-regions of this fishery. These SHLs represent the best estimates the Department of Fisheries’ Research Division is able to provide and are subject to the performance criteria and evaluation criteria described elsewhere in this document.

The SHLs are subject to the following constraints:

1. The historical data for the recreational catch in the Perth metropolitan area has a degree of variability reflected in the error bars around the estimates.
2. The commercial catch data may reflect rotational fishing activity and can vary within sub-regions from year to year as a result of fisher behaviour.

As the SHLs are based on the retained catch of commercial operators and recreational fishers under current fishing operations, they represent the total quantity of abalone that may be taken by the commercial and recreational sectors. They do not include

unquantified catches such as the illegal catch (see section 8.5) and the customary catch (section 8.3), which have been accounted for in the SHL estimating procedure.

The range given for the SHL is due to the variability in the recreational catch as the commercial catch is subject to a quota. Not only does the recreational catch vary from year-to-year according to weather conditions³, but there is also error around the estimates because of the survey methods used.

Sub-region	SHL
North Perth	36 (Range: 30 – 40)
Central Perth	23 (Range: 18 – 26)
South Perth	18 (Range: 15 – 20)
Total	77 (Range: 73 – 83)

Table 17: Perth metropolitan Roe’s abalone Sustainable Harvest Levels (in tonnes whole weight)

8.7.2 All species – outside the Perth metropolitan region

Outside the Perth metropolitan area total allowable catches for the commercial sector are set annually for each area (1–7). There is no total allowable catch set for the recreational sector. However, catches in each area are considered to be within sustainable harvest levels, because adjustments are being made to the TACC annually to maintain overall stock levels (see appendices 1 and 2). This process, together with the conservative size limits relative to size at first breeding for each species, and recreational management arrangements ensure that all species are being harvested sustainably.

Data being collected on the recreational catch in 2004/05 is expected to enable the estimation of SHLs for abalone outside the metropolitan area.

³ Adverse wind and swell conditions make recreational fishing more hazardous because most abalone are taken by wadding or snorkelling on shallow reef top platforms over a very short time period.

SECTION 9 IMPACTS OF FISHING

9.1 Ecological impacts

A full examination of the ecological impacts of the Abalone Managed Fishery can be found in the “*Application to Environment Australia on the Abalone Fishery*” (DoF, 2002). A summary of that analysis follows.

9.1.1 On primary species

The stock of Roe’s abalone is fished recreationally by wading or snorkelling on subtidal reef platforms. This fishing, in addition to reducing the biomass of legal sized abalone, can in adverse weather conditions result in some unintended discard mortality of undersize abalone as it is not as easy to identify the size of abalone before they are removed. There is also some evidence to suggest that some fishers ‘high-graded’, that is if abalone are found that are larger than the ones that have been found previously, the latter are sometimes discarded by fishers. Abalone typically do not survive or re-attach to rocks/reefs if damaged. Accordingly, the Department in its abalone brochures draws fishers’ attention to the need to, choose the abalone they wish to remove carefully, use an appropriate technique, and not ‘high grade’.

The only research on estimating discard mortality from the recreational Roe’s abalone fishery near Perth has given highly variable estimates (Hancock et al 2004).

This secondary impact of fishing should be minimised, but is likely to have only a minimal impact on stock sustainability and overall yield from the fishery. That is, annual production is largely controlled by density-dependent growth and survival, which limits the carrying capacity of each reef.

The recreational catch estimates provided in this report are likely to underestimate the total recreational fishing induced mortality, as they do not include estimates of the secondary impact of recreational fishing. However, this secondary impact has been implicitly taken into account in determining the sustainable harvest levels for Roe’s abalone in the Perth metropolitan region. Further research is required to more precisely measure this secondary impact overtime and adjust future sustainable harvest levels appropriately.

This secondary impact of fishing is generally not significant in the commercial fishery as fishers operate in deeper water and are more expert in fishing.

9.1.2 On bycatch species

The commercial Abalone Managed Fishery is based on catching abalone only. No other species are collected and retained for commercial use. Recreational fishers are entitled to harvest sea urchins and other molluscs during the abalone season within the bag limits.

9.1.3 On the general environment

There are no major issues associated with the impacts on the environment as a result of removing abalone from the reef ecosystems. It is unlikely that the fishery has any significant effect on the food chain in the region, as all three species predominantly feed

on detached drift algae and are a small proportion of the molluscan fauna on coastal reef systems.

9.2 Socio-economic impacts

9.2.1 Commercial and recreational fisheries

See Section 4 of this report for a discussion of the socio economic impacts of fishing for abalone.

9.2.2 Social impacts

The recreational fishery provides a major social benefit to sectors of the community and anecdotally is largely a family activity in the Perth metropolitan portion of the fishery. Some sectors of the recreational fishing community consider it a seafood delicacy.

Apart from collecting abalone being a recreational activity and providing enjoyment from that perspective, it provides members of the public who want to access fresh abalone as a food an alternative to buying abalone.

SECTION 10 REFERENCES

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APPENDIX 1 TOTAL ALLOWABLE COMMERCIAL CATCH (TACC) AND PERFORMANCE INDICATORS

Area	Performance Indicator	Value/Range/Comments
Overall	<i>Greenlip</i>	
	TACC	71.4 tonnes
	Catch	65.6 to 76.7 tonnes (meat weight)
	Effort	1,035-1,428 diver days
	Catch rate	48 to 63 kg meat weight per diver day
	<i>Brownlip</i>	
	TACC	14 tonnes meat weight
	Catch	12.6 to 14.6 tonnes (meat weight)
Area 1	<i>Greenlip</i>	
	TACC	1.2 tonnes meat weight
	Catch	0 to 1.2 tonnes
Area 2	TACC	28.6 tonnes
	Catch Rate	55 kg meat weight per day
	Meat Weight	180 g
	Catch	28.6 tonnes
Area 3	TACC	41.6 tonnes
	Catch Rate (overall)	60 kg per day
	Catch Rate (Hopetoun)	50 kg per day
	Meat Weight	240 g (Augusta), 200 g (Hopetoun)
	Catch	41.6 tonnes
Area 2	<i>Brownlip</i>	
	TACC	7.2 tonnes
	Meat weight	265 g
Area 3	TACC	6.8 tonnes
	Meat weight	270 g
All Areas ¹	Average Shell size	Shell size by location
	Fishing Mortality	Shall be based on growth parameters and commercial shell data
	Stock Density	Shall be based on fishery independent surveys

Table 1: TACCs and performance indicators in Western Australia's greenlip/brownlip abalone stocks for the 2004-2005 fishing season. Note that most of these vary slightly from season-to-season and the values presented here are not applicable beyond the current season. Also, data on greenlip and brownlip weights are meat weight data, not whole weight.

¹ Indicators for all areas are still under development.

Area	Performance Indicator	Value or Range (if appropriate)
Overall	TACC	110.9 tonnes
	Catch	104.3 to 121.7 tonnes (whole weight)
	Effort	679-914 diver days
	Catch rate	106 to 137 kg whole weight per diver day
Area 1	TACC	9.9 tonnes
	Effort range	19 – 43 diver days
	Catch rate range	129-290 kg per day
Area 2	TACC	18 tonnes
	Effort range	163 – 211 diver days
	Catch rate range	113-142 kg per day
Area 5	TACC	20 tonnes
	Effort range	85 – 125 diver days
	Catch rate range	90-134 kg per day
Area 6	TACC	12 tonnes
	Effort range	76 – 124 diver days
	Catch rate range	97-154 kg per day
Area 7	TACC	36 tonnes
	Effort range	170 – 208 diver days
	Catch rate range	173-216 kg per day
	Density (<60 mm) ¹	28 to 38 per m ²
	Density (60+ mm) ¹	28 to 34 per m ²
Area 8	TACC	15 tonnes
	Effort range	122 – 182 diver days
	Catch rate range	103-151 kg per day

¹ Data from fishery independent stocks surveys. Ranges still under development.

