Australian Government
Australian Fisheries Management Authority

Australian Sea Lion Management Strategy

Southern and Eastern Scalefish and Shark Fishery (SESSF)

29 June 2010

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Executive Summary

This strategy has been developed to reduce and monitor interactions between Australian sea lions and gillnets used by Commonwealth shark fishers in the Southern and Eastern Scalefish and Shark Fishery.

AFMA and industry members have supported research into fishery interactions with Australian sea lions. A recent report produced by the South Australian Research and Development Institute (SARDI) suggests that bycatch mortality may be limiting the recovery of most colonies in South Australia.

Gillnet fishing effort and the corresponding risk to sea lions in South Australian waters peaked in 1987 with nearly 43,000km of net set. Management actions, including the introduction of shark quotas and the implementation of the Commonwealth Harvest Strategy Policy have significantly reduced the fishing effort. In recent years, less than 18,000km of net have been set.

Since 2000 AFMA has introduced a number of closures and other measures that provide protection to Australian sea lions. In response to preliminary results from the SARDI research, AFMA and industry introduced voluntary closures in waters within 7.3km (equivalent to four nautical miles) of all 48 South Australian sea lion colonies in December 2009.

At the same time, AFMA increased the at sea, independent observer coverage to collect additional information on interactions between gillnets and Australian sea lions including trials of underwater video cameras as a method of electronic monitoring.

In April 2010, SARDI released the final report on sea lion interactions in the fishery. Since then AFMA has held two stakeholder workshops and received comments on a draft management strategy. Under the strategy, AFMA will implement long-term management measures including formal fisheries closures (covering 6,300km^2) around all 48 colonies, increased independent monitoring of fishing activity (i.e. from 2.4% to 11%) and adaptive management arrangements for further closures to respond to further sea lion interactions. These additional closures would cover nearly 100% of the fishery off South Australia if implemented.

AFMA's observer coverage for the 2009/10 financial year shows that the observed bycatch rate is, at most, one third that estimated by the independent observer program used by Goldsworthy et al. (2010). The observed AFMA rate is between 0 and 0.004 sea lions per km net set depending on the observer protocols used. The underlying bycatch rate from the SARDI report was 0.013 sea lions per km net set.

The strategy will also support development of an industry Code of Conduct, research into mitigation trials to reduce the risk posed by gillnets and facilitate a transfer of fishing effort to hook methods. It is expected that these measures will lead to a significant reduction of the impact of fishing activity on Australian sea lions and enable the recovery of the species

A key feature of the strategy will be the ongoing review of new data and information on the level and nature of interactions. For the first year of the strategy AFMA will undertake quarterly reviews of the effectiveness of the strategy utilising all available information. These quarterly reviews will engage all key stakeholders. Changes to the strategy may be necessary to respond to new information about the ongoing risk to sea lions.

While the objectives of the strategy are to reduce the impact of gillnet fishers on Australian sea lions and enable their recovery, a number of other factors impact on Australian sea lions such as marine debris, State commercial fisheries (e.g. rock lobster), aquaculture and

tourism. Recovery of Australian sea lion populations will benefit from action to reduce all impacts on sea lions.

Introduction

The Australian sea lion population was significantly depleted by sealing activities in the 18th and 19th centuries. Sea lion distribution diminished, with breeding sites from Victor Harbour, South Australia to the Mallacoota, Victoria and across the north coast of Tasmania disappearing (Campbell et al. 2008). The species was listed as threatened (vulnerable) under the *Environment Protection and Biodiversity Act 1999* (EPBC Act) in 2005.

The nature and extent of interactions between Australian sea lions and the gillnet sector of the Southern and Eastern Scalefish and Shark Fishery (SESSF) are poorly understood. Due to this uncertainty Australian sea lions were assessed to be at high ecological risk from the impacts of gillnet fishing during AFMA's ecological risk assessment (ERA) process.

To reduce uncertainty, AFMA and industry members supported additional research into fishery interactions with Australian sea lions. Industry members took marine mammal experts to sea onboard their vessels during fishing operations to observe and record interactions.

A report produced by the South Australian Research and Development Institute (SARDI) provides an assessment of the risks to Australian sea lion from the shark gillnet sector of the SESSF. The report predicts that high levels of bycatch mortality are limiting the recovery of most colonies in South Australia. (Goldsworthy et al. 2010)

This management strategy is created under AFMA's legislation and is designed to pursue the objectives of the *Fisheries Management Act 1991*. The key legislative objectives pursued by the strategy are:

- to ensure that the exploitation of fisheries resources is sustainable with regard to target and non-target species as well as the broader marine environment; and
- to maximise the net economic returns to the Australian community from the management of Australian fisheries.

Population Information

Australian sea lions currently have 76 known pupping locations along the coast and offshore islands between the Houtman Abrolhos Islands in Western Australia to the Pages in South Australia. The total population of Australian sea lions is estimated to be around 14,730 animals and the total pup production during a breeding cycle (i.e. 17.5 months) is estimated to be around 3,610 (Goldsworthy et al. 2009).

Reliable census data are only available for six of the 48 South Australian colonies. While consecutive survey counts are available for a number of colonies census methods are generally unreliable (Goldsworthy et al. 2009), and a number of colonies have not been surveyed in the last 20 years.

Robust population trends are only available for the four largest colonies at Seal Bay, North and South Page Islands and Dangerous Reef. Pup production at the Dangerous Reef colony appears to be increasing by approximately 5% percent per breeding season. There appears to be no significant change to pup production at North and South Page Islands however there has been an estimated 3-4% decline in pup production at Seal Bay (Goldsworthy et al. 2009).

Biology

Australian sea lions, *Neophoca cinerea*, are one of seven sea lion species. They are the only pinniped species endemic to Australian waters and are one of the world's rarest sea lion species.

Australian sea lions are atypical among pinnipeds as the only species that has a non-annual breeding cycle interval of 17 to 18 months. Breeding cycles are asynchronous across its range meaning different colonies do not breed at the same time (Gales et al. 1994). The gestation period is up to 14 months (longest of any pinniped), a protracted breeding period is 4 to 7 months (the length of time which mating occurs over a breeding cycle) and a lactation period of 17.5 months.

Sealing

During the 18th and 19th centuries Australia's colonial sealing industry hunted Australian fur seals (*Arctocephalus pusillus doriferus*), Australian sea lions (*Neophoca cinera*), New Zealand sea lions (*Phocarctos hookeri*), New Zealand fur seals (*Arctocephalus forsteri*) and Southern elephant seals (*Mirounga leonina*) (Ling 2002).

As sealing grounds were closely guarded secrets, the early sealers left few records of the identity, distribution and abundance of sea lion colonies from which to draw comparisons with the sea lion colonies today (Ling 2002).

Early writers often remarked on large numbers of fur seals or elephant seals to be seen at the various island haul-outs which they visited, but there do not appear to be any references to a great abundance of sea lions. The numbers harvested may therefore be as much a reflection of the small size of the original populations as of the low commercial value of the pelts. (Ling 2002). Although the pre-harvested population size of Australian sea lions is unknown, the overall population is believed to be depleted relative to pre-European colonisation of Australia (Goldsworthy et al. 2010) and the population is still believed to be in recovery.

Fishery History

The SESSF is an important component of the Australian fishing industry, taking the largest tonnage and supplying most of the fresh fish for Sydney and Melbourne. The Gross Value of Production (GVP) for the SESSF was approximately $87 million in 2007/08 while the Shark Hook and Shark Gillnet sector of the SESSF recorded a GVP of $20 million in 2007/08 (Wilson et al. 2009). Approximately $6 million of this value was derived from the shark gillnet sector in South Australia. The valuable Gummy Shark catch taken by the shark gillnet sector in South Australia provides the flake used for retail fish and chip shops throughout the region.

