Innovation and Accountability in Commercial Fisheries

The case for reform of harvest and management practices for Australia's SESSF and related fisheries

A report for

By Wayne Dredge

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Executive Summary

Australia's Southern and Eastern Scalefish and Shark Fishery (SESSF) is a multi-species fishery that covers nearly 50% of Australia's Exclusive Economic Zone (EEZ) and is made up of seven different fishing sectors. The total economic value of the fishery in (2014-2015) was AU$68 million (Patterson, *et al.*, 2016) and unlike many other high value Australian fisheries, mainly supplies the domestic market with fresh finfish and shark.

Within the SESSF is the Shark Gillnet sector which predominantly targets Gummy shark in the Commonwealth waters off Victoria, Tasmania, South Australia (SA) and Western Australia (WA). The biological stock of Gummy shark is considered sustainable with a Total Allowable Catch (TAC) of 1,836 tonnes and commercial catches are reported in 16 separate fisheries across southern Australia. The demersal gillnets used to catch Gummy shark are considered a passive, selective and low impact form of fishing.

In response to a report by Goldworthy *et al,* (2009) suggesting that the failure of the Australian Sea Lion (ASL) population to recover from sealing activities in the 18th and 19th centuries was in part, due to high levels of bycatch mortality within the Shark Gillnet sector, the Australian Fisheries Management Authority (AFMA) imposed formal fishery closures encompassing 6,300 km^2 in June 2010 to protect known ASL breeding sites. Since May 2011 further closures were implemented to strengthen ASL protection and reduce the incidence of gillnets interacting with dolphins, bringing the total area closed to gillnet fishing to 129,992 km^2.

These closures had a significant economic impact on fishers and onshore businesses that relied on the shark fishery. Many businesses believe that in order for them to become economically viable again alternative fishing methods must be found which can be used to target Gummy shark in areas closed to gillnet fishing.

Further complicating these issues are the manner in which Australian fisheries are managed whereby the Commonwealth has jurisdiction over certain species while the States have jurisdiction over others. Many commercial species overlap between State and Commonwealth waters resulting in conflict between fishing sectors and management authorities. The conflicting objectives between State and Commonwealth fishery managers mean that Commonwealth vessels are forced to discard State species and vice versa. Although such discards do not necessarily affect the sustainability of Australia's fisheries they do come at an

economic loss to fishers and the overall resource. Furthermore, discards are increasingly becoming a social and political issue and have the potential to negatively affect the industry's social licence. As such, any advances in fishing technology that has the potential to increase catches of fish not permitted under a respective licence are a risky investment for fishers.

Over 100 fishing ports were visited in 20 countries while researching this report to observe different fishing practices used on a wide range of vessels. Hundreds of fishers were spoken with as well as leading researchers, fishery managers, technology companies and industry representatives to gain a diverse perspective on the issues facing not just Australian but global fisheries and to learn what solutions other countries had found who experienced similar problems to Australia's Shark Gillnet sector. The overall question was: how can fishers innovate to overcome operational or environmental issues when regulation often inhibits innovation, while not creating conflict with other fishing sectors or management authorities.

Although no ideal fishing solution was found as an alternative to gillnets, a number of longline systems are being used in fisheries elsewhere in the world or are currently in development by leading technology companies that could be adapted to target Gummy shark within Australia's SESSF.

Due to complicated regulatory and jurisdictional arrangements amongst Australian fisheries any shift in technology regarding fishing practices has significant potential to cause conflict between fishing sectors harvesting from the same resource under different licensing arrangements or, amongst management authorities. As such, capital investment in Australian fisheries production is inherently risky and lack of resolution regarding these management arrangements is causing a loss of confidence within the industry; comes at an economic cost to fishers; reduces consumer choices for Australian seafood; and decreases the current production potential of Australia's marine resources.

Proactive reform driven by industry that seeks to increase individual accountability and responsibility; improve data auditing processes through Electronic Monitoring (EM); as well as the ability to transfer fishing rights between State and Commonwealth fishers, would have the potential to open the door for greater innovation in fishing practices; improve industry productivity; and decrease compliance costs across the sector. Any attempt at these reforms without concurrently addressing management and jurisdictional conflicts would only result in increased costs to industry without productivity gains and more burdensome regulation

within what is currently an inherently dysfunctional legislative and decision-making framework. Recommendations include:

1. All management authorities and industry stakeholders should undertake a thorough and comprehensive review of the management structure of Australian fisheries to identify:
    - Areas of conflict between fishing sectors;
    - Jurisdictional conflict between management authorities;
    - Regulatory provisions that inhibit innovation without clearly defined objectives; and
    - Industry practices that inhibit the ability of managers to make the most informed decisions possible.
2. AFMA and State management authorities must resolve jurisdictional conflict by creating a more innovative strategy for fisheries management that centralises policy and management under a single authority but is administered by regional structures.
3. Implement a standard platform for data collection across all fisheries to reduce costs, increases efficiency and better monitors ecosystem impacts of fishing.
4. Introduce 100% EM requirements across all multi-species fisheries or fisheries that experience high bycatch, or marine mammal or seabird mortalities, which would enhance accountability and individual responsibility. The implementation of EM must be industry driven and innovative in ways that reduces costs to fishers and provides a productivity dividend to the industry.
5. Removal of sector, input, spatial or technological restrictions that do not serve a specific biological purpose in order to promote a greater culture of innovation within industry and allow fishers to be more adaptive to changing circumstances and consumer markets.
6. Significantly greater onus must be placed on industry to be the driver of regulatory reform rather than being the victim or reactionaries of it.

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Foreword

In recent years the Gillnet, Hook and Trap (GHaT) fishery underwent significant spatial closures in Commonwealth fishing grounds off South Australia (SA) resulting from Marine Mammal Interactions (MMIs) between shark gillnet boats, Australian Sea Lions and Common Dolphins. These closures imposed significant restrictions on gillnet fishers as it meant that up to 70% of available waters were closed to fishing in the area off SA (Knuckey*, et al.*, 2014).

Furthermore, all vessels operating within the fishery became subject to 100% independent scientific observer coverage or were required to fit onboard cameras for observation by management authorities. These measures added additional production costs to industry, and the spatial closures resulted in reduced catches, additional operational costs and decreased profitability for many shark fishers.

Between March and December 2012 trials were conducted to assess the viability of using Deep Sea Automated Longline (ALL) fishing technology off SA as an alternative to gillnets in areas with a high risk of MMIs. While the trials showed some promise for the use of ALL they also highlighted some of the setbacks and limitations that industry would face in transitioning to these systems (the Deep Sea ALL systems trialled are described in the compendium to this report).

Since the commencement of my research for this report, AFMA has approved the use of ALL in the SA GHaT fishery however industry has yet to take up the technology.

Given that closure of available fishing grounds generally corresponds with decreased catches of the same magnitude (S. Boag, pers. comm., 5 March 2015) the original aim of this study was to identify other fishing techniques that could be implemented that would reduce MMIs; allow previously closed areas to be reopened to fishing; and improve the economic efficiency of the industry.

In undertaking this research, it became apparent that longline methods and other fishing techniques could be utilised in the SESSF and GHaT fisheries but that current management or regulatory arrangements prohibit them; make entry into the fishery extremely difficult; or that using different fishing methods would cause conflict with other fishing sectors.

This report addresses some of those issues and makes recommendations as to how fisheries management authorities could better allow industry to adapt to changing circumstances while maintaining the environmental, economic and social integrity of the fishery.

Considering the broad scope of research conducted throughout the course of this study, this report intentionally does not address every aspect of decision-making that fishery managers must take into account. Instead, it aims to outline a general framework of options that when combined with other management tools lead to greater cooperation between all stakeholders. It does not aim to simplify what are complex problems but identify the common objectives that need to be addressed in order to solve them.

The primary countries which were considered relevant to visit included Argentina, Chile, the United States, Canada, Belgium, the Netherlands, Denmark, Sweden, Norway, France, Spain, United Kingdom, Ireland, Belgium and Portugal. Additionally, there was consultation with industry and management in Australia, and published works from Australia and many other countries have been drawn upon.