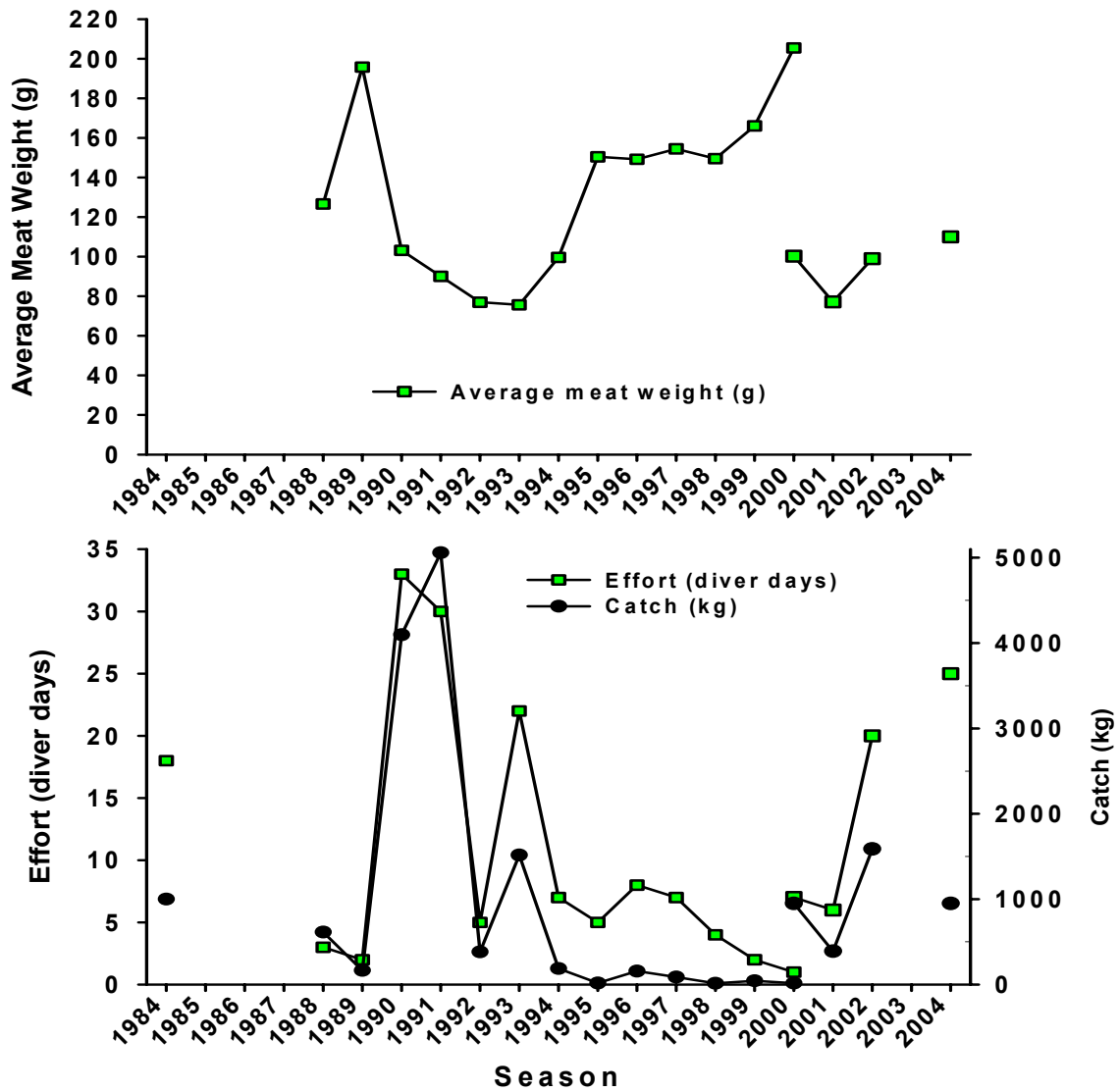
Table 2: *TACCs and performance indicators in Western Australia's Roe's abalone stocks for the 2004-2005 fishing season. Note that most of these vary slightly from season-to-season and the values presented here are not applicable beyond the current season.*

APPENDIX 2: STOCK ASSESSMENT AND COMMERCIAL CATCH AND EFFORT FIGURES BY AREA

Area 1: Greenlip

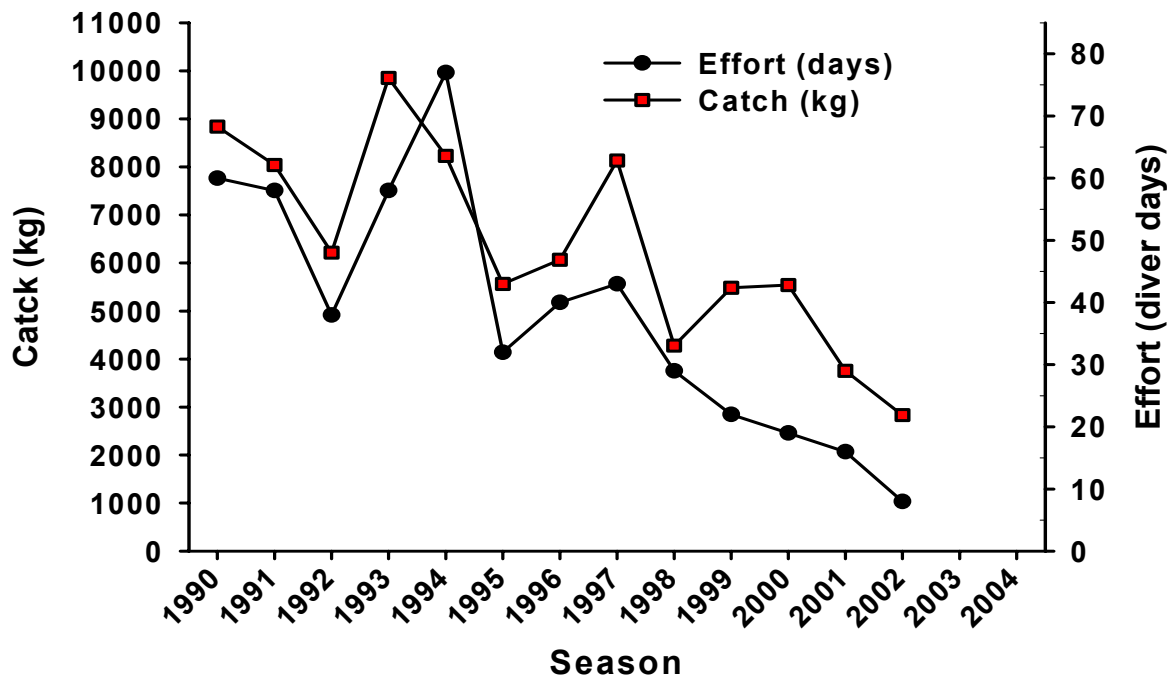
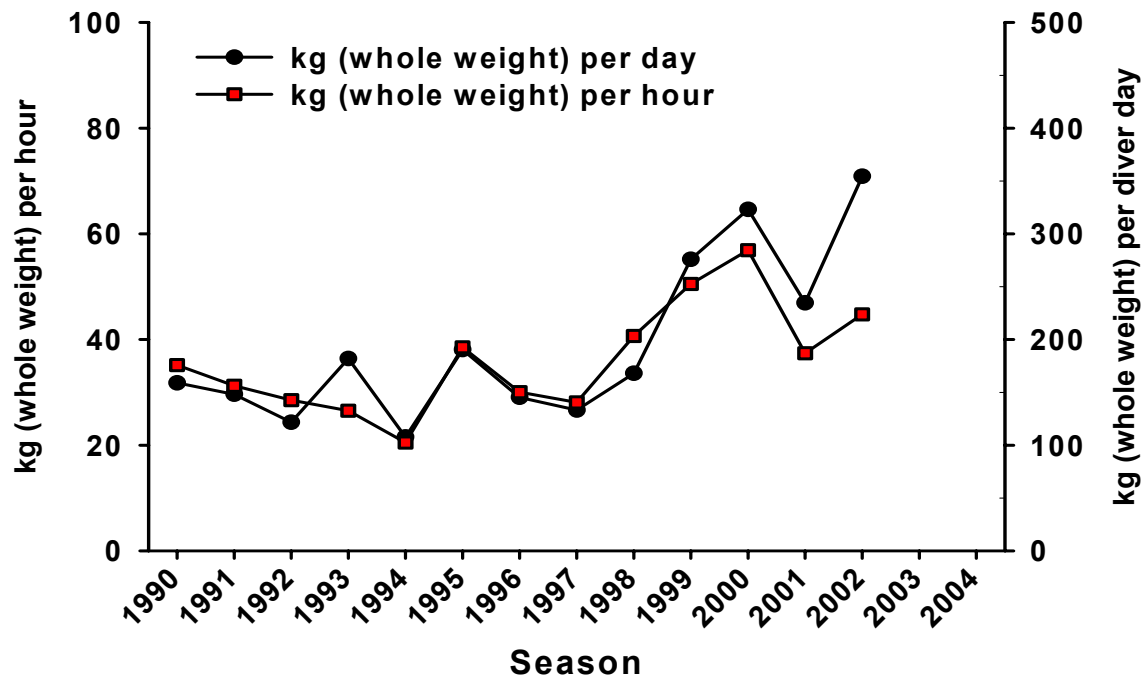
- Total allowable commercial catch (TACC) of 1.2 tonnes in 2004.
- Consists mainly of isolated pockets of stunted stocks of low productivity.
- No catch for 2002 or 2003.
- TACC due to be taken at reduced legal minimum size (120 mm shell length) during January and February 2005.

Area 1 Greenlip statistics (overall)