Shark fishing in southern Australia was first recorded in 1927 with fishers targeting sharks with demersal longlines. Between 1927 and the early 1960s the shark fishery developed in line with increased demand for shark meat and vitamin A from shark liver oil. By the early 1970s, monofilament gillnet methods had been introduced and the fishery moved from a primarily demersal longline fishery targeting School Shark to a demersal gillnet fishery targeting Gummy Shark.

Gillnet fishing effort in South Australian waters peaked with nearly 43,000km of net lifts in 1987. Management interventions have significantly reduced the fishing effort in this region to the current levels of around 17,000km of net set in recent years. There are currently 62 statutory rights to use a boat in the gillnet fishery. In addition there are four South Australian coastal waters gillnet fishing permits and 16 South Australian coastal waters gillnet and hook fishing permits authorised to use gillnets in the South Australian waters of the SESSF.

In addition to the Commonwealth-managed SESSF, the State-managed Marine Scalefish Fishery (MSF) operates in all coastal waters of South Australia including gulfs, bays and estuaries (excluding the Coorong estuary), from the Western Australian border to the Victorian border. The MSF includes gillnet methods in areas overlapping with sea lion foraging areas.

Population Risks

Historically the main anthropogenic threat to the Australian sea lion was hunting and over-harvest through sealing. Although this activity was stopped more than 80 years ago, the sea lion population has not recovered to pre-exploitation levels. The current anthropogenic threats are entanglement with marine debris and interactions with fisheries. The largest sources of bycatch mortality include interactions with gillnets in the SESSF and lobster pots in the state managed southern and western rock lobster fisheries (Goldsworthy & Page 2007).

AFMA has undertaken detailed ecological risk assessments (ERAs) for all major Commonwealth-managed fisheries as a key part of the move towards ecosystem-based fisheries management. ERAs assess the risks that fishing poses to the ecological sustainability of the marine environment. The main purpose of ERAs is to prioritise the management, research, data collection and monitoring needs for each fishery.

For the gillnet sector of the SESSF five seal species were assessed as high risk through the ERA process. These are the Australian fur seal, New Zealand fur seal, Australian sea lion, leopard seal and southern elephant seal. The Australian sea lion is of greatest concern because of its small population size and complex breeding populations in southern Australia. The Australian fur seal and New Zealand fur seal have much larger populations that appear to be increasing. The leopard seal and southern elephant seal are distributed over a very wide geographic range, with only very small proportions of their populations occurring within the range of the shark gillnet sector of the SESSF.

The gillnet sector of the SESSF is only one factor affecting Australian sea lion populations. The DEWHA Draft Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) and the associated Technical Issues Paper, list a number of other factors including aquaculture, marine debris, disease, human disturbance, habitat degradation, pollution, climate change, competition for food and shark predation, that may impact on sea lion populations and play some role in inhibiting sea lion recovery. The Draft Sea Lion Recovery Plan recognises that further work needs to be undertaken on these issues before there is a full understanding of the dynamics affecting sea lion recovery.

While AFMA acknowledges the need to minimize bycatch so as to enable the recovery of sea lions, AFMA and the fishing industry are not solely responsible for ensuring the recovery of sea lion populations. AFMA will contribute to implementation of the overall strategic framework for the recovery of Australian sea lions being developed by DEWHA.

Estimated bycatch mortality

Goldsworthy et al. (2010) completed an assessment of the risks to Australian sea lions from the gillnet sector of the SESSF in South Australia. The study estimated that approximately 374 Australian sea lions are removed as bycatch mortality each breeding cycle (17.5 months). Population viability analyses from these data indicate that the likelihood of further declines would be reduced and the capacity for the species to recover would be enhanced if the bycatch of adult females was reduced.

While Goldsworthy et al. (2010) utilised sophisticated modelling to produce an estimate of sea lion bycatch, significant uncertainty around those estimates exist. The authors extrapolate a bycatch rate from an independent observer program that observed 12 mortalities and then combine fishing effort with Australian sea lion foraging effort to estimate a fishery wide level of bycatch. This methodology assumes that bycatch interactions between sea lions and gillnets are effectively passive, sea lions do not actively interact with nets and that the chance of a sea lion interaction is entirely dependent on the foraging distribution of the animals in that area.

Location data are available for the 15 total observed interactions with Australian sea lions including the 12 observed interactions from Goldsworthy et al. (2010). The majority (73%) of the interactions occur within a **12.5** km range of colonies (Table 1). In contrast to this, the models produced by Goldsworthy et al. (2010) predict that 73% of interactions occur within the significantly larger range of **60** km with some interactions predicted as far as **130** km from colonies. This flows onto the recommendations for spatial closures in Goldsworthy et al. (2010) being much larger than the observed mortalities would suggest.

Table 1 – Locations of 15 observed Australian sea lion interactions.

Distance from Colony (Km)	Observed Interactions	Cumulative percent of Interactions
2.5	3	20
5	1	27
7.5	3	47
10	1	53
12.5	3	73
15	0	73
>15	4	100

AFMA's Shark Resource Assessment Group (SharkRAG) raised concerns regarding the modelling which underpinned the bycatch estimates in Goldsworthy et al. (2010). SharkRAG considered the tracking and movement modelling work on sea lion foraging behaviour to be very good and the overlay of foraging areas with fishing effort to be appropriate in order to provide an idea of the risk interactions between sea lions and fishing gear. However, the observer coverage used to estimate interactions rates was unbalanced and primarily conducted in areas of low fishing effort without sampling the areas where both sea lion foraging effort and fishing effort are high. This resulted in significant uncertainty in the bycatch estimates.

To monitor interactions with Australian sea lions the AFMA observer program increased its monitoring of fishing activity in South Australian waters in the 2009/10 financial year. The AFMA observers also revised their protocols in December 2009 to implement sea lion specific protocols to monitor 'drop outs', that is, instances where Australia sea lions fall from the nets as the nets break clear of the water. These sea lion specific observer shots where the

observer watches the net leave the water 100% of the time are included in Table 1 under "Sea lion protocols". The "ISMP protocols" includes the data from shots where observers undertake a range of observations and are not watching the net 100% of the time. In these circumstances observers may not notice any 'drop outs'. Despite the revised protocols, both sea lion interactions in the 2009/10 financial year were observed using the ISMP protocols even though the sea lions did in fact drop out of the net. This highlights the fact that either protocol can be effective at detecting sea lion interactions.

The bycatch rates of sea lions observed by the AFMA observer program in 2009/10 is substantially lower than that observed by Goldsworty et al. (2010). The observed AFMA rate is 0 and 0.004 sea lions per km net set for the sea lion protocols and ISMP protocols respectively. The underlying bycatch rate from Goldsworthy et al (2010) was 0.013 sea lions per km net set.