My primary background prior to authoring this report includes ten years' experience in the southern and eastern trawl sector and seven years' experience in the Victorian and Tasmanian rock lobster industries. I have also previously been active in the GHaT (shark gillnet) and have worked in squid, prawn, estuary, scallop and longline fisheries at different times. I currently own two boats, have financial interests in Commonwealth, Tasmanian and Victorian fisheries and spend approximately six months every year at sea. As a fisher myself I can attest to problems currently faced by many in the industry and sincerely hope for ongoing efforts to resolve them so the next generation of Australian's can gain as much enjoyment from being an active fisher as I have throughout my career. There really is no better job in the world.

Acknowledgments

I would firstly like to thank Nuffield Australia for this opportunity and FRDC and Woolworths Australia for their continued investment in the Nuffield Scholarship program and dedication to the Australian seafood industry.

The hundreds of individuals who helped me throughout the world are too numerous to list but I would be remiss not to mention the following people who generously gave their time and knowledge; Gabrielle Blanco and the staff of INIDEP in Argentina; Professor Carlos Moreno, University of Valdivia, Chile; Shawn Stebbins and the staff from Archipelago Marine Research, BC, Canada; David Boyes and Lara Erikson, International Pacific Halibut Commission; Wes Erikson, Pacific Halibut Management Association of British Columbia; Chris Sporer, Pacific Prawn Fisherman's Association, BC, Canada; Christina Burridge, BC Seafood Alliance, Canada; Ann-Marie Copping and Theodora Geach, Ocean Wise at the Vancouver Aquarium; Kathy Heiss, Vancouver Aquarium; Brian Mose, Deep Sea Trawlers Association, BC, Canada; Professor Ray Hilborn, University of Washington, Seattle; Dean Adams, Seattle; Clyde Burnside, Port Hardy, Vancouver Island; Jeff Mikus, Tofino, Vancouver Island; Gro Tollefsrud and Benny Sorensen, Mustad Autoline, Norway; Trond-Inge Kvernevik, Egil Moe and Jakob Hals, Fiskevegn, Norway; Kathryn Stack, MD Europeche, Brussels; Javiar Garat, President Europeche, Brussels; Esben Sverdrup-Jensen, Danish Pelagic Producers Organisation; Ment van der Zwan and Cor Blonk, PFA, Netherlands; Erik Lindebo, EDF, Brussels; Despina Symons, Director, European Bureau for Conservation & Development, Brussels; Arie Dekker; Saskia Richartz, EU Oceans Policy Director, Greenpeace, Brussels; and a very special thanks to Jean Roullot from Le Drezen, France, who went far above and beyond in giving me his time, never have I met another man so dedicating to the pursuit of fishing.

I would also like to pay tribute to Ms Tameezan Mawani whose brilliant thesis on British Columbia's Commercial Groundfish Integration Pilot Program has been pivotal in writing this report. Any person wishing to gain a greater understanding of how fisheries can move toward ecosystem based approaches would benefit from reading Ms Mawani's thesis.

Thanks to the skippers and crew from all around the world who were willing to entertain having an Australian on board, we rarely shared a common language but did share a common passion.

To those in Australia who helped me throughout my research my gratitude knows no limit. Special thanks to; Anthony Ciconte who encouraged me to apply for the Nuffield Scholarship in the first place and has been a constant source of support; Simon Boag from the South East Trawl Fishing Industry Association who generously shared his extensive knowledge; Ian Rule and Luke Hill for so willingly imparting their years of knowledge in the shark gillnet industry; Jo-Anne Ruscoe from FRDC for her continued support; David Power and Steve Bolton from AFMA; Philios Tomoouzos from the Fish Factory in SA; Rhys Arangio from Austral Fisheries for his extensive contacts and advice; and David Stone for personally highlighting so many of the issues our industry is currently faced with.

A huge thank you to all the hosts on my Global Focus Program (GFP), the introduction you each gave our group to your respective countries is a privilege few people get. I hope one day I can return the favour for you in Australia.

Finally, to Tommy, Ben, Daryl, Hannah, Sarah, Dan, Simon and Jenny who I shared a remarkable six-week journey through international food production with. Thank you for being patient with the lone fisherman and explaining in simple terms some of the more intricate things about soils, crops, cows, sheep, roses, sugar and bees. It was a trip I'll never forget and one for which I'm incredibly grateful to have shared with each of you.

Abbreviations and Glossary

ALL – Automatic Longline

AMR – Archipelago Marine Research

ASL - Australian Sea Lion

CGIPP – Commercial Groundfish Integrated Pilot Program

CPUE – Catch Per Unit of Effort

EM - Electronic Monitoring. Onboard cameras which are used to monitor fishing events aboard vessels at sea

FOI – Freedom of Information

GHaT – Gillnet Hook and Trap

ICES – International Council for the Exploration of the Sea

IQMI – International Quota Management Inc.

ITQ – Individual Transferable Quota

MLL – Manual Longline

MMI (s) – Marine Mammal Interaction (s)

MPA (s) – Marine Protection Area (s)

MS – Member States or countries that are members of the European Union

MSY – Maximum Sustainable Yield

NSW – New South Wales

SESSF – South Eastern Shark and Scalefish Fishery

SFR – Statutory Fishing Right

OCS (s) – Offshore Constitutional Settlement (s)

SA – South Australia

TAC (s) – Total Allowable Catch

WA – Western Australia

Objectives

1. Identify fishing methods being used or developed internationally and assess their viability within Australia's SESSF and GHaT Fisheries for targeting Gummy shark and/or other species.
2. Research ways in which other fisheries are managed with regard to conflict issues that exist between fishing sectors and management jurisdictions.
3. Identify the regulatory and legislative factors in Australia that are inhibiting industry from adopting new technology and discouraging investment in fisheries production.

Chapter 1: Introduction

The Southern and Eastern Scalefish and Shark Fishery – Overview, Licensing and Jurisdictional Arrangements

The SESSF is a multi-sector, multi-species fishery that encompasses almost 50% of the Australian Fishing Zone (Figure 1). It is managed by the Australian Fisheries Management Authority (AFMA), which uses a range of mechanisms to ensure the sustainability of the fishery. These include output controls with total allowable catches (TACs) set for each species combined with measures such as limiting the number vessels licensed to fish in the zone, trip limits, size limits, incidental catch limits, prohibited take, spatial and temporal closures, gear restrictions and Marine Protected Areas (MPAs) (AFMA, 2017a).

Each year the SESSF Resource Assessment Group and South East Management Advisory Committee make recommendations to the AFMA Commission on TACs for each species in the given year. Based on this information from scientists, the fishery manager and stakeholders, the AFMA commission sets a TAC for each species which is the amount of catch that is sustainable and provides the maximum economic, environmental and social benefit to the Australian community.