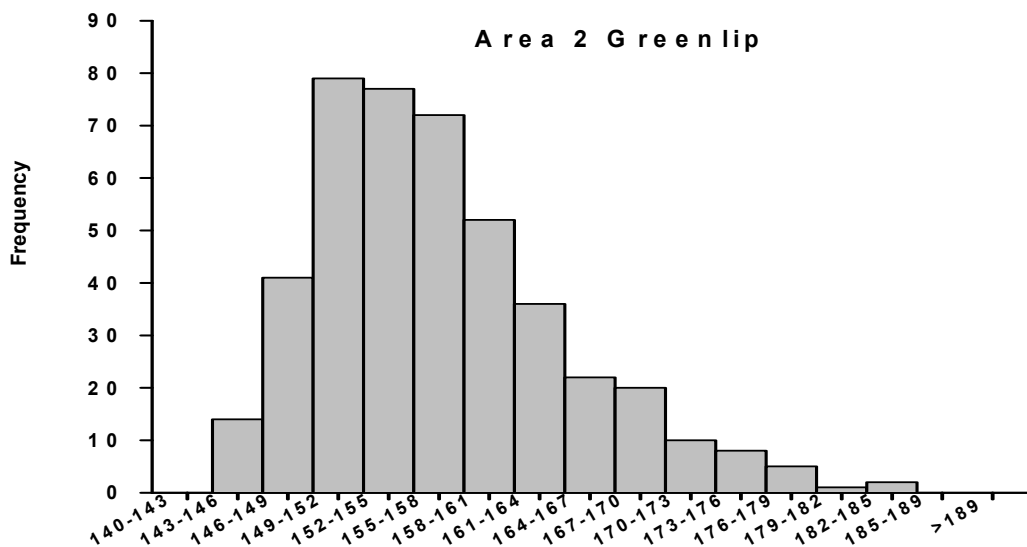
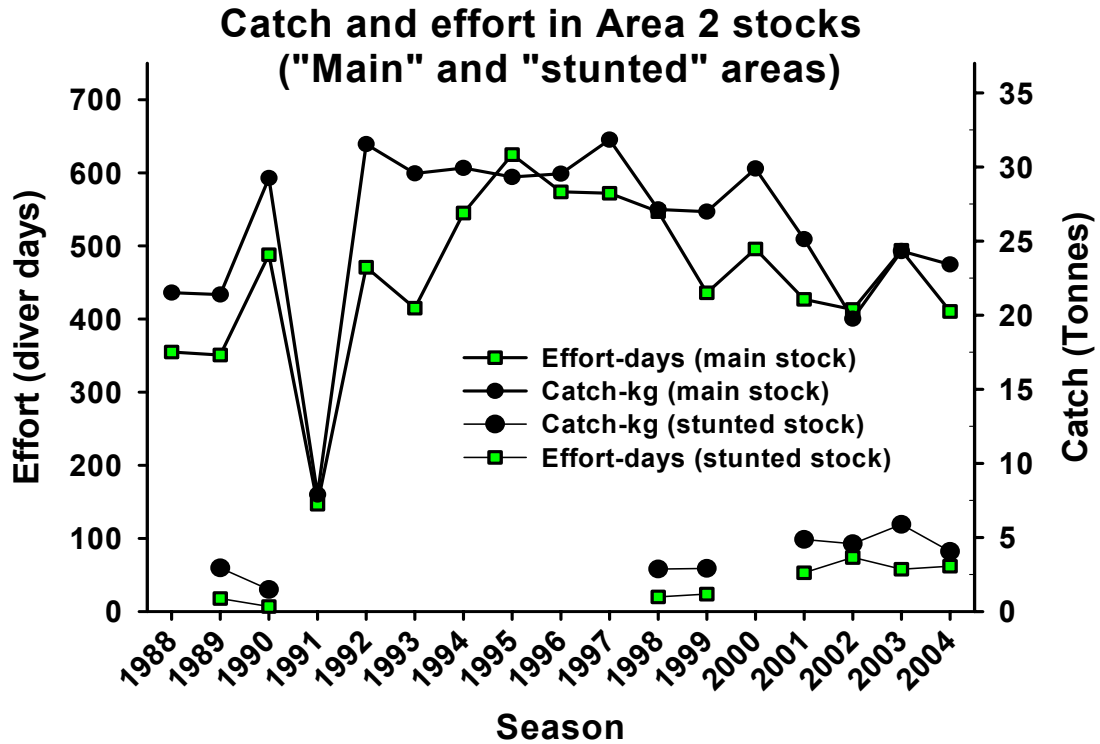
Area 1: Roei fishery

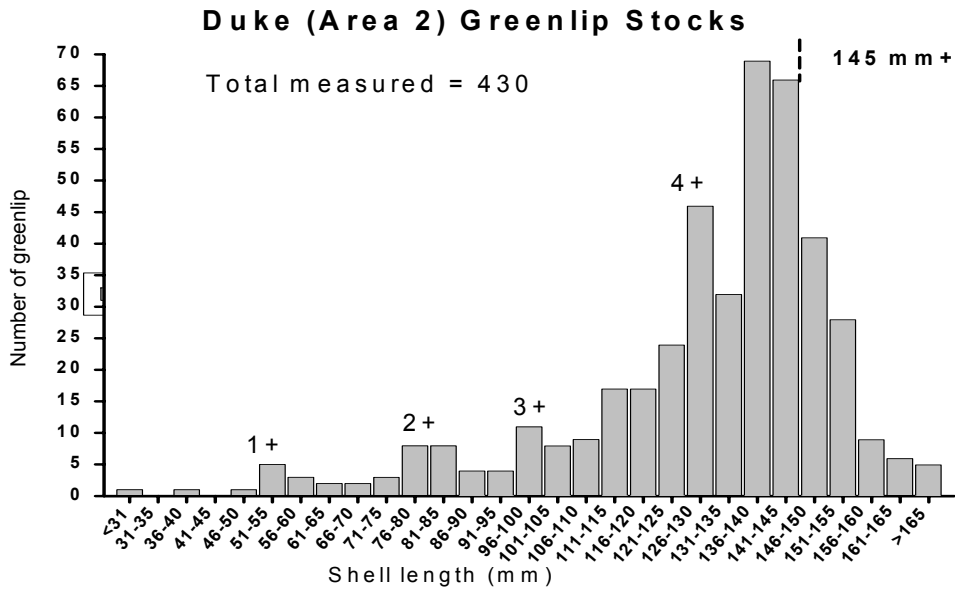
- Exploratory quota (TACC) of 9.9 tonnes in 2004.
- Consists of isolated pockets of productive reefs with a high legal minimum size (70 mm).
- The main Area (Twilight Cove) has not been fished for three years.
- No catch so far taken in the 2003 or 2004 season.
- Stock shows long-term decline in catch and effort.
- Catch rates are increasing.



Area 2: Greenlip

- TACC of 28.6 tonnes meat weight in 2004.
- Quota divided up into 23.4 tonnes from main stocks and 5.2 tonnes from stunted.
- Main stock TACC subject to performance indicators:
 1. Catch rate: 55 kg per day.
 2. Meat weight: 180 g.
- Greenlip catch as at 15 November was 26.5 tonnes (22.5 tonnes main stocks; 4 tonnes stunted stocks).
- Main catch taken with 412 days fishing effort.



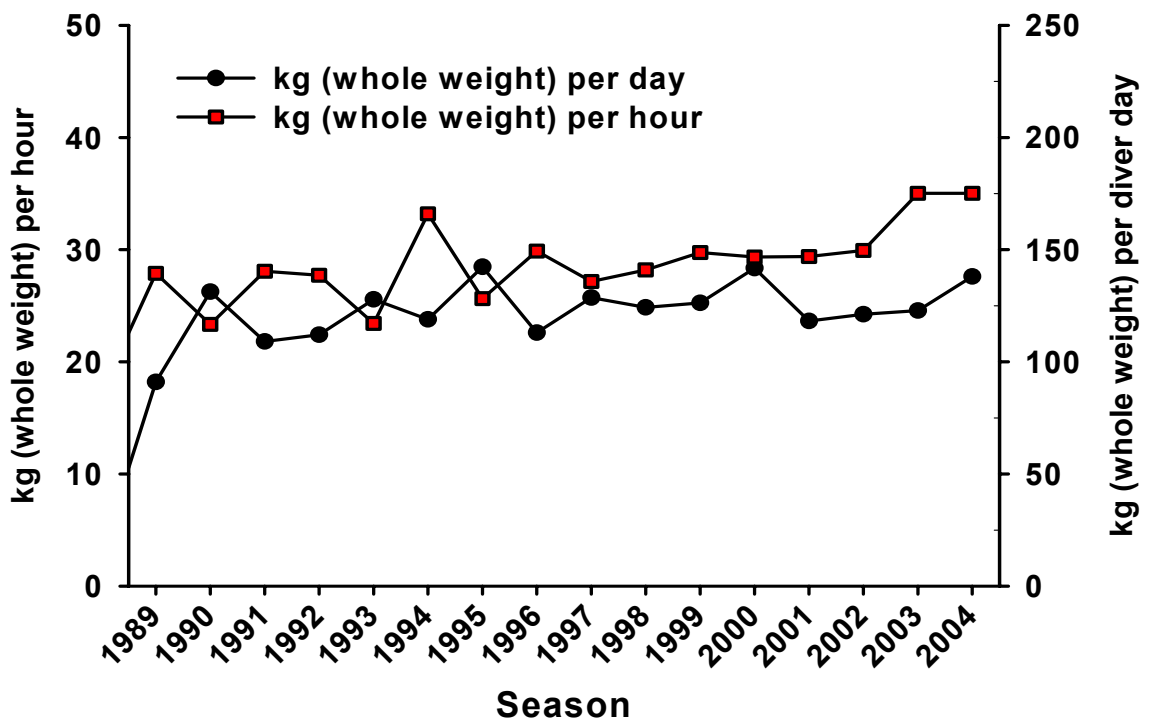
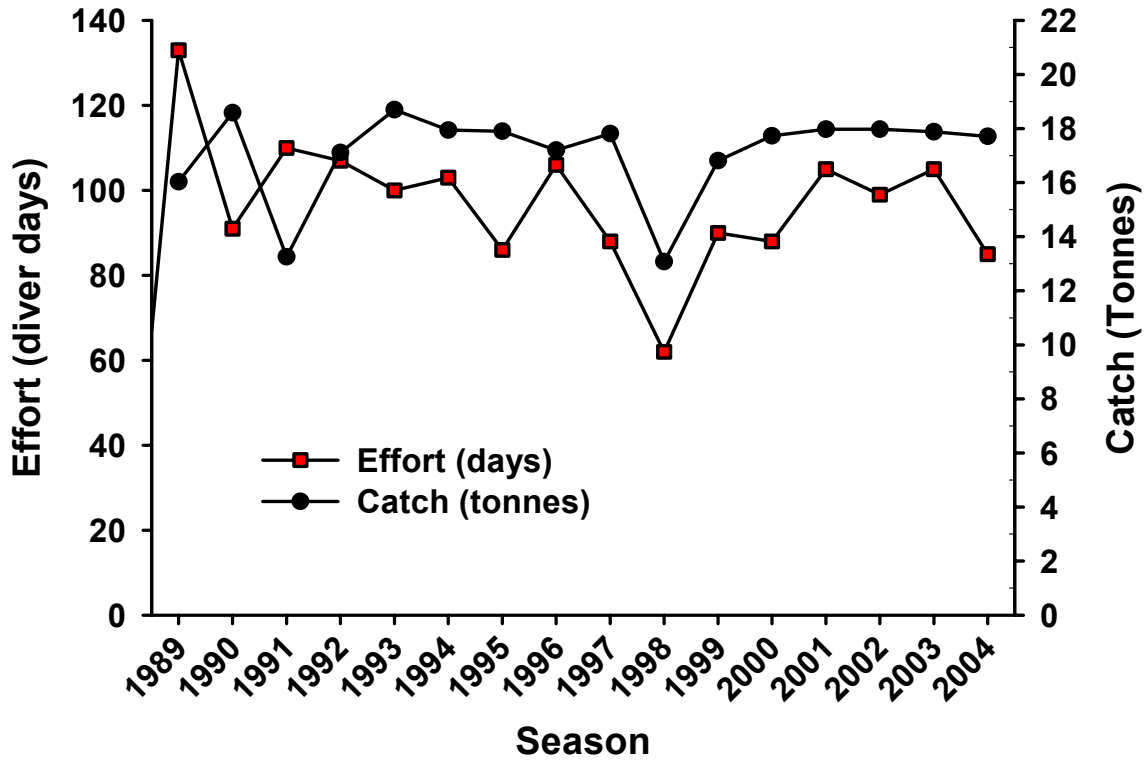