Table 2 – AFMA Observer coverage in South Australian waters from July 2009 to 8 June 2010

Observer Method	Sea Days	Shots Observed	Km Observed	ASL Interactions
Sea lion Protocols	108	109	429.3	0
ISMP Protocols		114	435.3	2
	Total	**223**	**864.6**	**2**

The life history data used in the Population Viability Analysis (PVA) was also considered uncertain by SharkRAG due to the assumptions made about mortality. Consequently, the PVA does not necessarily support the conclusions drawn in the report. SharkRAG considered the extinction risk output from the PVA as the source of a great deal of uncertainty because the PVA model has no density dependence mechanism and because it is based on data from a small number of colonies. SharkRAG considered density dependence particularly important in this type of situation when trying to predict extinction risk over long time periods. At some point population growth should decrease naturally as populations reach carrying capacity. If a model does not have density dependence, the population will, if perturbed, inevitably reach infinity or zero. The impact not using a density dependence mechanism is exacerbated by the potentially small carrying capacity of some sea lion colonies due to the type of terrain they inhabit and the limited available space. SharkRAG advised that due to the lack of density dependence the model is not adequate for predicting extinction risk and its use should be limited to examining the relative vulnerability of colonies.

SharkRAG also advised that further investigation into the population structure is required as the results from Goldsworthy et al. (2010) are based on the assumption that each colony is a distinct sub-population. This assumption is the most precautionary approach upon which to base a management strategy, however it would result in extensive management measures and a significant cost to industry. In terms of genetic differentiation and determining whether each colony should be considered a separate sub-population, Campbell (2003) showed a genetic differentiation between sea lion colonies with a significant correlation between genetic differentiation and geographic distance. For South Australian colonies this infers that while there will be no mixing between colonies with large distances in between, this is not necessarily the case for closer colonies.

Campbell et al. (2008) and Campbell (2003) provide a rationale for regional management of sub-populations rather than management on an individual colony basis. This is based on the fact that two small colonies in Western Australia showed no genetic separation; these were colonies that were in close proximity and where breeding occurred at a similar time. There is similar proximity and similarity in breeding time among a number of colonies within South Australia.

Based on the available data it may be more precautionary to assume complete genetic separation and manage all colonies separately, however, there is also evidence suggesting a regional approach is appropriate. In recognition of this, Goldsworthy et al. (2009b) identified a number of meta-populations for Australian sea lions using a distance matrix as a proxy for genetic distance. AFMA has utilised a similar meta-population or regional approach to form the basis for the regions used in the identification of closures and the adaptive management system of this strategy.

It is recognised by all stakeholders that interactions between gillnet fishers and Australian sea lions do occur and that these interactions need to be reduced. However, while Goldsworthy et al. (2010) produced models that are useful in assessing the relative risks in certain areas, the estimate of total bycatch mortality and consequences of this mortality remains uncertain due to the lack of balanced observer data and other assumptions underpinning the models.

Consultation

The fishing industry, primarily those operators in the gillnet sector of the SESSF in South Australia, will be impacted by this management strategy. AFMA has undertaken widespread consultation in developing the strategy; this has included members of the fishing industry, scientists, conservation groups and representatives from various State and Commonwealth government agencies.

In striving to achieve a balance between resource use and conservation, AFMA draws upon advice provided by Resource Assessment Groups (RAG) which has been established for each major fishery group or individual species. RAGs comprise fishery scientists, industry members, fishery economists, management and other interest groups.

AFMA's SharkRAG was first presented with some of the preliminary results from Goldsworthy et al (2010) in November 2009 and discussed various recommendations from these results which formed the first stages of the development of this strategy.

Industry workshops were held on 25 November 2009 and 26 February 2010 to discuss the available information on Australian sea lion interactions and to develop appropriate management responses. The measures implemented in Stage 1 of this strategy were developed after the 25 November 2009 workshop as an interim measure pending the outcomes of research.

AFMA held a general stakeholder workshop with conservation groups, scientists, tourist operators and representatives of State and Commonwealth government departments on 8 April 2010. This workshop coincided with the SARDI release of the Australian sea lion foraging models, giving stakeholders a chance to input into, and help develop, the Australian sea lion management strategy before consideration by SharkRAG. Stakeholders at this workshop decided another workshop should be held after SharkRAG giving them time to digest the report and the suggestions from SharkRAG.

SharkRAG met on 15 – 16 April 2010 to consider the Australian sea lion bycatch mortality estimates produced by Goldsworthy et al (2010) and considered the management strategy being developed by AFMA.

A further stakeholder workshop was held 23 April 2010 in Adelaide to discuss the development of the strategy. Stakeholders considered spatial closures and the preliminary components of the adaptive management or trigger level concept were presented to all stakeholders along with other elements of the management strategy.

On April 29-30 South East Management Advisory Committee (SEMAC) considered AFMA's proposed management actions for inclusion in this strategy. SEMAC recommended AFMA formally implement closures in Stage 2. SEMAC also provided in principle support for the adaptive management or trigger system pending advice on the level of interactions required to prompt management action.

A draft of this Strategy was distributed to all stakeholders for comments on 17 May 2010. Submissions were received by a range of stakeholders and these submissions were considered when the strategy was being finalised.

AFMA will convene further stakeholder workshops to consult on the implementation and review of this strategy as more information becomes available. Industry has shown strong support for the stakeholder working group as it enhances communication with conservation groups, scientists and government organisations.

Objectives

This strategy is designed to meet AFMA's obligations under the *Fisheries Management Act 1991* (FMA) and the EPBC Act. The broad objectives are to ensure that the exploitation of fisheries resources is sustainable with regard to target and non-target species as well as the broader marine environment, and to maximise the net economic returns to the Australian community from the management of Australian fisheries.

Within this broader context the specific objectives of the strategy are to significantly reduce the ecological risk the SESSF poses to Australian sea lions and enable their recovery. Measures to achieve this are to:

1. implement long-term management measures, including formal fisheries closures and other actions, that will lead to a significant reduction of the impact of fishing activity on Australian sea lions. These measures will be clearly directed towards enabling recovery of the species, including all sub–populations; and

2. in consultation with marine mammal experts, continue to monitor and review the adequacy of management measures towards the objective of avoiding mortality of, or injuries to, Australian Sea Lions so as to enable the recovery of Australian sea lion populations, including all sub-populations.

Current & Previous management

In considering the effectiveness of management and conservation measures for relatively long lived species such as Australian sea lions, it is worth noting the changes that have been made previously as well as those currently being implemented. AFMA and industry have initiated a range of management measures over time that, while not specifically directed at the conservation of sea lions, have afforded protection to the species. Some of these measures, for example reductions in total fishing effort and spatial closures, are likely to have substantially reduced the bycatch mortality of sea lions over time.

Fishing Effort Reductions

Gillnet fishing effort in South Australian waters peaked in 1987 at approximately 43,000 km of net set. Changes to management arrangements implemented since this time, including limited entry, gear restrictions and the move to manage the SESSF through output controls such as

quota under the management plan have seen this effort reduced to the current level of approximately 17,000 km of net set per year. This equates to a reduction in effort in the waters adjacent to Australian sea lion colonies of approximately **60%** over two decades.

The Australian Government *Securing our Fishing Future* voluntary fishing concession buyback initiated in 2005, resulted in the removal of 26 shark gillnet boat SFRs, and 17 South Australian coastal waters permits were removed from the SESSF. This structural adjustment package has effectively reduced the number of vessels that can fish with gillnets in South Australia by **27%**.

The introduction of the Commonwealth Fisheries Harvest Strategy Policy in 2007 has resulted in a move towards the target of Maximum Economic Yield (MEY) in Commonwealth managed fisheries. At MEY the level of catch and fishing effort in the fishery is capped at a level which enables profits to be maximised. The general application of MEY to fisheries results in sustainable catches with lower levels of effort and prevents significant expansions of effort into the future. In this regard, the Total Allowable Catch (TAC) for Gummy Shark, which is the primary target species of the gillnet sector, will be set at MEY and this will prevent any significant increases in fishing effort in the gillnet sector.