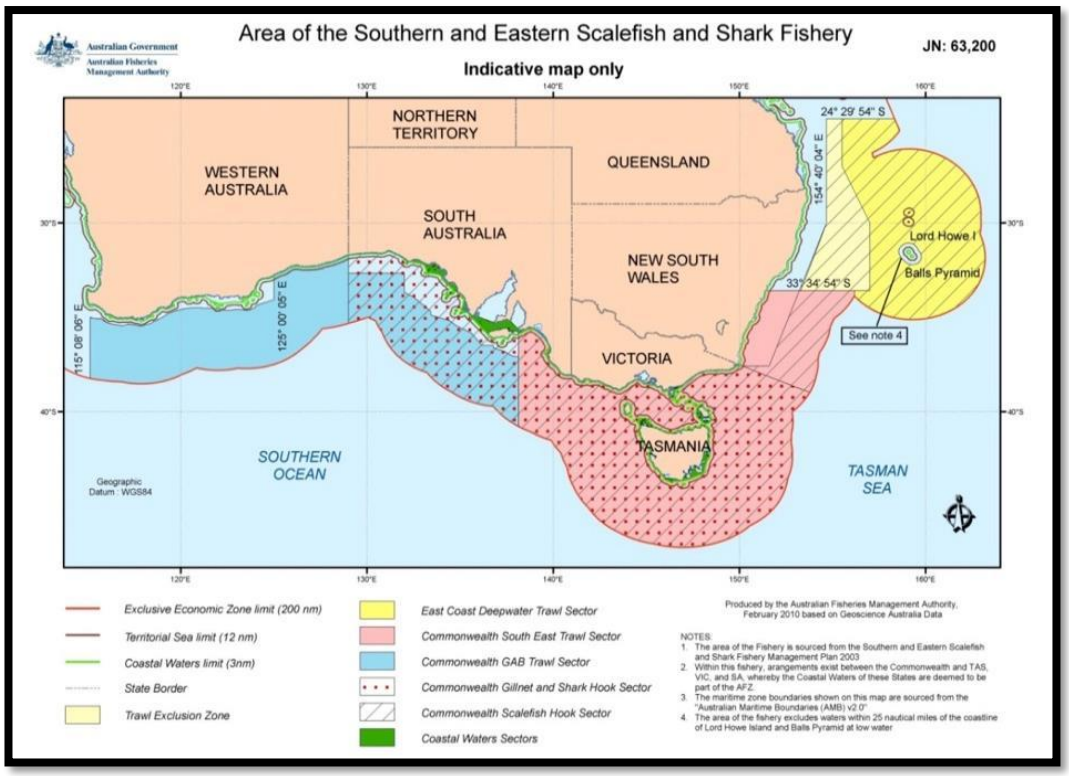

Figure 1: Map of the SESSF (AFMA, 2017a)

The total economic value of the fishery in 2014-15 was $AU 68 million and unlike many high value State managed fisheries the main market is for domestic supply and consumption of fresh shark and finfish (AFMA, 2017a). The seven fishing sectors within the SESSF are; the Commonwealth Trawl Sector; the East Coast Deep Water Trawl Sector the Scalefish Hook; Shark Hook; Shark Gillnet; Trap; and the Great Australian Bight Trawl Sector.

In order to fish within the SESSF an operator must hold a relevant boat Statutory Fishing Right (SFR); the relevant quota SFRs for the fish they catch; and any additional permits that may be required to operate within State waters or spatial/temporal closures. Such SFRs can be owned or leased between industry stakeholders/fishing operators to allow them to begin or maintain production within the fishery. For example, one vessel may own a Shark gillnet SFR allowing them to fish for shark with gillnets but not own any quota SFRs. In this case they can lease quota SFRs from a third party for an agreed sum of money. AFMA maintains a record of such transactions to ensure accountability and compliance within the industry. All catch of quota species must be reconciled against a quota SFR.

Within the geographic region described above, State managed fisheries also exist and operate concurrently with the SESSF, often within the same fishing grounds. This causes conflict due to agreements set out in Australia's Offshore Constitutional Settlements (OCSs) that stipulate which species of fish/crustacean is to be managed by the State or Commonwealth.

Due to these overlapping management jurisdictions, vessels often catch a species of fish not permitted under their respective SFR or state licence and are forced to discard any quantity not deemed to be within the range of incidental bycatch[1] which can be as low as zero. While such discards may not negatively affect the sustainability of the fishery, the practice of discarding high quality food product is fast becoming a significant social and political issue and one which consumers can blame commercial fishers for.

Shark Fishery

Overview

The Shark Hook and Shark Gillnet sectors exist concurrently in the waters from the NSW/Victoria border westward to the SA/WA border inclusive of the waters around Tasmania

[1]Incidental bycatch refers to a quantity of catch that cannot be avoided during the course of other targeted fishing operations. Trip limits imposed upon such bycatch are designed to discourage targeting of non-target species.

to the extent of the Australian Fishing Zone. Within this zone all targeting of shark is prohibited within Victorian state waters[2] however targeting of shark within Tasmania and SA coastal waters is permitted if the fisher holds a relevant state coastal waters permit.

Gummy shark are distributed throughout southern Australia's temperate coastal waters (Figure 2) and the most recent research indicates that the stock is made up of four separate biological stocks, three of which are managed by the Commonwealth and the fourth by WA. The species is widely fished throughout southern Australia and commercial catches are recorded in 16 separate fisheries (Marton, *et al*., 2014).

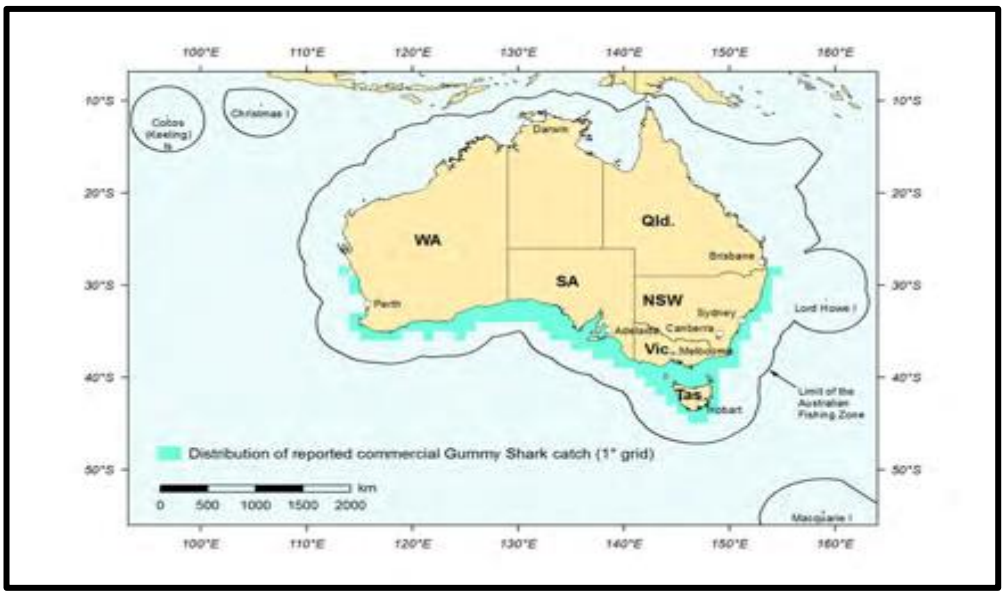

Figure 2: Distribution of Gummy shark in the SESSF (Marten, et al., 2014)

The most recent assessment of the Status of Australian Fish Stocks (2014) lists Gummy shark as being sustainably fished. The TAC recommendation for Gummy shark for the 2017-2018 fishing season is 1774 tonnes (AFMA, 2017b).

Additional information on the history of the shark fishery and status of stocks interacted with other than Gummy shark can be found in the compendium to this report.

[2] State waters are generally defined as waters within 3nm of the coast

Gillnet

The most common fishing method for Gummy shark is the use of monofilament demersal gillnets. Gillnets act like a barrier or fence placed along the sea bed which shark or fish swim into and due to the light nature of the monofilament mesh, become entangled (Figure 3). Demersal gillnets are considered a passive and relatively low impact form of fishing with minimal disturbance to the benthic environment (Gascoigne & Wilsteed, 2009).