Assessment against performance indicators

Indicator	Fishery data	Assessment/comments
<i>Greenlip</i>		
Total catch	26,600 kg (total) 4,085 kg (stunted)	93% of total quota
Catch rate (overall)	55 kg/day	Equal to performance indicator
Meat weight (Hopetoun)	195 g	8% above performance indicator of 180 g
<i>Brownlip</i>		
Total catch	7,000kg	97% of total quota
Meat weight	288 g	12% above performance indicator of 256g

Area 2: Roei

- TACC of 18 tonnes in 2004.
- Industry target a high legal minimum size (70 mm).
- Industry views are generally that this stock is in good shape.

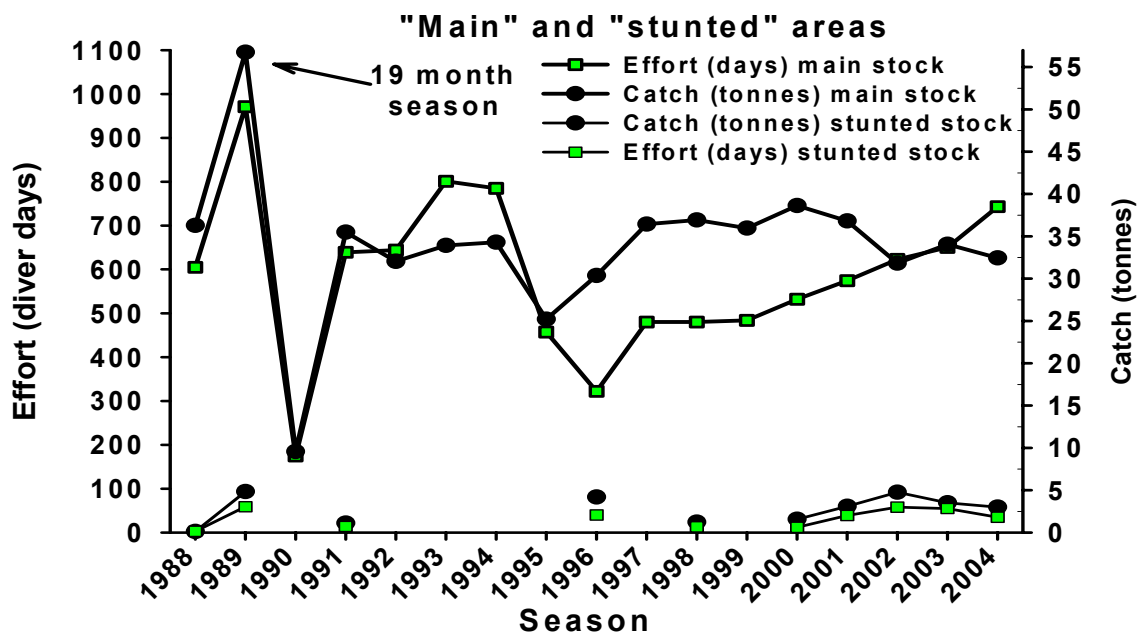
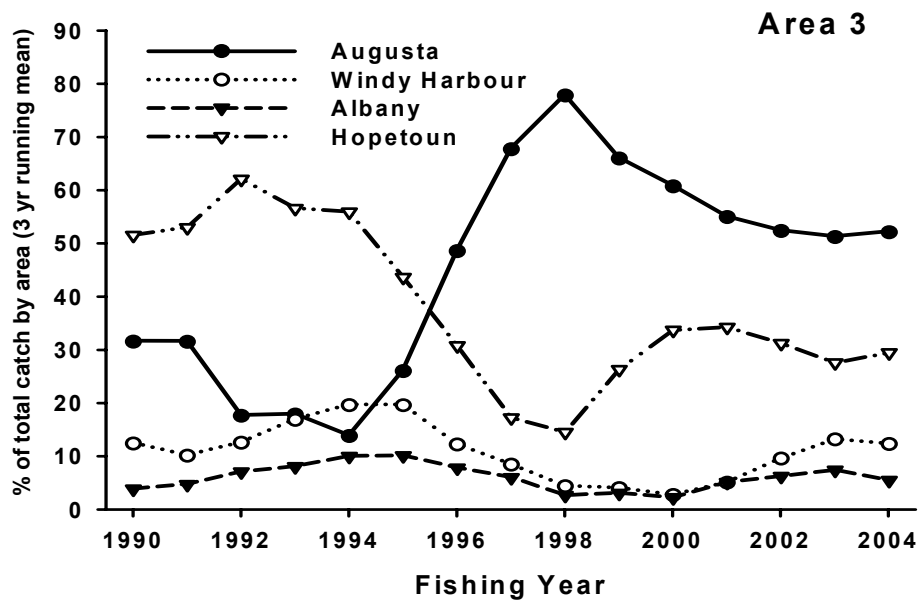


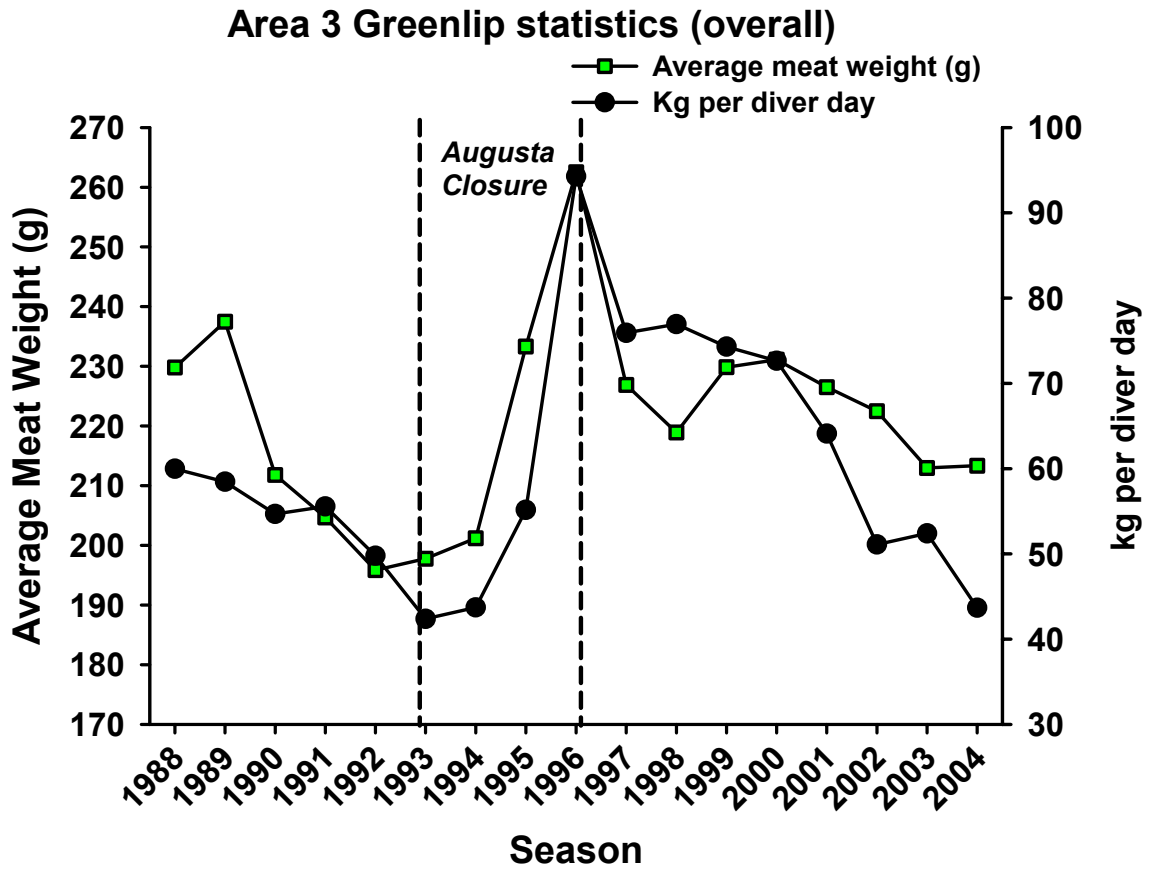
Assessment against performance indicators (Roei – Area 2)

- No defined quantitative indicators as yet.
- General approach for Roei is to consider trends in three key indicators.
- For Area 2 Roei, indicators are:
 1. Has catch quota been achieved?
 2. Effort to achieve quota.
 3. Catch rate to achieve quota.
- For Area 2, effort to take quota is declining and catch rates are increasing.