A chronology of management changes in the gillnet sector is included as Appendix 1.

Current Area Closures

A large number of area closures have been implemented across the SESSF to protect a range of species. A number of these closures were implemented through offshore constitutional arrangements (OCS) and also in response to the Ministerial Direction 2005 to recover overfished stocks and manage the broader environmental impacts of fishing. The following existing closures, afford some level of protection to Australian sea lion foraging areas:

- *All internal waters of South Australia*
- *Murat Bay*
- *Seal Bay*
- *The Pages*
- *Head of the Great Australia Bight*
- *Backstairs Passage*
- *Kangaroo Island*
- *Victor Harbour to the Victorian Border*
- *All waters deeper than 183m*

A summary of these closures can be seen in figure 1. The areas covered by these existing closures are coloured with a red and white stripe.

The total area of the gillnet sector in South Australia is approximately 592,000 km^2, the existing closures listed above cover approximately 415,000 km^2 or **69.1% of the area available for fishing**. A total of **27 out of the 48** Australian sea lion colonies in South Australia lie within the closed areas and are consequently afforded some level of protection.

In addition to the closures implemented by AFMA, further areas are closed by the Great Australian Bight Marine Park. The Marine Mammal Protection Zone of this park, which is situated in the head of the Great Australian Bight, is closed from 1 May to 31 October every year. This affords further protection to 9 of the 48 colonies.

Gear Restrictions

In addition to the management measures listed above the gillnet sector is also subject to a number of gear restrictions which limit the size and type of gillnets used. These gear restrictions are designed for the net to select sub-adult Gummy Sharks without capturing the adults and juveniles. Commonwealth operators are restricted to the use of 4,200m of net with further restrictions on the height of nets to ensure the total net area is also restricted. While a broad range of mesh sizes have been permitted in the past, over time the mesh size restriction has been refined and only a narrow range is now permitted. Previously fishers were permitted to use nets of up to 200mm, however to reduce the capture of larger sharks fishers are now restricted to nets with a mesh size between 150mm and 165mm in width. Advice from gillnet experts on SharkRAG has indicated that the decrease in mesh size would have reduced the risk of sea lion bycatch mortality.

Commonwealth fishers targeting shark in state waters, such as those holding coastal waters permits, are further restricted to 1,800m of net.

Bycatch and Discard Work Plans

Bycatch and Discard Work Plans have been developed for the gillnet sector of the SESSF. These work plans identify the specific bycatch issues in each sector based on the outcomes of the ERAs and detail actions required to address those issues. The primary focus for the work plans is to mitigate the impact of fishing on high risk species; threatened, endangered and protected species (TEP) as listed under the EPBC Act; and reduce overall levels of bycatch and discarding. These work plans are integrated into the management arrangements for the fishery to enable actions outlined, to be implemented. The work plans were formally implemented in July 2009 and are reviewed every 12 months and formally renewed every 2 years, in line with AFMA's *Program for Addressing Bycatch and Discarding in Commonwealth fisheries: an Implementation Strategy*.

The bycatch work plans outline management actions to assist in addressing the impact of fishing on them. However, whilst consistent with the bycatch work plans, the actions outlined in this management strategy are more developed and focused than those currently outlined in the work plans. This management strategy will form an addendum to the overarching bycatch work plans.

Identification Guides

In 2005 AFMA produced a Protected Species ID Guide with funding support from the Australian Government through the Natural Heritage Trust to help industry with identification of all threatened, endangered and protected (TEP) species which was distributed to all Commonwealth vessels at the time. Numerous education campaigns, including port visits, have also been conducted to improve the recording of interactions with TEP species.

Additional management arrangements – December 2009

The measures outlined below in Stage 1 commenced implementation on 23 December 2009.

Voluntary Area Closures

Industry introduced the voluntary fishing closure to gillnet fishing within a radius of 7.3 kilometres (equivalent to four nautical mile) around all forty eight Australian sea lion colonies in South Australia. These closures were introduced in December 2009 and have been monitored by AFMA since that time. Analysis of vessel tracking systems has indicated a high level of compliance with these closures.

The 7.3 km closures were implemented as provisional advice received by AFMA indicated that 75% of observed interactions from 234 independently observed net sets occurred in this area (Goldsworthy et al. 2010). Detailed analysis undertaken by AFMA since that time indicates that **50% of the observed interactions** from these observed net sets actually occurred in this area.

Increased observer coverage

Prior to December 2009 the AFMA Observer Program budgeted for one hundred sea days across the gillnet sector of the SESSF each financial year. Stage one includes an increase of the observer program in this sector by a further seventy days to supplement the current coverage within South Australian waters. This increased observer coverage levels from approximately 50 to 120 days within SA waters for the current financial year. This will further be **increased to 227 days** from 30 June 2010 during stage 2 of the strategy.

This large increase in the level of observer coverage seeks to improve information on interactions between the gillnet sector and Australian sea lions and assist in the development of the longer term management strategy.

Due to the extra observer coverage, the observer protocols have also been changed for all gillnet trips from South Australian ports. From December 2009 until July 2010 the change in protocols required that observers dedicate every second shot they observe to watching the net emerging from the water. **From 1 July onwards observers will dedicate every shot they observe to watching the net emerging from the water.** This change in protocol is designed to identify sea lion 'drop outs'. 'Drop outs' are instances where sea lions have been caught in the net but dropped out as the net breaks the surface of the water. On these occasions the sea lion has not been landed aboard the vessel and may not have been seen by the crew or an observer. There are no reliable estimates of the rate of drop outs.

All AFMA observers were trained with the new protocols at the annual AFMA observer program training workshop held early March 2010. Marine mammal expert Mr Derek Hamer attended and gave a presentation of the protocols he used for the collection of the independent observer data used in his sea lion observer work. Mr Hamer's advice was sought as he undertook the fieldwork component for the sea lion bycatch modelling undertaken by Goldsworthy et al. (2010).

Electronic Monitoring Program

AFMA's Bycatch and Discard Program is currently trialling underwater video cameras as a method of electronic monitoring for the gillnet sector. The current outcomes of this pilot study trialling colour and black and white cameras seem very positive for use in assessing drop out

rates of gillnets for all species (especially sea lions). Continuing with this project over time could strengthen assumptions regarding drop out rates and could also be considered as a future management response to pick up the increased requirements of observer coverage.

Additional management arrangements – July 2010

The measures outlined below in Stage 2 will be implemented from 1 July 2010.

Formal Closures

The spatial closures in Stage 2 are designed to significantly reduce the impact of fishing activities on Australian sea lions and enable the recovery of species, including all sub-populations. The Stage 2 spatial closures are tiered with base level closures and then additional protection afforded to each colony depending on the colony's size and risk associated with bycatch. Predicted *bycatch mortality*, *terminal extinction risk* and *pup production* in this section refers to the outcomes of modelling produced by Goldsworthy et al. (2010). Figure 1 includes a map of the closures to be implemented in Stage 2.

The spatial closures are designed to offer protection to all colonies with the greatest protection afforded to those that have the highest predicted female bycatch mortalities. This approach also ensures that the large populations on a regional basis are afforded significant protection.

ACTION 1 – Baseline Closure to inshore areas around all 48 colonies in South Australia

The current 7.3 km (4 nautical miles) radius closures will be formally implemented as a base level of protection for all colonies. These base level closures are designed to cover the foraging areas closest to all sea lion colonies. These areas close to colonies generally have higher sea lion foraging effort, are inshore and are the areas that must be traversed each time sea lions leave to forage and come ashore to haul out.