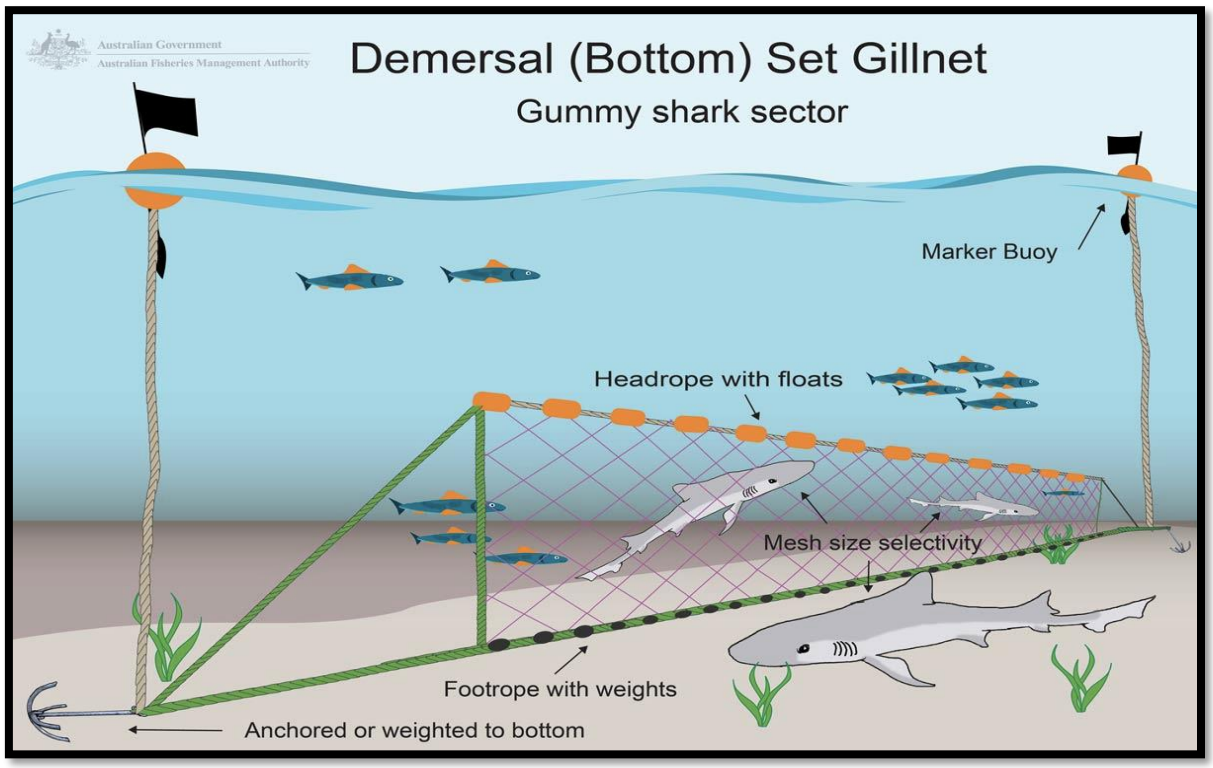

Figure 3: Demersal gillnet (AFMA, 2017c)

The sustainability of the Gummy shark fishery has in part been credited with the selective nature of gillnets within the fishery. Through an industry practice of using only 6 inch gillnet the method becomes highly selective in the size of fish being retained as small fish can easily pass through the net and larger fish generally bounce off without becoming entangled. This means that juvenile stock is left unharvested while larger breeding stock is preserved (Knuckey, *et al.,* 2013). The TAC arrangements of the fishery are heavily dependent on this selectivity.

Longlines

Although the shark fishery mostly transitioned from longlines to gillnets in the 1970s some individual operators have continued to fish using longline methods. Demersal longlines used to catch Gummy shark comprise baited hooks that are attached to a mainline via a snood and manually attached clip (Figure 4).

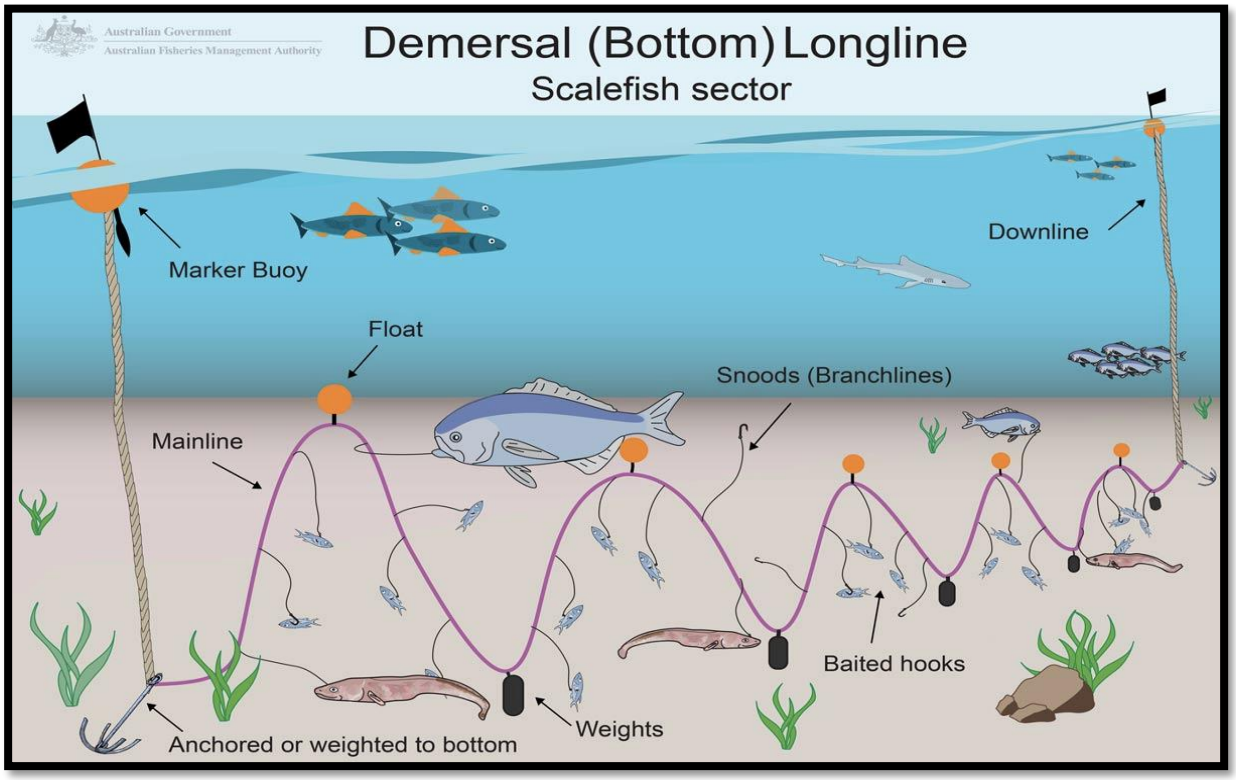

Figure 4: Demersal longline (AFMA, 2017d)

Although longline fishing for Gummy shark has shown historically to be successful it also poses a number of issues from an operational, environmental and management point of view. Operationally Manual Longline (MLL) is more labour intensive than gillnets as each hook is hand baited and clipped onto and off the mainline individually. Subsequently this technique poses higher safety risks due to the manual handling of hooks and snoods which increases the likelihood of crew becoming hooked through a hand or clothing and being injured or pulled overboard. MLL is also more cost intensive than gillnets due to the need for bait.

Some fishers are concerned that widespread hook fishing may result in higher School shark mortalities and given the conservation dependant nature of the species this may have negative effects on the rebuilding of School shark stocks. Another environmental concern is

that longlines experience a higher interaction rate with seabirds than gillnets and mitigation measures relating to seabirds are discussed in the compendium of this report.

Finally, longlines also raise questions from a fisheries management perspective. Given hooks are perceived to be less selective in what they catch than gillnets, some fishers argue there is a higher likelihood hook fishing will catch a greater quantity of crossover species that may cause conflict with other fishing sectors in addition to shifting the size structure of retained shark. Knuckey *et al*, (2014) reported that during trials conducted in SA with longlines caught a similar size structure of Gummy shark as 6 inch gillnet. This correlation and the selectivity of hook fishing is further discussed at more length in the compendium to this report.

Australian Sea Lion and Dolphin Spatial Closures

The Australian Sea Lion (ASL) population was depleted by sealing activities in the 18th and 19th centuries and unlike Australian Fur Seals has failed to recover to its pre-exploitation levels (Knuckey, *et al.,* 2014). Contributing factors to the lack of recovery amongst the ASL population include a long breeding cycle of 18 months and the fact that sexually mature females only return to their birth place to breed which inhibits emigration and dispersal (Knuckey, *et al*., 2014). In 2008 ASLs were listed as an endangered species by the International Union for the Conservation of Nature (Goldsworthy, *et al.,* 2009).