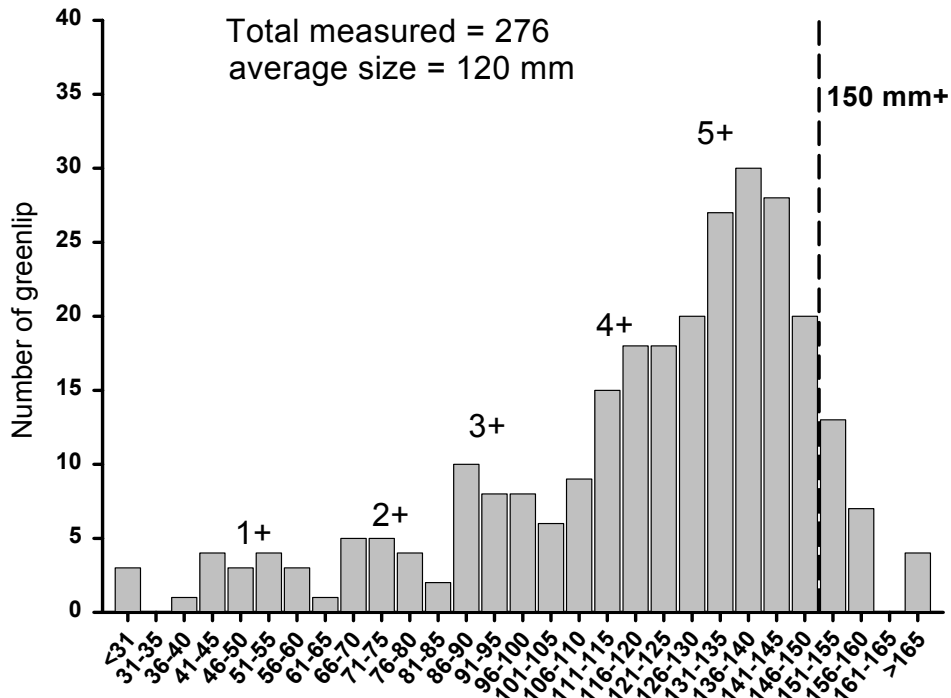
Area 3: Greenlip/Brownlip fishery

- Greenlip TACC of 41.6 tonnes meat weight in 2004.
 - Quota divided up into 37.4 tonnes from main stocks and 4.18 tonnes from stunted.
 - Brownlip TACC of 6.8 tonnes meat weight in 2004.
 - Main stock TACC subject to performance indicators.
1. Greenlip overall catch rate: 60 kg per day.
 2. Greenlip Hopetoun catch rate: 50 kg per day.
 3. Greenlip Augusta meat weight: 240 g.
 4. Greenlip Hopetoun meat weight: 200 g.





Fishery independent surveys 2 Mile Greenlip Stocks Hopetoun (1+, 2+ etc..., are age cohorts)



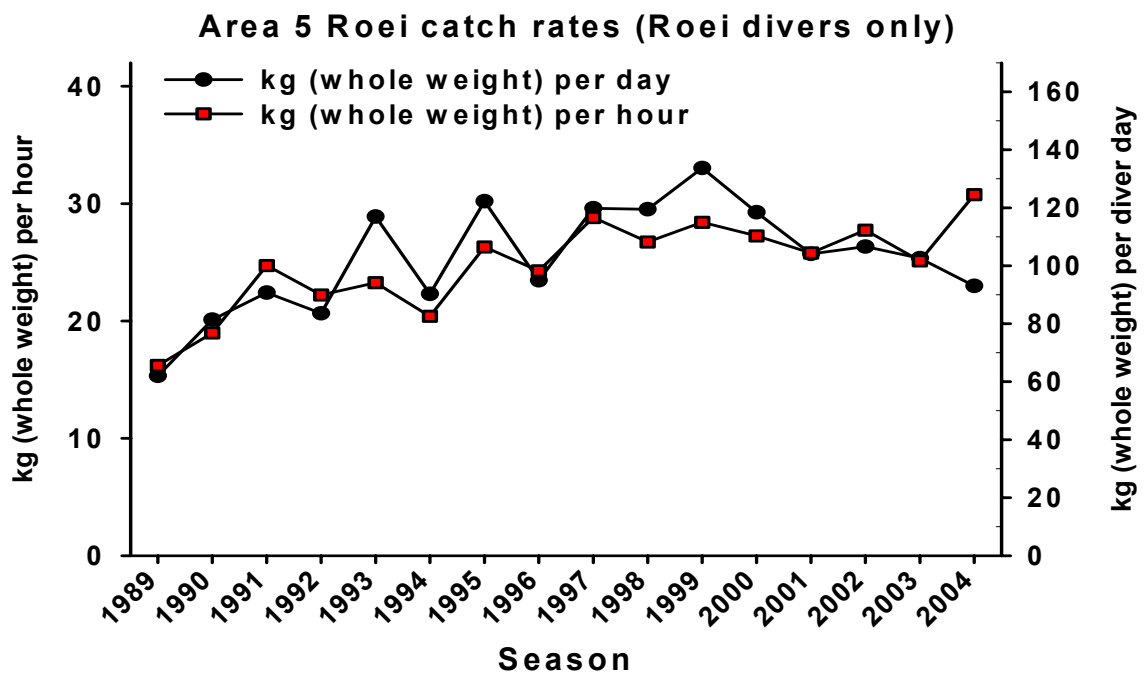
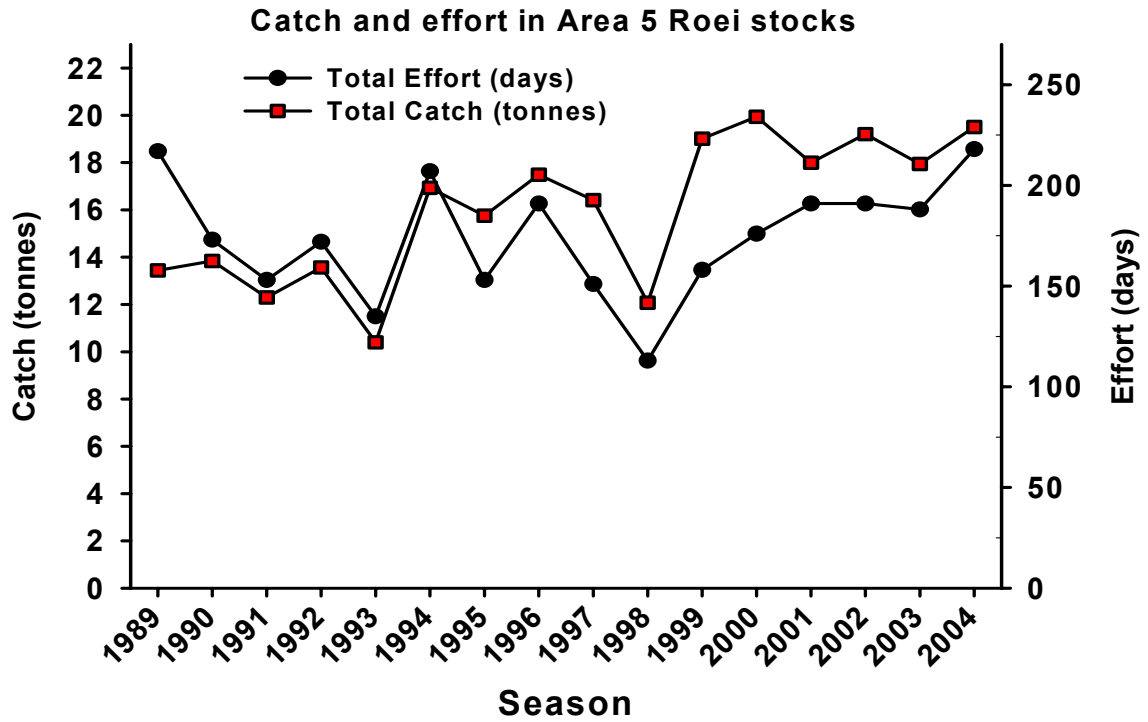
Assessment against performance indicators

Area 5: Roei

Indicator	Fishery data	Assessment/comments
<i>Greenlip</i>		
Total catch	28,500 kg (total) 3,009 kg (stunted)	68% of TACC of 41.6 tonnes
Catch rate (overall)	55 kg/day	9% below performance indicator of 60 kg per day
Catch rate (Hopetoun)	43kg/day	9% below performance indicator of 50 kg per day
Meat weight (Augusta)	251 g	5% above performance indicator of 240 g
Meat weight (Hopetoun)	190 g	5% below performance indicator of 200 g
<i>Brownlip</i>		
Meat weight	274 g	1.5% above performance indicator of 270 g

Area 5: Roei Fishery

- TACC of 20 tonnes in 2004.
- Anecdotal reports are that some areas of this stock are under pressure.
- This prompted a closer scrutiny of our fishery data, and data presented are a considerable updated from last year.