The 7.3 km baseline closures will cover an approximate **additional 3,500 km^2** of sea lion foraging area around all colonies. These closures preclude fishing in the area in which **40%** of all observed sea lion interactions have occurred.

ACTION 2 - Enhanced protection for the colonies with the highest risk of immediate extinction if subjected to fishing mortality

SharkRAG advised that the colonies that currently produce fewer than 5 pups have the highest risk for immediate terminal extinction if they are subjected to fishing mortality. Consequently these colonies should be the highest priority for immediate protection.

To afford protection to these colonies which produce fewer than 5 pups, the following additional closures will be implemented:

- a 7.3 km wide 'strip' closure from the West Australian border to Twin Rocks. This closure covers all colonies in the Bunda Cliffs area. These colonies are also afforded additional protection by the GAB Marine Park Marine Mammal Protection Zone between May and October.
- a 7.3 km wide 'strip' closure from Cape Bedout to Point Reynolds in the Kangaroo Island area.
- 11.1 km (6 nm) 'radius' closures around Nuyts Reef East, Point Fowler & Dorothee Is.

ACTION 3 - Enhanced protection around colonies with higher relative vulnerability to fishing mortality

The modelling work completed by Goldsworthy et al. (2010) indicated a group of colonies with higher relative vulnerability to fishing mortality. Those colonies with a predicted female mortality between one and five animals per breeding cycle and low pup production rates are at a higher relative risk.

To afford protection to these colonies, the radius closures around the following colonies will be 11.1km (6 nautical miles):

- Jones Island
- Rocky North Island
- Four Hummocks Island
- Price Island & East Island.

ACTION 4 – Enhanced protection around colonies with the highest predicted interactions

The highest reductions in estimated interactions and consequently greatest benefit to the sub-populations will be achieved by affording greater protection around the colonies with the highest predicted interaction rates. The colonies with a predicted female bycatch mortality above five per breeding season account for more than 77% of the total female bycatch mortality. To further reduce total sea lion mortality, radius closures of 14.8 km (8 nautical miles) will be implemented around the following colonies:

- North Page Is.
- South Page Is.
- Waldegrave Is.
- Olive Is
- Nicolas Baudin Is.
- Ward Is.

Noting that the colony at Seal Bay is both estimated to be subject to the highest level of female mortality and population trend data indicates a decline of 3-4% per breeding season, this colony will be protected by an 18.5 km (10 nautical miles) radius closure.

Spatial Closure Summary

In total the Stage 2 closures prevent fishing with gillnet methods over approximately **6,300 km^2** of sea lion foraging area which offers varying levels of protection to all colonies in South Australia. These closures will also prevent fishing with gillnet methods in the areas where **67% of all observed sea lion fishing mortalities** occurred to date and 15-20% of the model estimates from Goldsworthy et al. (2010).

When these closures are added to the spatial closures already in place in the gillnet sector, the total area of the fishery closed to gillnet methods is 421,000km^2. After these closures, fishers operating with **gillnet methods will be restricted to 28.8% of the area that could be fished** prior to the management of shark fishing being ceded to the Commonwealth government under the Offshore Constitutional Settlement (OCS) in 2000.

The closure in Stage 2 will have a significant consequence for the commercial viability of operators in South Australia. The closures in stage displace significant catch with 52 tonnes of Gummy Shark and 10 tonnes of School Shark caught in these areas in 2009. Industry members have advised that these closures will result in the loss of the more productive and consequently profitable inshore grounds resulting in increased costs and lower catch rates.

Industry members have estimated that with the more productive fishing grounds closed approximately 30% of the gillnet operators in South Australia will leave the industry and it is uncertain whether the remaining operators will be profitable in the future.

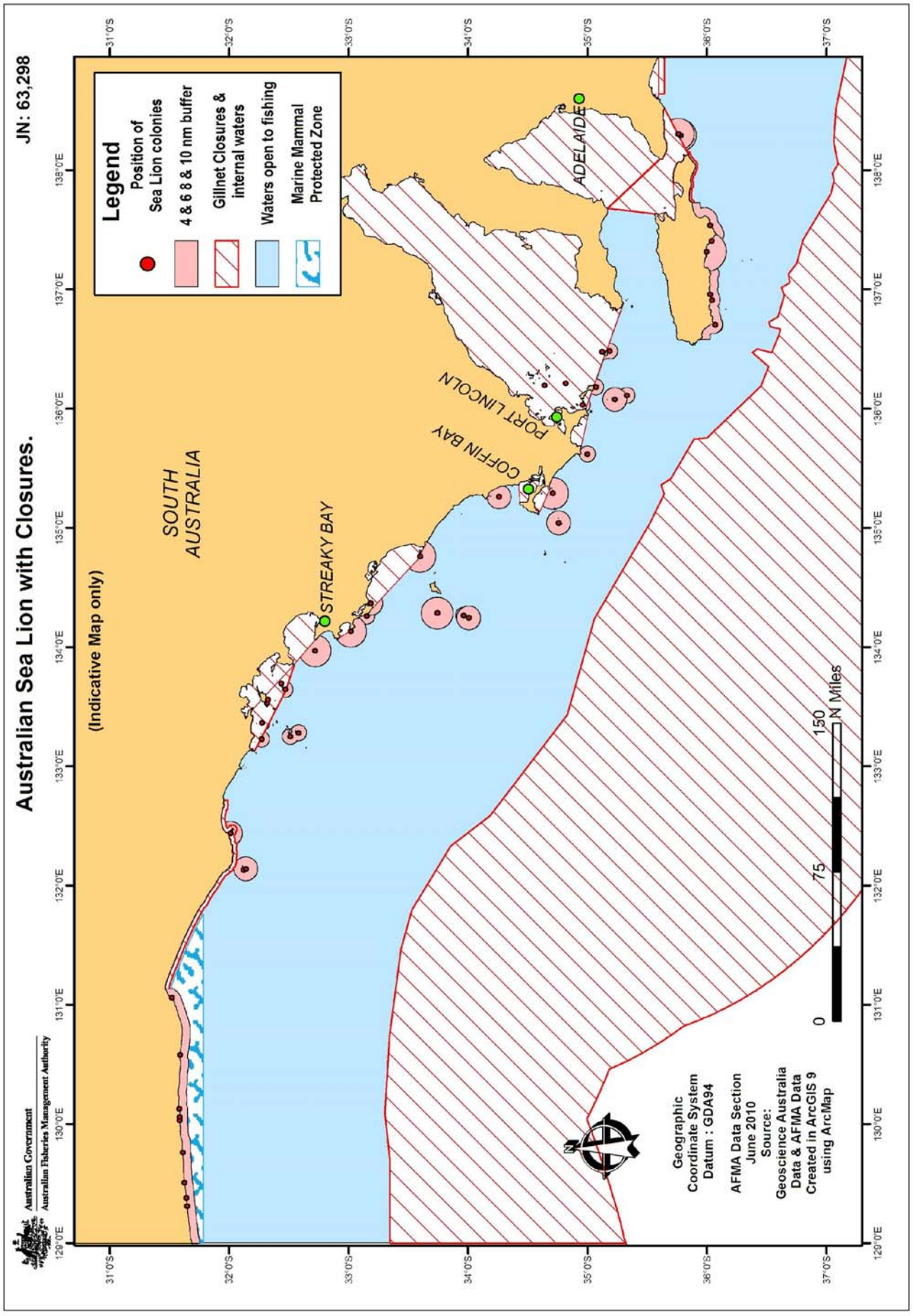

Figure 1 – Map of closures to be implemented in stage 2 of this strategy

Action 5 - Adaptive Management System

The adaptive management system will implement significant spatial closures if unacceptable levels of ongoing Australian sea lion interaction are observed. Under the system, South Australian waters are divided into seven management regions (See Figure 2). These regions were determined with reference to advice on sea lion 'meta-populations' in Goldsworthy et al. (2009b), the level of fishing effort (km of net set), the number of colonies, total pup production and the corresponding sampling zones used by the Integrated Scientific Monitoring Program (ISMP).