Goldsworthy *et al.* (2009) reported that 86% of known breeding sights are found in the waters off SA and since ASLs are vulnerable to entanglement and drowning in demersal shark gillnets, suggested that high levels of bycatch mortality have limited the recovery of ASL colonies in SA. Responding to these reports in June 2010, AFMA implemented long-term management measures including formal fishery closures that encompassed 6,300 km^2 to protect the known ASL breeding colonies (Knuckey, *et al*., 2013).

Since May 2011 further closures have been implemented to strengthen the protection of ASLs and other species including dolphins, seabirds and some shark species (Knuckey, *et al.,* 2013). These additional closures brought the amount of fishing grounds closed to gillnetting to 129,992 km^2 (Knuckey, *et al*., 2013).

Additionally all gillnet vessels operating in the remaining waters off SA became subject to 100% observer coverage or EM. These area closures and observer coverage reduced the profitability of many SA shark fishing operations (Knuckey, *et al*., 2013). In turn many SA operators either stopped fishing altogether or moved to adjacent fishing grounds in Tasmania,

Bass Strait or Victoria resulting in increased fishing effort in those regions. In addition to fishing businesses being affected, some onshore businesses that were dependant on the shark fishery have suffered extreme financial hardship (Knuckey, *et al*., 2013). Many SA businesses believe that to become viable again and have certainty into the future, alternative fishing methods may have to be found to target Gummy shark in areas with a high risk of MMIs.

Chapter 2: Mitigating Marine Mammal Interactions in international gillnet fisheries

Acoustic Deterrent Devices

Acoustic Deterrent Devices (ADD) emit high frequency sound intended to keep marine mammals away from commercial fish farms or fishing equipment. ADDs have been used with mixed results in some capture fisheries to deter cetaceans from interacting with fishing equipment (Coram, *et al.,* 2014).

Despite some success with ADDs, concerns have been raised about potential negative effects that continued use of ADDs can have on target and non-target species including habituation, abandonment of feeding grounds, loss of hearing and behavioural alterations (Coram, *et al*., 2014).

Argentina's artisanal coastal gillnet fishery operating in the Rio de la Plata was experiencing interactions with a local dolphin species (*Pontoporia blainvillei*). As a mitigation measure, trials were conducted using ADDs and interactions decreased as a result. However, the local sea lion population soon began associating the sound of ADDs with food (due to fish entangled in gillnets) and instances of sea lion interactions increased markedly - in effect trading one form of marine mammal interaction for another (G. Blanco, pers. comm. 29th April 2014). Similar reports of mitigating interactions with cetacean species only to increase levels of interactions with sea lions and seals were also reported in US and Canadian fisheries (K. Heise, pers. comm. 6th June 2014).

Reflective and coloured nets

Researchers in Argentina also conducted trials using visually reflective netting in an attempt to mitigate interactions with *Pontoporia blainville.* No conclusive data was collected that would suggest reflective netting reduced interactions (G. Blanco, pers. comm. 29th April 2014).

Kathy Heise of the Vancouver Aquarium (pers. comm. 6th June 2014) has conducted research trying to establish why dolphins, which have highly advanced sensory systems, become entangled in fishing nets. From controlled experiments it appears dolphins turn off or tune out much of their sensory information and rely upon eyesight when feeding in close proximity to

one another. Additionally, she pointed out that dolphins only have one type of cone cell in their eyes and although there has not been much work done on colour discrimination, this suggests that they cannot tell colours apart.

Sea lions and seals however have the ability to see some colours therefore research into different net colours may offer some mitigation strategies for interactions with these species.

Procedural mitigation measures

Commonly used strategies by fishers for effective mitigation of MMIs across all countries visited were offal management and fishing equipment setting and retrieval techniques.

Offal management refers to the practice of retaining offal or waste fish on board during the setting or retrieval of nets and lines, and at dawn and dusk when risk of interacting with marine mammals is higher.

AFMA's Dolphin Strategy to Minimise Gillnet Bycatch (2014) recommends best practice mitigation measures for reducing dolphin bycatch with gillnets and can be found in the compendium to this report. Similar measures to AFMA's publication were reported by fishers encountered through the course of this study with little variation.

Chapter 3: Alternative Fishing Methods

Chile

The Chilean Patagonian toothfish fishery uses a form of MLL rebranded the 'Chilean longline' (see compendium for details) and there is evidence to suggest that the increased localised density of bait used with this method provides a greater attractant to fish which has resulted in an increased CPUE when compared with conventional longlines (C.A. Moreno, pers. comm., 9th May 2014).

Also reported by artisanal fisherman in Punta Arenas, Chile, was that the use of a swivel at both the hook and clip end of snoods increased retained catch (I. Marcelo, pers. comm., 1st May 2014).

British Columbia, Canada

British Columbia's (BC) Integrated Groundfish Fishery (IGF) is a multi-species, multi-method fishery that had the most similarity to Australia's SESSF of any fishery researched throughout the course of this study. Fishing methods employed are trawl, trap and longline. At the time of this study only one ALL vessel was operating in BC while just over 200 MLL vessels were operational (D. Boyes, pers. comm. March 2016). BC's EEZ borders the US/Alaskan border and there are large numbers of ALL vessels operating in Alaskan waters.

Longline fishing for Halibut in BC is widespread and similar in some ways, although much larger in scale, to the limited longline fishery for Gummy shark in the SESSF. A mainline is used that is spooled onto a drum while individual snoods are clipped on at varying intervals depending on the abundance of fish in an area at the time of setting. All hooks are manually baited and the number of hooks set per day varies from one to four thousand. Fishers frequently vary the spacing of hooks to target more productive areas. BC longline fishers reported no MMIs that resulted in mortalities within their fishery however are increasingly experiencing killer whale depredation.

A number of fishers who operate near the Canadian/Alaskan border reported increased catches of juvenile Halibut and Dogfish on the Canadian side that had damaged mouths and jaws. BC fishers believed these fish had been caught and released by US vessels using ALL systems with de-hookers.

BC Halibut fishers report that hook size is a factor in size selectivity of fish being caught as larger hooks catch a larger average size of fish. Likewise, smaller hooks result in increased numbers of juveniles hooked.

Europe

Europe's longline fisheries are hugely varied in scale and species. Norway in particular has a large number of automated longline vessels using coastal and SelectFish™ style systems (explained below). Like in Chile, Norwegian fishers reported that trials done with longline snoods that had a swivel at both the hook and clip end increased CPUE by up to 70% compared with one swivel just off the mainline (Master of MV Joker, Normela, Norway. Pers. comm. 31st October 2014). It was assumed that the extra swivel decreased the strain on monofilament snoods created by the monofilament twisting as fish were brought to the surface.

MLL systems are also used extensively throughout Europe. Large Spanish vessels operating from the Irish port of Castletown-Bearhaven reported setting and retrieving 15,000 hooks per day using manual baiting on a fixed line system to target Hake. These operations were extremely labour intensive with vessels crewed by a minimum of 7-8 people.

Mustad Autoline – SelectFish™ System

A form of ALL relatively new to the market is Mustad Autoline's SelectFish™ system. SelectFish™ was designed for vessels from 35 to 100 feet. Only 3 people are needed to operate the SelectFish™ system compared to a minimum of 4 to operate coastal ALL systems.

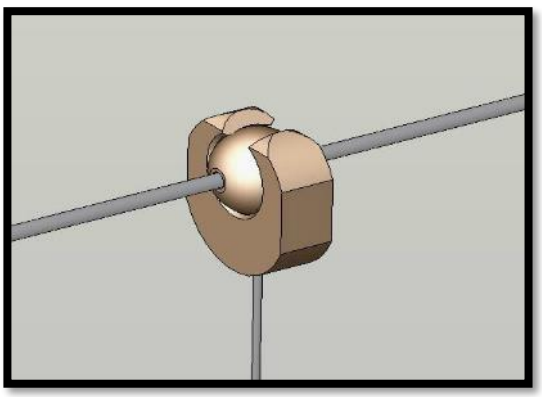

Figure 5: Select Fish snood attachment system (Mustad, 2015)

Lines are stored on drums which makes it space efficient and eliminates the problem of tangling lines and snoods, snoods and hooks are stored on space saving magazines independent of the mainline (Mustad, 2015).