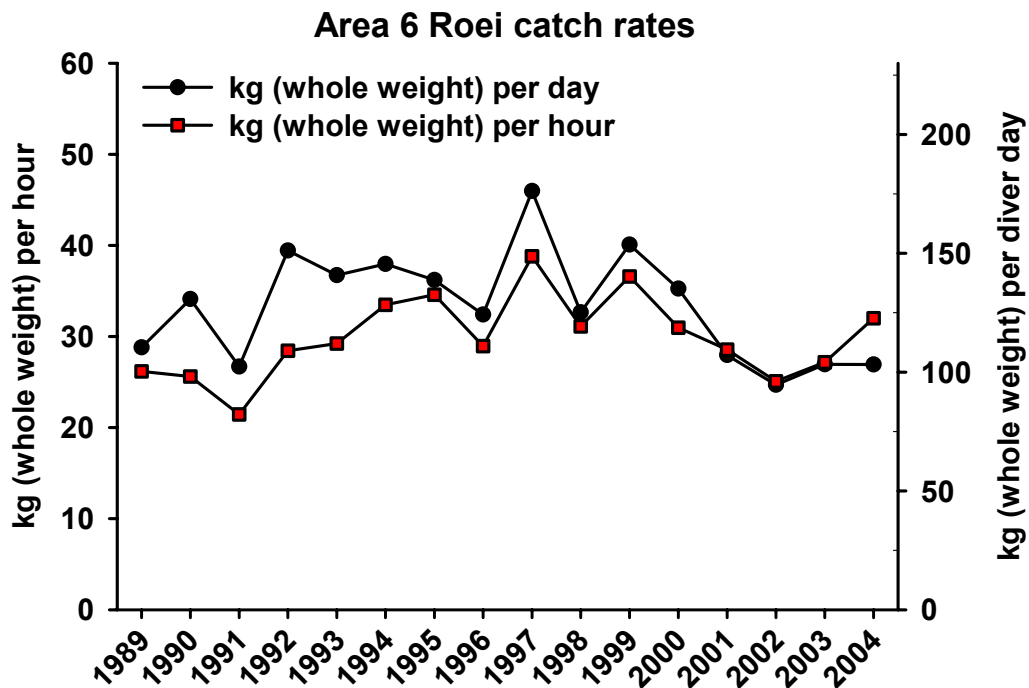
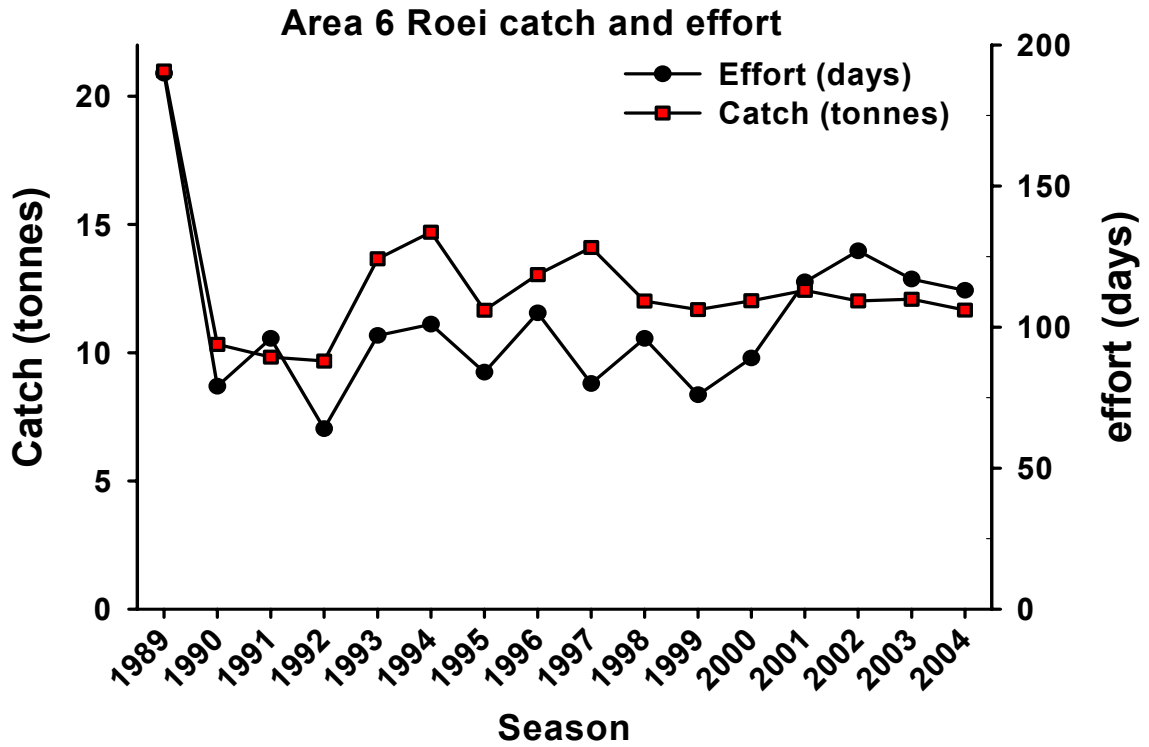


Assessment against performance criteria

- No defined quantitative indicators as yet.
- General approach for Roei is to consider trends in three key indicators
- For Area 5 Roei, indicators are:
 1. Has catch quota been achieved?
 2. Effort to achieve quota.
 3. Catch rate to achieve quota.
- Four-year increasing effort (1999-2002) for stable catch, followed by 2003 in which quota was not caught.
- Eight-year (1997-2004) declining hourly catch rate.

Area 6: Roei Fishery

- TACC of 12 tonnes in 2004.
- Anecdotal reports are that some areas of this stock are under pressure.
- This prompted a closer scrutiny of our fishery data, and data presented are considerably updated from last year

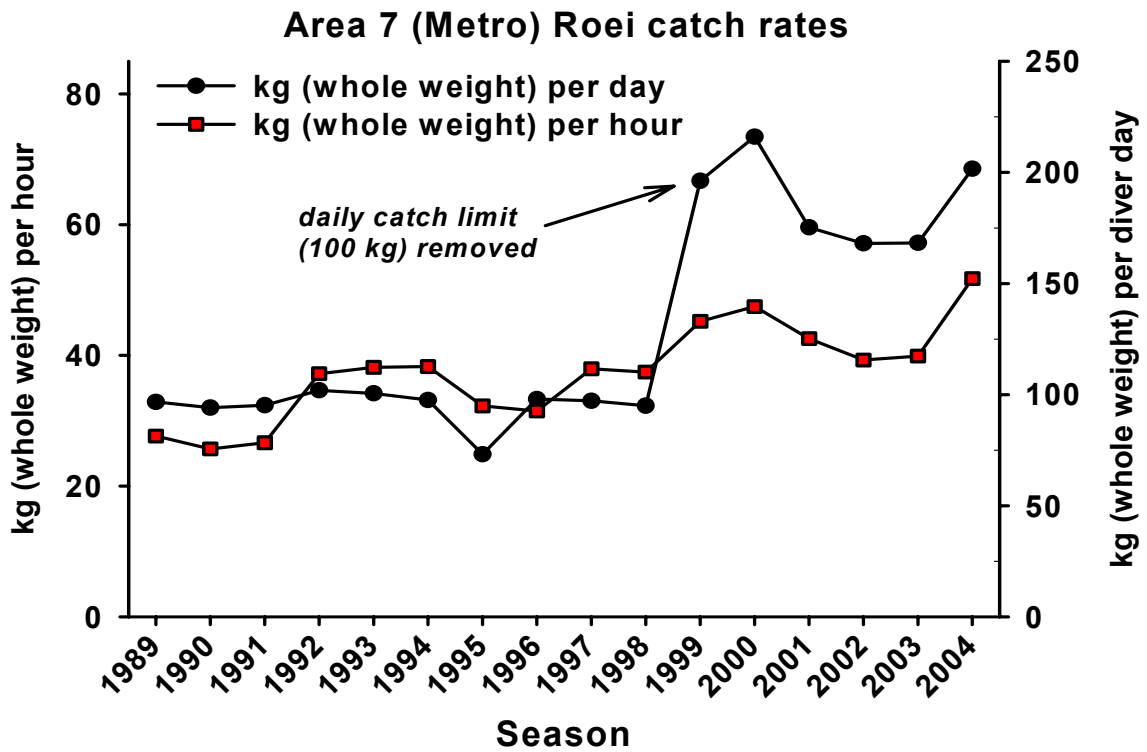
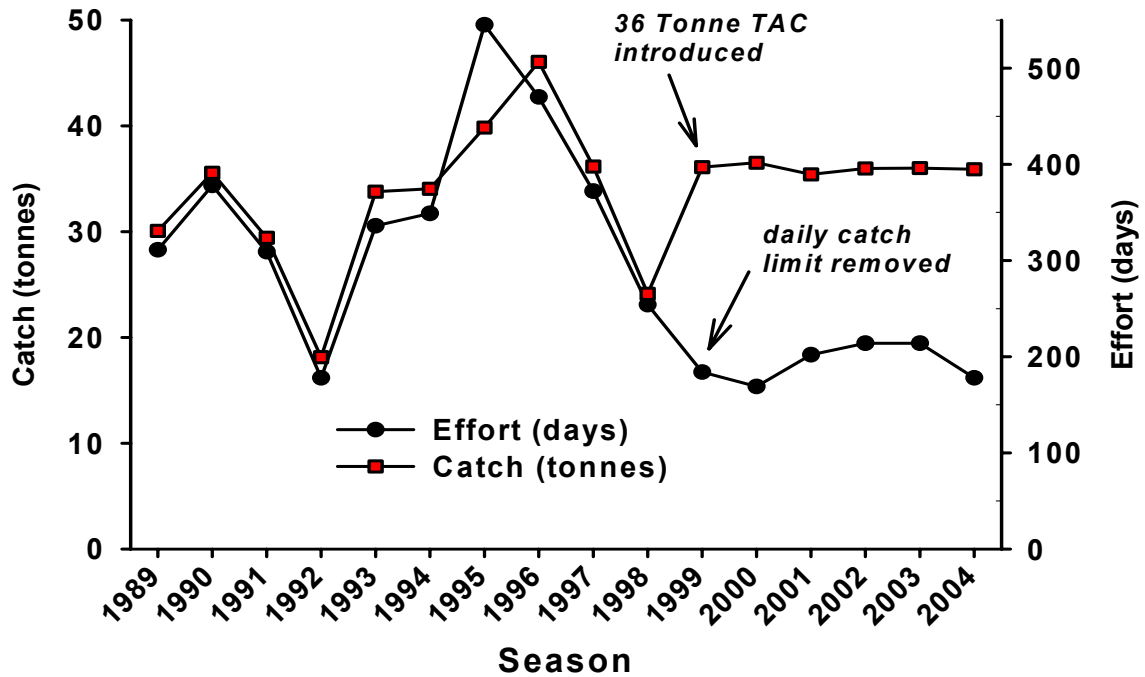