The trigger for further closures in each region is a pre-set number of observed sea lion mortalities (both male and female sea lions). Both sexes are included in the trigger due to the difficulty in determining the sex of sea lions at sea, particularly if the animal is not landed aboard the vessel. For more detail on the determination of the trigger levels refer to appendix 2.

If the interaction level is reached for a region, it will be closed for the remainder of the fishing season. The closure will stay in place for the remainder of the fishing season because the level of bycatch in that region had been such that the recovery of the populations in that region may have been hindered. Further bycatch mortality in a twelve month period may result in possible sub-population declines.

The expected level of observer coverage in the regions and the corresponding trigger levels are provided in Table 3 below. As the trigger levels are based on observer coverage as outlined in Table 3, any marked change in the observer coverage will require a corresponding adjustment of the trigger levels. The observer coverage rates are effective rates as observers will now be watching all shots for drop outs.

Table 3 – Total pup production, budgeted observer coverage (2010-11) on effort and trigger levels per region for the adaptive management system

Region	Pup Production	Trigger	Observer Coverage	Observer days
A	166	3	20.5 %	21
B	659	4	5.7 %	14
C	357	4	10.1 %	41
D	96	3	29.8 %	53
E	900	3	30.3 %	36
F	286	5	17.3 %	30
G	589	6	10.1 %	32
Total			**11%**	**227**
Overall trigger		**15**		

The trigger system has been designed based on an 80% probability that a region would not be triggered purely by chance. Given this level of confidence the effectiveness of the trigger system is more effective at reducing the overall mortality if there is an overall trigger, in addition to a trigger for each region.

The overall larger trigger is considered more efficient as it is based on a larger number of predicted observations which is less likely to be triggered by chance. However, the overall trigger is not sensitive to differences in sea lion productivity or risk between regions, consequently a combined approach with both triggers is preferred. Based on an observer coverage of 11%, the overall trigger level has been set at 15. If 15 sea lion mortalities are observed in a season the remaining regions open to fishing are closed to gillnet fishing for the duration of that season.

One of the underlying assumptions in the adaptive management strategy is that the observer coverage will be representative of the areas being fished by the entire fishing fleet. AFMA will assess this at regular intervals to ensure that there is no detectable 'observer effect'.

Time delays in implementing closures will be minimised and closures will be implemented within one month of an observed sea lion mortality triggering further closures. This allows the necessary time for the fishing trip to end, for the observer to submit a brief report verifying the interaction, for AFMA to draft and implement the closure direction and then provide notice to concession holders.

Observer coverage is a significant component of the management costs of the fishery and these costs are currently recovered in full from fishing concession holders. Observer coverage under this strategy will be increased to approximately 11 % of days fished (227 days). This large increase is necessary to support the adaptive management system and gather necessary information on interaction rates. It is inequitable to charge the additional sea lion observer coverage to the whole gillnet, hook and trap sector of the SESSF directly. Consequently a payment system has been devised where fishers will be charged for observer coverage when fishing inside the regions.

Concession holders will be sent invoices at regular intervals to recover the costs of observers across the adaptive management regional. The invoices will attribute costs based on the number of days each boat is inside the adaptive management regions whether they are carrying an observer or not. In this fashion the system is designed to ensure the observer costs are shared across all participants in the region and the observer coverage is not biased with boats actively avoiding observer coverage in an attempt to avoid the payment of observer costs.

Following outcomes from AFMA's Bycatch and Discard Program (see Electronic Monitoring Program), the feasibility of using cameras to replace some or all human observation will be assessed.

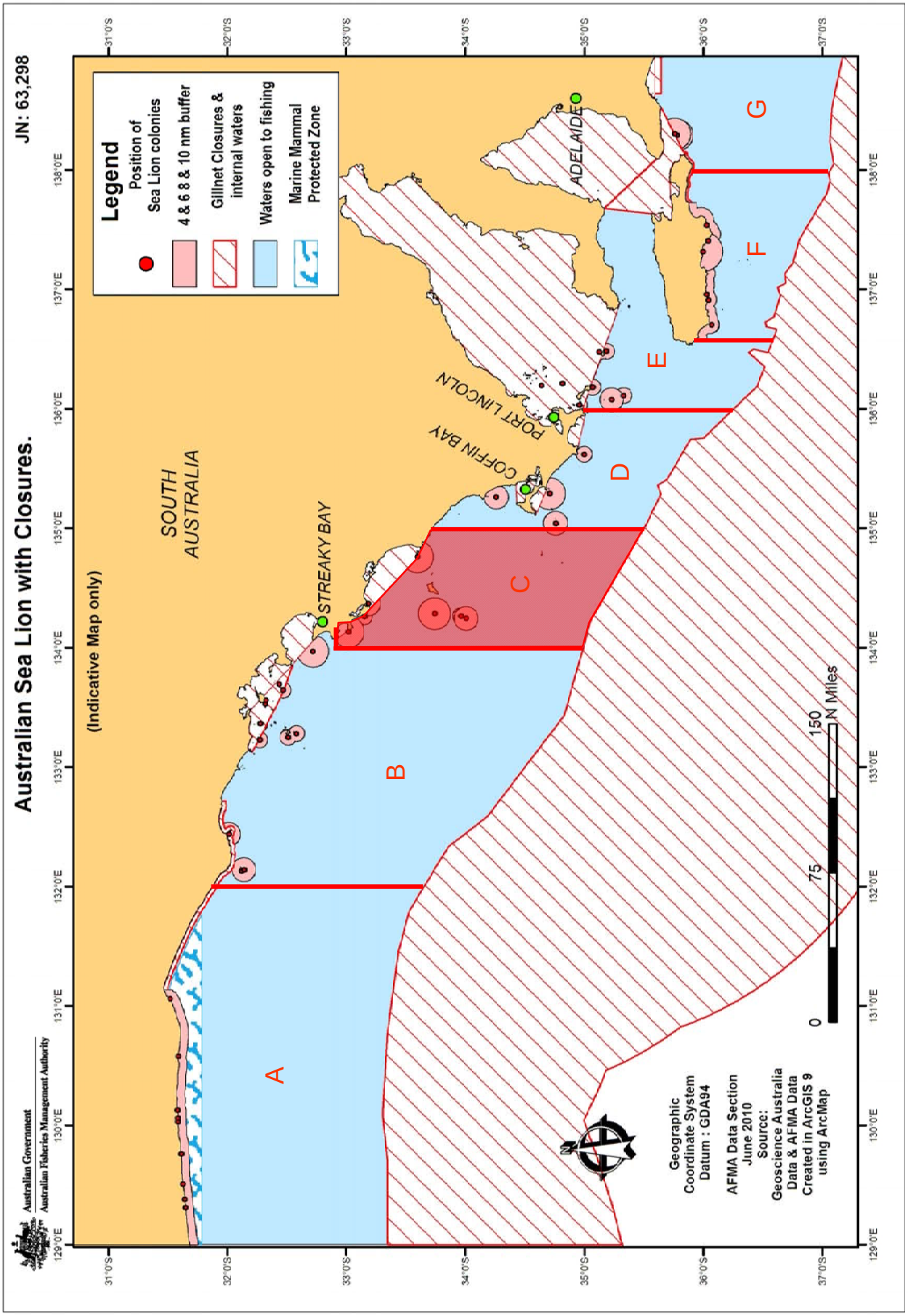

Figure 2 – Map of regional closures to be implemented in the adaptive management component of stage 2. In this example the trigger in region C has been reached and that region closed.