SelectFish™ is flexible and can easily be adapted according to season, species or other conditions such as bottom substrate. The snooded hooks are automatically attached to and detached from the mainline by a plastic ball and clip (Figure 5). The

snooded hooks with clips are then stored on magazines for easy handling and storage while the mainline is spooled onto space saving drums. Each drum has the ability to be fitted with a mainline that can be specifically manufactured to have hook spacing set at particular intervals. This allows a vessel could carry a range of mainlines with varying fixed spaces on each spool. This would be an advantage in the Gummy shark fishery given spools of mainline could be kept on board for when a vessel was locating a productive area to fish (increasing the hook spacing and minimising bait costs) and once that location was found, the mainline could be changed to allow more hooks to be set over the more highly productive area (decreasing the hook spacing and concentrating fishing effort).

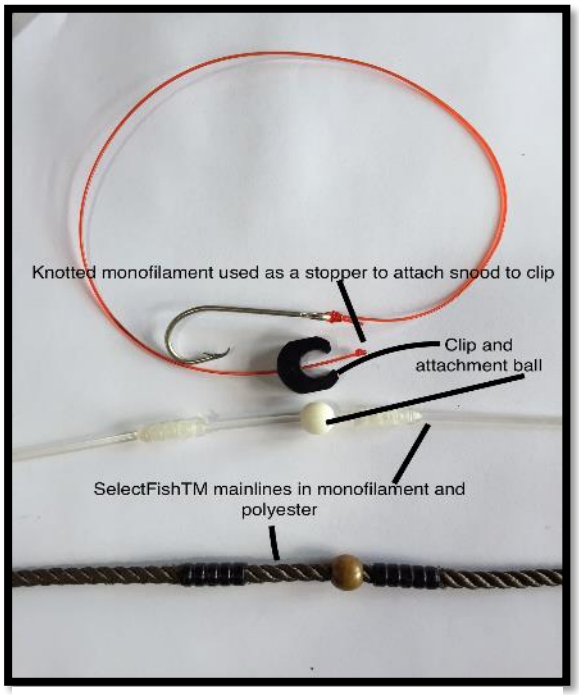

Figure 6: Components of SelectFish system

Some of the problems identified with SelectFish™ in relation to targeting Gummy shark are:

1. The construction of the snoods – As shown in Figure 6 the snoods are attached to the clip by a knot in the monofilament which acts as a stopper as the line passes though the clip. This is a weak point, especially when catching Gummy shark as they fight against the line hardest when near the boat. It's at this time that the main line offers the least amount of flexibility and breakoffs occur.
2. The snood lengths are shorter than what would be ideal – In order to reduce the incidence of fighting fish breaking the line off near the boat, a longer snood allows greater movement for the fish and doesn't apply the same degree of strain over a short distance of monofilament.
3. The clips that attach to the balls on the mainline disconnect at between 20-35 kg of pressure and fishers report losing approximately 5-8% of snoods per 1,000 (pers. comm. Benny Sorenson, Mustad Autoline, Oct. 2014) – As Gummy shark fight against the line more than species which suffer barotrauma, it's likely that a lot of fish would be lost through snoods becoming unclipped as the shark swims against the line. This problem would

become worse in adverse weather conditions when vessels move around more, placing additional strain on the mainline and snoods.

4. Presently the system is being manufactured to use only size 11/0 easy baiter hooks - These are smaller than the standard size used for Gummy shark and would result in higher mortality rates amongst juveniles.

Semi-automated longline system

At the time of this study no observations were made anywhere in the world where an integrated system of auto-baiting with manual clipping of snoods onto a mainline was being used. Conversations with fisherman in BC, the US, Norway, France and Belgium (D. Boyes., W. Erikson., S. Leonhardsen., J. Roullot, A. Dekker. pers. comm. May-Oct 2014) indicated that were such a system developed there could be a market for it amongst smaller commercial vessels.

Fiskevegn, one of the world's leading manufacturers in automated hook fishing technology, has subsequently conducted trials by manually clipping snoods onto a mainline and using an auto-baiting machine to assess the feasibility of such a system. The trials proved successful and Fiskevegn has moved ahead in developing an auto-baiting machine called *Vesttek* which is suited to smaller vessels (T. Kvernevik., pers. comm. 28th June 2016).

While there is still limited scope for a complete semi-automated solution at present, the emergence of such a system could be beneficial for many fisheries around the world including the SESSFs Gummy shark fishery.

International trap fishing

Presently the SESSF only has two trap fishing SFRs (A. Trappett, pers. comm. 8th Sep. 2015) despite trap fishing being a low impact and selective form of harvesting that produces some of the highest quality fish (Gascoigne & Wilsteed, 2009). Throughout this study, highly targeted and effective trap fisheries were encountered in multiple countries.

Norway and France are making advances in collapsible or foldable traps designs while also addressing species and size selectivity through the placement of escape gaps in different locations of the trap for different species (J. Roullot, pers. comm. 1st Oct. 2014). By adapting

the entrance of the fish trap, larger fish, seals and sea lions could be excluded from entering while escape gaps on the inside allow juvenile fish to exit. Jean Roullot of Le Drezen in France reported traps had proved effective in catching European Spiny dogfish (pers. comm. 2014) which share many characteristics with Gummy shark.

One company operating in the Timor Sea made underwater observations of their traps and concluded that any trap has a carrying or holding capacity. Their observations indicate that once a certain number of fish have entered a trap others will remain circling on the outside but not enter until one of the fish inside exits. The camera footage showed that fish frequently move in and out of the trap regardless of the entrance design (P. Ingram, pers. comm. March 2015) and using a smaller number of larger, well-located traps fished more frequently, proved more efficient than increasing fishing effort through increasing trap numbers (P. Ingram, pers. comm. March 2015).

Chapter 4: Fisheries Management

Fisheries management uses information provided by fisheries science, industry and public stakeholders to best manage public fishery resources so sustainable exploitation is possible.

Early management models focused on input controls that stipulated how much fishing effort was permitted in a fishery. As fisheries science evolved, management moved towards individual stock management where the biomass of fish species were scientifically assessed and individual specie quotas put in place.

Studies have shown the effectiveness of quota management in ensuring stability of and/or increasing the biomass of fish stocks (Costello, C., *et al*, 2008). Criticisms that quota management fails to fully address ecosystem impacts of fishing and can lead to socio-economic inequalities do at times have merit (Soliman, 2014). Increasingly there is evidence that individual stock management doesn't account for ecosystem impacts of commercial fishing and today management authorities are, or should be, taking a more ecosystem based approach to how fishery resources are managed.

Figure 7 (below) demonstrates that fisheries science, management, compliance and industry are interconnected but serve different and distinctive purposes. This relationship is further complicated in Australia by the crossover jurisdictional boundaries and species management between Commonwealth and State governments.