Assessment against performance criteria

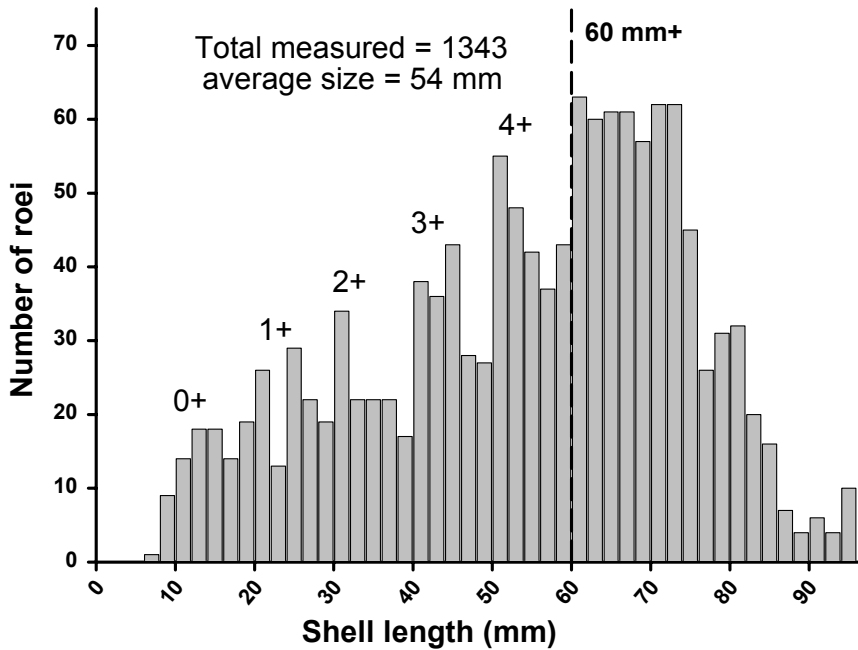
- No defined quantitative indicators as yet.
- General approach for Roei is to consider trends in three key indicators.
 1. Has catch quota been achieved?
 2. Effort to achieve quota.
 3. Catch rate to achieve quota.
- Five-year increasing effort (1999-2002) for stable catch.
- Five-year (1999-2004) declining catch rate.

Area 7: Roi Fishery

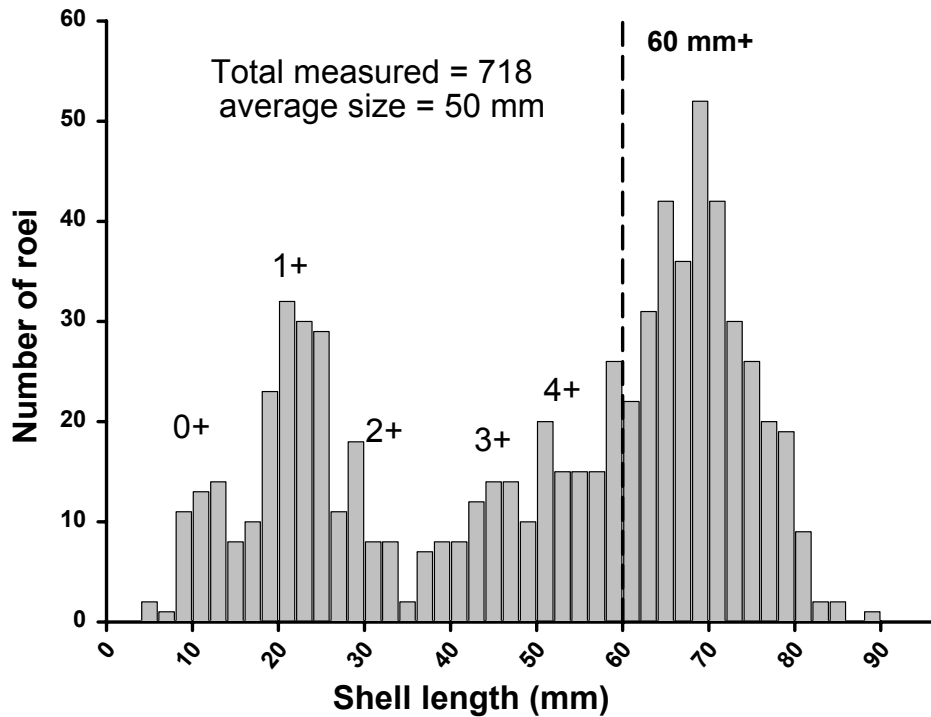
- Perth metropolitan fishery.
- TACC of 36 tonnes in 2004.
- Industry concerns are that some areas of this stock are under pressure.



**Fishery independent surveys
North metropolitan Roei Stocks - 2004
(1+, 2+ etc..., are age cohorts)**



**Fishery independent surveys
Central metropolitan Roei Stocks - 2004
(1+, 2+ etc..., are age cohorts)**

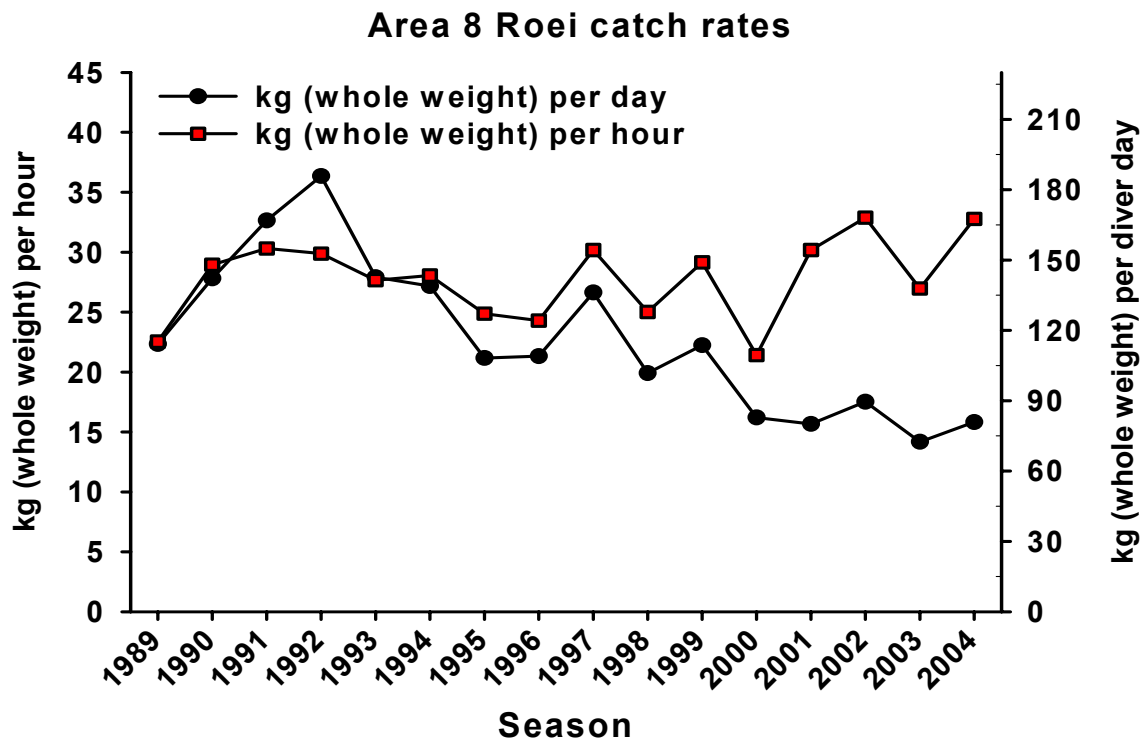
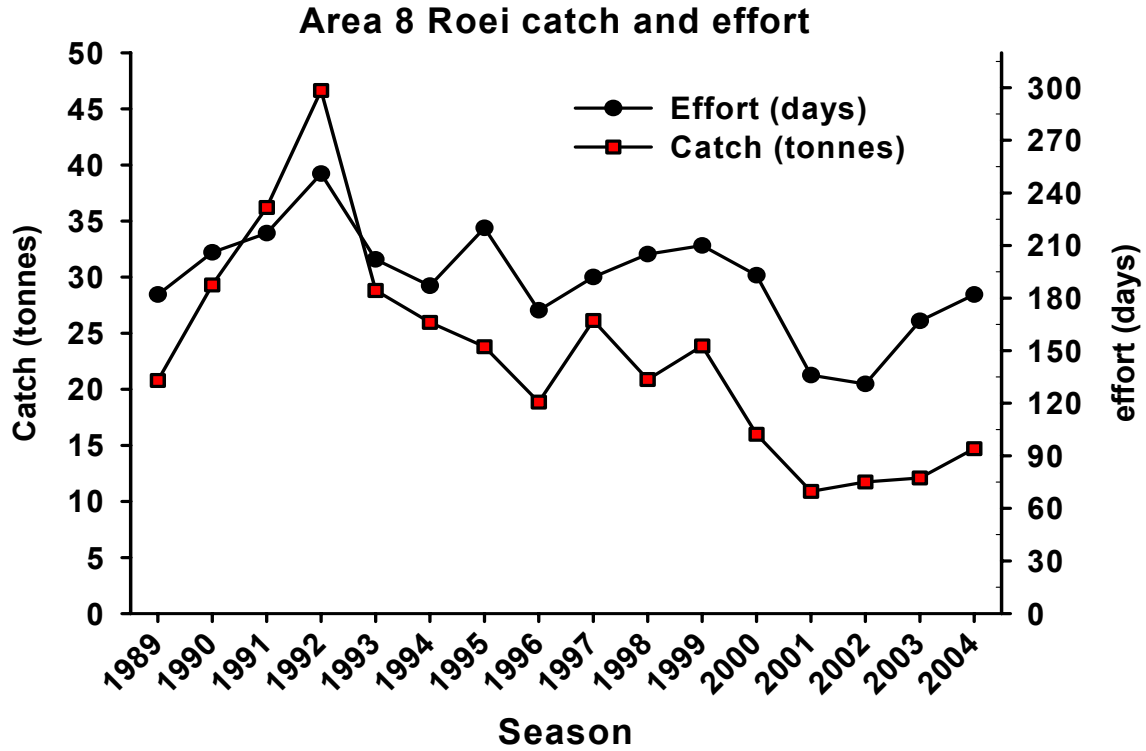