Action 6 - Gear changes

Review of gillnet restrictions

The adaptive management system will allow AFMA to pursue further mitigation measures in addition to spatial closures. AFMA in consultation with SharkRAG and Industry will seek to assess the ability of changes to current fishing gear requirements to mitigate against interactions of sea lions. AFMA's Bycatch and Discard Program has submitted funding applications from various sources for further studies into gear modifications.

A range of mitigation measures have been identified to reduce the risk of entanglement and subsequently increase the chance of escapement. The gear changes to be assessed are the use of deterrents such as coloured nets or other devices in the net to deter sea lions, adopting tighter slinging ratios to reduce the total net in the water and set them in a way to reduce entanglement, smaller mesh size to avoid juvenile interactions and weaker net types to allow sea lions to escape.

At the SharkRAG meeting in April 2010, members suggested a reduction in the current mesh size is likely to decrease interactions with juvenile sea lions, while increasing the slinging ratio, increasing float buoyancy and ground rope weight are likely to reduce entanglements of adult sea lions. SharkRAG supported the phase out of 165mm mesh size for 150mm and the implementation of tighter hanging ratios.

Gear modifications have been supported by Industry to provide additional protection to sea lions. Other modifications that Industry suggested that possibly will decrease bycatch mortality of sea lions included reducing monofilament diameter of gillnets and experimenting with different gillnet colours. Both of these modifications would need to be investigated to assess their effectiveness and to make sure their effects are positive.

Trials to test the efficacy of changes to fishing gear in reducing interactions with sea lions will not target sea lions and will not be conducted within areas closed to gillnet fishing. Due to the rare occurrence of sea lion interactions and the fact that they are listed under the EPBC Act, AFMA's Bycatch and Discard program will designed the research using other species as proxies to measure changes to sea lion interactions. Gear trials, if funded as anticipated, will be undertaken over an 18 month period.

Redistribution of effort - Shifting to hook methods for catching sharks

AFMA is assessing the feasibility of changing to hook methods inside and outside spatial closure areas to reduce the gillnetting effort adjacent to sea lion colonies. This can be facilitated through the granting of fishing permits to fish with hooks rather than gillnets in certain areas. This action is specifically designed to reduce the effects of effort being displaced to the boundaries of spatial closures. AFMA will also assess the feasibility of a larger shift to hook methods to catch Gummy Shark in South Australia as a longer term mitigation measure.

While this would be effective in reducing interactions with sea lions SharkRAG raised a number of issues with this suggestion. Current gillnet techniques are very selective for target and bycatch species, with the current gillnet requirements designed to target only four sub-adult and maturing year classes (4-7 year old) of Gummy Shark, avoiding adult age classes (Punt 2000). This selectivity underpins the sustainability of the fishery and substantial changes to selectivity may cause a reduction in the productivity of the stock.

Changing the primary fishing method to hooks would decrease selectivity for both target and non-target species (catching more fish outside these year classes, generally juveniles and larger pupping females). With respect to non-target species, AFMA currently has reliable data on the bycatch associated with gillnet methods, a significant change to hook methods would need to closely monitor any shift in the species being captured.

Economics would also have to be considered due to the following suggested issues, high costs involved in purchasing and modifying the boat setup, the costs of running large (ex-gillnet boats), reduced profit due to costs associated with skippers learning a new method of fishing, and reduced catches due to the limit of hooks allowed.

Wholesale changes to the gear used in fisheries generally requires a sufficient period of time to phase in. This allows fishers to replace gear in their general maintenance cycle and also allows netmakers and chandlers and other suppliers time to acquire and make the new equipment. To reduce the financial impact on fishers any new gear implementation will be phased in over an agreed period of time.

Action 6- Additional Measures

Industry Initiatives

South Australian Industry representatives have committed to developing a Gillnetting Code of Conduct with assistance from AFMA and Commonwealth Fisheries Association (CFA) within three months of this strategy being implemented.

The Code of Conduct will address the following issues; reducing the length of net soak times, increasing awareness of skippers to move on if they observe an abundance of sea lions in the vicinity of their boat or they are in high scalefish areas, introducing guidelines regarding the retention of marine debris and offal management, and working with scientists to retain samples if possible to help gather important information about sea lions.

AFMA observers will be utilised to monitor the adherence to and potential effectiveness of the Code of Conduct.

In addition to the Code of Conduct AFMA has been advised that a consultant has been employed by industry representatives to develop an Environmental Management System (EMS) for South Australian operators. The EMS will assist with the mitigation of sea lion interactions as well as improving the broader environmental performance of operators.

The Industry has also proposed a stakeholder working group to enhance communication with conservation groups, scientists, and government organisations (State and Commonwealth). This working group will be used to develop additional management arrangements and design further monitoring methods for sea lion populations.

Electronic Monitoring Program

AFMA's Bycatch and Discard Program is currently trialling underwater video cameras as a method for electronic monitoring in the gillnet sector. Results to date are positive especially for assessing drop out rates from gillnets for all species and especially sea lions. Continuing this work would provide information regarding drop out rates and could reduce the need for human observers.

Education Program

AFMA will continue to work with South Australian operators to highlight the importance of avoiding interactions with Australian sea lions. Australian sea lions are often confused with fur seals by inexperienced observers as they all inhabit similar areas. Currently there is no easy-to-follow identification key for the inexperienced observer or fisher. AFMA is actively seeking an identification key that can be used for observers and industry members.

To assist education of observers, marine mammal expert, Derek Hamer, has provided a presentation to all AFMA observers on identification of Australian sea lion and the two fur seal species. He also explained how to tell the sex of each species.

Population Monitoring Program

The recently released draft Australian sea lion recovery plan will attempt to establish strategic integrated framework so that all relevant jurisdictions work together to address threats to the species. This framework will include future monitoring of sea lion populations and rates of change. AFMA and industry will assist where possible in the framework to ensure a strategic approach to sea lion monitoring is undertaken.

Although outside the scope of this management strategy AFMA will encourage DEWHA to commission research to determine the genetic structure of Australian sea lion populations as the uncertainty about the population status of individual colonies is a major impediment to management decision making well beyond fishing impacts.

Performance Management

Review of Management Strategy

For the first year of the strategy AFMA will undertake quarterly reviews of the effectiveness of the strategy utilising all available information. These quarterly reviews will involve all stakeholders and will look into issues such as observer coverage, observed sea lion interactions and any potential triggers being reached.

In assessing the effectiveness of the strategy SharkRAG will be asked to provide advice on the number and location of interactions and also the level and representativeness of observer coverage. In reviewing this information SharkRAG will be asked to provide advice on whether the locations of sea lion interactions warrant increasing the size or changing the location of the closures outlined in Actions 1 – 4. For example, if a cluster of interactions were detected adjacent to a closure boundary, extending the closure boundary may be recommended. Further closures may also be considered if multiple triggers are reached in one fishing season. Further decision rules will be developed by SharkRAG by 30 June 2011.