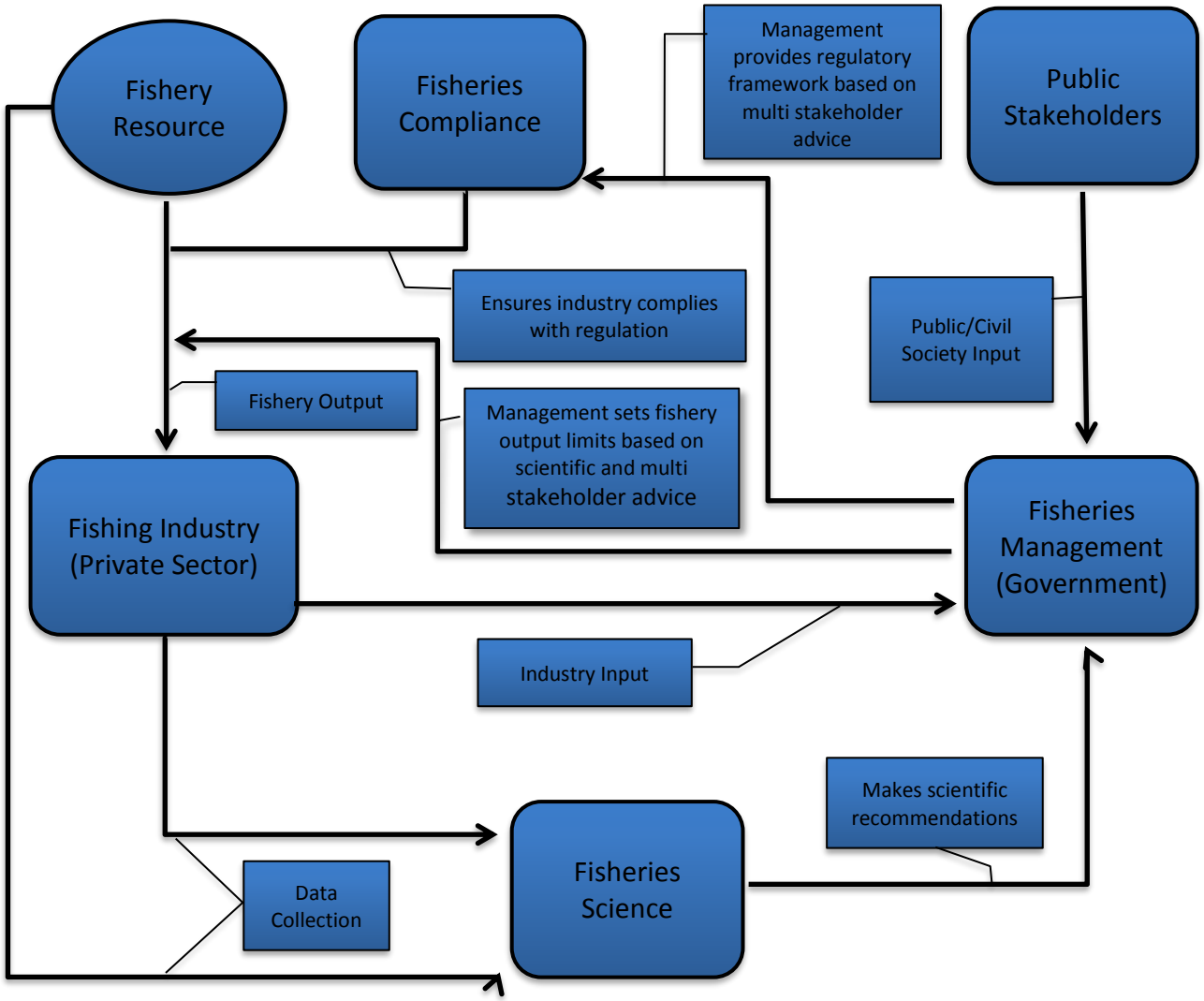

Figure 7: Flow chart depicting the interconnected relationship of fisheries science, management and private and public stakeholders

British Columbia – Integrated Groundfish Fishery

In 1995 the BC trawl fishing industry was, in the words of the President of the Deep Sea Trawlers Association, Brian Mose, "completely out of control". They were overharvesting nearly every species, discarding large quantities of marketable fish through high grading practices, while fish they were not permitted to take were often mislabelled and sold as something else (B. Mose, pers. Comm. 4th June 2014). In a drastic move the Department of Fisheries and Oceans (DFO) shut down the trawl fishing sector and prohibited boats from going to sea until new management arrangements were put in place. After extensive consultation with industry the trawl fishery was re-opened in 1996 under the provision that all vessels be subject to 100% on-board observer coverage. Later in 1997 quota management was

introduced. While this had initial devastating economic and social impacts on stakeholders within industry these three events were the beginning of what would become BCs IGF.

Prior to 2006, BC had seven independent Groundfish fisheries (trawl, Sablefish, Halibut, outside Rockfish, inside Rockfish, Dogfish and Lingcod) operating simultaneously but licensed and managed separately within the DFO. As a consequence of these management arrangements, fishers were required to discard their incidental non-target catch with the associated mortality raising conservation concerns (Mawani, 2009). For example, Lingcod fishers were forced to discard their Halibut, Halibut fishers were forced to discard their Rockfish and Rockfish fishers were forced to discard their Lingcod and Halibut (T. Boyes, pers. comm. 20th Oct. 2016). These discards came at the expense of other fishers who owned licenses for the discarded species and at the expense of the overall resource.

In 2006 the DFO accepted an industry proposal called the Commercial Groundfish Integrated Pilot Program (CGIPP) that integrated all seven BC Groundfish fisheries under one management structure (Mawani, 2009). The CGIPP was the result of objectives stipulated by the DFO that focussed on the conservation of Rockfish species on the Pacific coast (Mawani, 2009. B. Mose, pers. comm. 4th June 2014). It should be noted that if industry had not developed the CGIPP then the DFO would have imposed their own alternative fishing plan. Mawani (2009) reports that the CGIPP is a sustainable template for multi-species commercial fisheries and a first step in achieving an ecosystem based approach to fisheries management. During the implementation of the CGIPP five interlinked objectives were required to be met:

100% Monitoring

With the implementation of the CGIPP in 2006 all vessels operating in the IGF (trawl, trap and longline) were required to have 100% on-board monitoring or 100% EM for all fishing and dockside offloading activities. Since 2006 Archipelago Marine Research (AMR) has been the main supplier of EM and dockside monitoring services (S. Stebbins, pers. comm. May 2014, B. Mose, pers. comm. 4th June 2014).

AMR is a private company contracted by individual businesses that operate in the IGF to provide independent monitoring of fishing activities. The EM technology used by AMR is only activated when the vessel is engaged in fishing operations (deploying or hauling fishing equipment). All data collected by AMR's observers or EM installations

is audited against vessel logbook entries with the relevant information being passed to the DFO ensuring regulatory compliance.

Although 100% monitoring was a DFO objective it was implemented proactively by industry to allow them flexibility in how data is collected, handled and reported. Because AMR audits the data on behalf of fishers and reports only the relevant information to the DFO, all EM and vessel data remains the express property of the vessel/business it was collected from.

In excess of 30 IGF fishers were consulted during this study and all of them admit to never having wanted EM on their vessels. However, without exception each fisher agreed the outcomes of EM had been worth it for two reasons. The first being that they were now 100% accountable for every fish caught and therefore untruthful claims of overfishing could be disproved. Second, and perhaps more interestingly, every fisher could be 100% certain that every other fisher was complying with exactly the same regulations, thus removing the attitude of, "well if he's doing it, why shouldn't I?" (F. Ross, pers. comm. 25th May 2014). Some fishers expressed concern that the costs of EM had continued to rise despite assurances they would not. Others believed cost increases with EM are more likely due to inflation pressures and the fixed costs associated with operating the EM system over fewer industry participants due to consolidation within the fishery over time (D. Boyes. Pers. comm. 2nd November 2016).

Recognising that multi-species trawl catches are too diverse to be fully accountable through EM alone and in efforts to bring the cost of monitoring down and make better use of fishing data being collected, the BC trawl sector launched a pilot program with Integrated Quota Management Inc. (IQMI) that goes beyond monitoring for compliance purposes.

Under the pilot program skippers and crew are trained to undertake the same role as onboard observers with all observations and estimates being documented, recorded and validated through the use of EM. All data collected is accumulated on a single server in real time that can be accessed from any platform (PC, tablet, etc.). From that recorded data the reporting requirements are forwarded to the DFO to meet with regulatory compliance.

Considering the BC trawl sector engages in 12,000 to 24,000 fishing events per year the quantity and quality of data being produced is revolutionary. In order to produce such accurate data for the purposes of scientific stock assessment through charter surveys and collection, the head of Groundfish at the Pacific Biological Association estimates it would cost tens of millions of dollars annually (B. Mose, pers. comm. 4th June 2014). This data has economic value to the scientific community and the intellectual property accumulated can be sold, giving industry a significant added value. The technology can also be sold to other fisheries and countries (B. Mose, pers. comm. 4th June 2014).