Assessment against performance criteria

- No defined quantitative indicators as yet.
- General approach for Roei is to consider trends in three key indicators:
 1. Has catch quota been achieved?
 2. Effort to achieve quota.
 3. Catch rate to achieve quota.
- Relatively stable effort (1999-2003) for same catch.
- Slight decline in catch rates (2000-2003), but 2004 quota taken at a historical high catch rate of 52 kg per hour.

Area 8: Roei Fishery

- Kalbarri fishery.
- TACC of 15 tonnes in 2004.
- Voluntary industry quota reductions have been taken in this fishery since 2001 due to stock concerns.
- Stocks have been subject to a rebuilding strategy since 2000.



Assessment against performance criteria

- No defined quantitative indicators as yet.
- General approach for Roei is to consider trends in three key indicators.
- For Area 8 Roei, indicators are:
 1. Has catch quota been achieved?
 2. Effort to achieve quota.
 3. Catch rate to achieve quota.
- 60 per cent of 2004 quota achieved at historically highest hourly catch rate of 35 kg per hour.
- Daily catch rates are also the highest they have been for 10 years.
- However, effort increased substantially from 2001 to 2003 with a stable catch.

FISHERIES MANAGEMENT PAPERS

- No. 1** The Report of the Southern Western Australian Shark Working Group. Chairman P. Millington (1986)
- No. 2** The Report of the Fish Farming Legislative Review Committee. Chairman P. Rogers (1986)
- No. 3** Management Measures for the Shark Bay Snapper 1987 Season. P. Millington (1986)
- No. 4** The Esperance Rock Lobster Working Group. Chairman A. Pallot (1986).
- No. 5** The Windy Harbour - Augusta Rock Lobster Working Group. Interim Report by the Chairman A. Pallot (1986)
- No. 6** The King George Sound Purse Seine Fishery Working Group. Chairman R. Brown (1986)
- No. 7** Management Measures for the Cockburn Sound Mussel Fishery. H. Brayford (1986)
- No. 8** Report of the Rock Lobster Industry Advisory meeting of 27 January 1987. Chairman B. Bowen (1987)
- No. 9** Western Rock Lobster Industry Compensation Study. Arthur Young Services (1987)
- No. 10** Further Options for Management of the Shark Bay Snapper Fishery. P. Millington (1987)
- No. 11** The Shark Bay Scallop Fishery. L. Joll (1987)
- No. 12** Report of the Rock Lobster Industry Advisory Committee to the Hon Minister for Fisheries 24 September 1987. (1987)
- No. 13** A Development Plan for the South Coast Inshore Trawl Fishery. (1987)
- No. 14** Draft Management Plan for the Perth Metropolitan Purse Seine Fishery. P. Millington (1987)
- No. 15** Draft management plan, Control of barramundi gillnet fishing in the Kimberley. R. S. Brown (1988)
- No. 16** The South West Trawl Fishery Draft Management Plan. P. Millington (1988).
- No. 17** The final report of the pearling industry review committee . F.J. Malone, D.A. Hancock, B. Jeffriess (1988)
- No. 18** Policy for Freshwater Aquaculture in Western Australia. (1988)
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- No. 20** The Offshore Constitutional Settlement, Western Australia 1988.
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- No. 40** The future for Recreational Fishing - Forum Proceedings. Recreational Fishing Advisory Committee (1991)
- No. 41** The future for Recreational Fishing - The Final Report of the Recreational Fishing Advisory Committee. Recreational Fishing Advisory Committee (1991)
- No. 42** Appendix to the final report of the Recreational Fishing Advisory Committee. (1991)
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- No. 48** Pearl oyster fishery policy guidelines (Western Australian Pearling Act 1990) Western Australian Fisheries Joint Authority (1992)
- No. 49** Management plan, Kimberley prawn fishery. (1992)
- No. 50** Draft management plan, South West beach seine fishery. D.A. Hall (1993)
- No. 51** The west coast shark fishery, draft management plan. D.A. Hall (1993)
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- No. 54** Rock Lobster Industry Advisory Committee, Management proposals for 1993/94 and 1994/95 western rock lobster season (July 1993)
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- No. 65** Not issued
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- No. 69** Long term management strategies for the Western Rock Lobster Fishery. (4 volumes) A market-based economic assessment for the western rock lobster industry, Volume 3. Marec Pty Ltd (September 1994)
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- No. 71** The Rock Lobster Industry Advisory Committee Chairman's Report, October 1994, The Western Rock Lobster Fishery - Management proposals for the 1994/95 and 1995/96 seasons (November 1994)
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- No. 96** Summary Report of the Freshwater Aquaculture Taskforce (FAT) by Chris Wells (*in press*)
- No. 97** Not used.
- No. 98** A Pricing Policy for Fisheries Agencies - Standing Committee on Fisheries and Aquaculture Management Committee. P Millington (March 1997)
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- No. 105** Plan for the Management of the Houtman Abrolhos Fish Habitat Protection Area (draft). Prepared by the Abrolhos Islands Management Advisory Committee in conjunction with Fisheries Western Australia (October 1997)
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- No. 125** Changes to Offshore Constitutional Settlement Arrangements; North West Slope Trawl Fishery and Western Deepwater Trawl Fishery. A discussion paper by Fiona Crowe and Jane Borg (May 1999)[not published]
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- No. 145** The Aquaculture of non-endemic species in Western Australia - Silver Perch (*Bidyanus bidyanus*). As amended October 2000. Tina Thorne. This replaces Fisheries Management Paper No. 107.
- No. 146** Sustainable Tourism Plan for the Houtman Abrolhos Islands (February 2001)
- No. 147** Draft Bycatch Action Plan for the Shark Bay Prawn Managed Fishery (Full Report) (April 2002)

- No. 148** Draft Bycatch Action Plan for the Shark Bay Prawn Managed Fishery (Summary Report) (April 2002)
- No. 149** Final Plan of Management for the Lancelin Island Lagoon Fish Habitat Protection Area (March 2001)
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- No. 152** Guidelines for the Establishment of Fish Habitat Protection Areas (June 2001)
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- No. 165** Report to the Minister for Agriculture, Forestry and Fisheries by the Integrated Fisheries Management Review Committee (November 2002)
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- No. 167** Draft Fisheries Environmental Management Plan for the Northern Region (*in press*)
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- No. 176** Fish Stock and Fishery Enhancement in Western Australia - a summary report. By Jane Borg (February 2004)
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- No. 178** Draft Plan of Management for the Kalbarri Blue Holes Fish Habitat Protection Area (March 2004)
- No. 179** A Draft Policy for the Translocation of Brown Trout (*Salmo trutta*) and Rainbow Trout (*Oncorhynchus mykiss*) into and within Western Australia for the Purposes of Recreational Stocking, Domestic Stocking and Commercial and Non-Commercial Aquaculture (August 2004)
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- No. 182** A Quality Future for Recreational Fishing in the Southern Region of WA. Proposals for Community Discussion. A five-year strategy for managing the recreational component of the catch, prepared by the Southern Recreational Fishing Working Group (July 2004)
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- No. 184** South West Beach Seine Management Discussion Paper
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