Should the current management strategy fail to meet the objectives, additional closures and other management actions will be considered. The implementation of further management needs to be considered in terms of the impact on a broader suite of species resulting from displaced fishing effort.

Bioregional Marine Planning

The Australian Government is currently in the process of designing and implementing a network of Commonwealth marine reserves around Australia (Marine Bioregional Planning).

All governments in Australia have a shared and international commitment to establish a National Representative System of Marine Protected Areas by the year 2012. The South West Region encompasses the area of distribution of Australian sea lions. The draft Plan for the South West Region was due for release in January or early February 2010. It is now expected that the draft Plan will be released in the second half of 2010.

Longer term review of Management Strategy

Following the first year of the operation of the strategy SharRAG will annually review the effectiveness of the strategy towards the objective of avoiding mortality of, or injuries to, sea lions so as to enable the recovery of sea lion populations, including all sub-populations. AFMA will invite marine mammal experts to these SharkRAG meetings to provide advice as required. Information gathered through the increased observer coverage and any subsequent interactions will be used to refine the spatial closures and also the adaptive management system. Annual reports on the implementation of the strategy will form part of the Annual Status Report of the SESSF required under the Wildlife Trade Operation for the fishery. The Annual Status Reports are made publicly available on the AFMA website.

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Chronology of events

1798 – 1920	Sealing activities reduce Australian sea lion populations
1927	Shark fishing in southern Australia was first recorded with fishers targeting sharks with demersal longlines.
1927 – 1960	The shark fishery develops in line with increased demand for shark meat and vitamin A from shark liver oil.
1970s	Monofilament gillnet methods replace demersal longline and shark fishery begins targeting Gummy Shark.
1987	Gillnet fishing effort in South Australian waters peaks at nearly 43,000km net set.
1987 – 2000	Management measures reduce fishing effort to current levels
1997	Large mesh nets removed from fishery, shark operators restricted to 150-165mm mesh
2000	Management of shark fishing being ceded to the Commonwealth government under Offshore Constitutional Settlement (OCS). All Internal waters of South Australia closed to shark fishing.
2001	Shark fishery moves to quota, total allowable catch (TAC) set Gummy Shark and School Shark.
2005	Australian Government *Securing our Fishing Future* voluntary fishing concession buyback initiated, results in the removal of 26 shark gillnet boat SFRs and 17 South Australian coastal waters permits.
2007	Commonwealth Fisheries Harvest Strategy Policy is implemented, results in a move towards the target of Maximum Economic Yield (MEY) in Commonwealth managed fisheries.
2007	Closures to inshore areas implemented throughout South Australia.
2009	Interim closures around all 48 Australian sea lion colonies implemented. Sea lion specific observing commences.
2010	Australian Sea lion management strategy implemented.

Determination of Trigger Levels

The trend in population growth was predicted for each colony by Goldsworthy et al. (2010) based on a demographic schedule estimated in one intensively monitored population. Bycatch rates, in addition to natural mortality, affect the survival of population age-subclasses and can be modified to determine whether a population increases, decreases or remains stable over time. In order to determine the maximum bycatch rate that would still enable the recovery of all regional populations, the survival probabilities in the demographic schedule were modified to estimate the maximum bycatch rate that would allow overall population growth per region.

This approach suggests that the maximum bycatch rate that would still allow population growth in each of the regions is approximately 2% per year (or 3% per breeding cycle). This equates to a reduction in the total predicted sea lion mortalities under the trigger system from 256 per fishing season (374 per breeding season) to 136 per fishing season or 47%. The corresponding trigger levels have been calculated based on the expected numbers of sea lion bycatch incidents to be encountered by AFMA observers based on this level of bycatch at a set level of observer coverage.

As the expected numbers of sea lion mortalities to be encountered by observers are subject to the effects of chance, theoretical probability distributions have been used to determine the ability to detect sea lion interactions within each region. To account for this, the trigger levels have been calculated based on an 80% confidence level. That means there is an 80% probability the trigger will not be reached due to chance alone. When triggers are reached, the underlying bycatch mortality is higher than the expected rate and additional closures are implemented.

Trigger points as outlined in Table 3 lose efficiency when only small numbers of interactions are expected in a region. The adaptive management system balances this by increasing the observer coverage in the regions where there is less confidence in detecting interactions.

Australian Sea Lion colony positions in waters adjacent to South Australia

Location	Latitude			Longitude		
Bunda Cliffs 'B9'	31º	38.80	S	129º	18.68	E
Bunda Cliffs 'B8'	31º	38.38	S	129º	22.86	E
Bunda Cliffs 'B7'	31º	37.50	S	129º	30.63	E
Bunda Cliffs 'B6'	31º	36.56	S	129º	45.71	E
Bunda Cliffs 'B5'	31º	35.11	S	130º	01.84	E
Bunda Cliffs 'B4'	31º	35.14	S	130º	03.67	E
Bunda Cliffs 'B3'	31º	34.94	S	130º	07.55	E
Bunda Cliffs 'B2'	31º	35.17	S	130º	34.85	E
Bunda Cliffs 'B1'	31º	31.05	S	131º	03.67	E
Nutys Reef (west)	32º	07.12	S	132º	07.88	E
Nutys Reef (east)	32º	08.32	S	132º	08.48	E
Point Fowler	32º	00.65	S	132º	26.27	E
Purdie Island	32º	16.19	S	133º	13.70	E
West Island	32º	30.65	S	133º	15.08	E
Fenelon Island	32º	34.86	S	133º	16.90	E
Lounds Island	32º	16.38	S	133º	21.94	E
Breakwater Island	32º	18.96	S	133º	31.80	E
Gliddon Reef	32º	19.32	S	133º	33.66	E
Blefuscu Island	32º	28.02	S	133º	38.64	E
Lilliput Island	32º	26.04	S	133º	41.58	E
Olive Island	32º	43.15	S	133º	58.19	E
Nicolas Baudin Island	33º	00.94	S	134º	07.98	E
Point Labatt	33º	09.14	S	134º	15.64	E
Jones Island	33º	11.12	S	134º	22.03	E
Dorothee Island	34º	00.30	S	134º	14.70	E
Pearson Island	33º	57.72	S	134º	16.02	E
Ward Island	33º	44.45	S	134º	17.10	E
West Waldegrave Island	33º	35.77	S	134º	45.69	E
Four Hummocks (North) Island	34º	45.46	S	135º	02.53	E
Rocky Island (North)	34º	15.52	S	135º	15.63	E
Price Island	34º	42.46	S	135º	17.37	E
Liguanea Island	34º	59.90	S	135º	37.19	E
Lewis Island	34º	57.42	S	136º	01.90	E
North Neptune (East) Island	35º	13.68	S	136º	04.62	E
South Neptune (Main) Island	35º	19.82	S	136º	06.71	E
Albatross Island	35º	04.12	S	136º	10.88	E
English Island	34º	38.27	S	136º	11.75	E
Dangerous Reef	34º	48.90	S	136º	12.72	E
North Island	35º	07.24	S	136º	28.57	E
Peaked Rocks	35º	11.10	S	136º	28.92	E
North Casuarina Island	36º	04.09	S	136º	42.15	E
Cape Bouguer	36º	02.50	S	136º	54.53	E
Cave Point	36º	01.55	S	136º	57.44	E
Seal Bay	35º	59.70	S	137º	19.02	E
Black Point	36º	02.29	S	137º	24.38	E
Seal Slide	36º	01.54	S	137º	32.17	E
South Pages Island	35º	46.63	S	138º	17.50	E
North Pages Island	35º	45.54	S	138º	18.07	E