The system that IQMI has developed allows for a comprehensive auditable trail that can be used as a "net to plate" traceability tool for marketing through sustainable seafood labelling schemes. Regardless of the IP value of the data being collected it is hoped that this measure will reduce compliance costs within the sector by around 20-30% (B. Mose, pers. comm. 4th June 2014).

Individual accountability and 100% accountability for all catch

Traditionally when individual fishers have been found guilty of non-compliance the response from management has been to impose additional regulations upon industry in order to avoid those actions being repeated. This has had a cumulative effect whereby early fishery management regulations have had "layers" of additional regulation placed on top of them, effecting natural innovative processes of the industry. It has always been a fine balance and given managers must apply the precautionary principle in all decision making, the tendency to regulate on the side of caution generally prevails.

In the IGF 100% monitoring and 100% accountability for all catch now make it possible to hold individuals directly accountable as opposed to the fishing sector as a whole. This paradigm shift in accountability on an individual basis means that fishers operating in output controlled fisheries can employ a wider range of technologies in order to harvest the same amount of fish more economically with a lower environmental impact. This benefits fishers through productivity gains and the ability to sell into

environmentally conscious markets. An example of how individual accountability works can be found below.

Examples of individual accountability in relations to discarded or damaged fish:
During fishing operations a small amount of discarded fish is unavoidable due to damage caused by fishing gear, seals or seabirds. However, an allowance for damaged discards can be factored into an auditing process. This example uses an allowance of 1% damaged fish.

1) Fisher A and fisher B are both active gillnet fishers in the SESSF shark fishery. Fisher A fishes responsibly and hauls their gillnets every 8-10 hours, averages 500 kg of shark per haul with only 5 kg of damaged or unsaleable shark. Fisher B however leaves their gillnets in the water for 15 hours and averages 800 kg of shark per haul but has 80 kg of damaged or unsalable shark due to lice damage or green discolouration.

2) Fisher A and Fisher B are both trawl fishers active in the SESSF. Fisher A tows their net for 3-4 hours before hauling, uses larger than regulated mesh netting to allow juvenile and unwanted fish to pass through the trawl and averages 1000 kg per tow with only 10 kg of damaged fish. Fisher B tows their net for 6 hours, uses smaller meshed netting and averages 2000 kg per tow but has 200 kg of juvenile, damaged or unsaleable fish.

In both situations where individual accountability is applied fisher B would be required to cover all discarded fish over the 1% discard allowance (72 kg and 160 kg respectively) with the relevant quota while fisher A would not. The economic burden of having to cover the quota for such high volumes of discards would inevitably force fisher B to adopt the better practices used by fisher A to avoid discards in the future.

Most importantly though, in both cases all discards would be recorded and reported correctly thereby improving the accuracy of data used to make management decisions.

Ownership and transferability of fishing rights

Ownership of quota in BC has meant that fishers had to implement better and more innovative strategies that achieved greater economic returns for less product brought to market. When ITQs were first implemented many fishers lost between 20-50% of their production capacity, causing significant financial hardship (B. Mose, pers. comm. 4th June 2014). The ITQ system extended the length of time fishermen could catch their fish, this meant that they could take better care of their product, provide both fresh

and frozen product, increasing profits and market it more effectively taking advantage of the value added economics of being certified by sustainable seafood ecolabels (T. Boyes, pers. comm 20th Oct 2016).

The ability to transfer fishing rights between fishers saved many operators from going bankrupt during transition to ITQs and gave others a viable way to exit the industry by becoming leasers of fishing rights (B. Mose, pers. comm. 4th June 2014). These leasers of fishing rights were critically important in the survival of those who remained producers in the industry. In order to ensure there was no over-consolidation of fishing rights, limits were also placed on how many ITQs any one company could hold, ensuring a more equitable industry for future generations.

Transferability was an important feature of the IGF's management structure. In any mixed species fishery, unavoidable catch of non-target species occurs. Being able to transfer ITQs between vessels targeting different species means fishers can cover the necessary quota for non-target species, therefore eliminating discards and greatly reducing production waste within the fishery.

Removal of competition

To create a collaborative environment amongst fishers removal of competition when fishing is critical. In BC, removal of competition was largely done before the CGIPP through the implementation of ITQs (D. Boyes, pers. comm. 2nd Nov 2016), however it was not until 100% monitoring and 100% accountability that complete cooperation between fishing sectors was achieved.

Once every fisher was operating under the same regulatory circumstances a "level playing field" was created that instigated collaboration between fishers (W. Erikson, pers. comm. 10th June 2014). This collaboration meant that instead of seeing other fishers as competitors for fish they suddenly became allies in their efforts to avoid choke species[3]. The result was that in the first year of implementing the CGIPP up to 50% of the available quota for these choke species remained uncaught, contributing

[3] Choke species refers to species of fish where little quota is available. In some fisheries these choke species cause fishers to remain in port due to an inability to acquire the minimum holding of quota that permits them to go to sea. In other instances choke species are illegally discarded at sea without being reported, thereby distorting the fishery's catch data.

to the stock rebuilding efforts of diminished stocks. Since 2006 the IGF has under-harvested every species including the choke species (W. Erikson, pers. comm. 4th June 2014).

Allocation of Individual Transferable Quotas between fishing sectors

One of the most difficult aspects of implementing the CGIPP was ensuring there was enough quota for choke species so that each sector could remain fishing for their target species. Many times, representatives from each of seven fisheries came together to negotiate how ITQs would be divided only to walk away without any result.

Each of the seven fishing sectors received most of the TAC for their target species with the remainder being made available to the other sectors to cover non-target catch (D. Boyes, pers. comm. 2nd Nov 2016). The more complicated and contentious part was how to divide the smaller ITQ allocations that covered non-target choke species. In the end, industry commissioned a retired judge to adjudicate the process and set the percentages of the TAC for each gear type and licence (D, Boyes, pers. comm. 2nd Nov 2016). Originally the allocation for Rockfish, which was the most difficult species to obtain quota for, was split 92% for trawl and 8% for hook and line. Within a few years this split proved unworkable and the trawl and hook and line sectors sat down to renegotiate the allocations in a manner that worked for all parties. These allocations are now "inscribed on a golden tablet and can never be altered" (D. Boyes, pers. comm. 2nd Nov 2016).

Summary of BC's Integrated Groundfish Fishery

The restructure of BC's IGF didn't occur without cause or reason. It only came about because the correct environment was created between industry and management where real co-management could occur, not just a round of consultation with fishers (EDF, 2014).

Today over 300 Canadian vessels participate in the IGF under a single management plan with strict and fully accountable output controls in place for over 70 species with up to five management areas per species, some of which are jointly managed between Canada and USA. Only one logbook is used amongst all fishing sectors, significantly streamlining data collection processes. The system devised proved to be affordable, fair and equitable from the smallest

boat in the fleet to the largest, and across all seven previously independent fisheries (EDF, 2014).

When asked if the BC trawl sector had seen increased economic benefits from being part of such proactive initiatives such as 100% accountability and 100% monitoring, Brian Mose responded by saying, “here’s one of the things that is always lost in that question. What would the eventual cost have been to the industry had we not? All of these measures protect you far more than they inhibit you.”

As with any industry reform not everyone was a winner and the system is still far from perfect, however the fishery has benefitted and each IGF fisher spoken with was proud to point out they were part of one of the most sustainable and most accountable fisheries in the world. Considering the position of the fishery in the 1990s and the open hostility between the seven fishing sectors it has come a very long way in a very short time.

Three significant individuals within the IGF all answered similarly when posed with the question of how the fishery managed to collectively achieve what it had. Essentially when the DFO gave the industry a series of objectives and told them to come up with a plan to meet them themselves or else they would do it for them, all fishers realised that the latter was the only thing that scared them more than having to work with each other (D. Boyes, B. Mose, W. Erikson, pers. comms. May 2014 – June 2016).

European Common Fisheries Policy and discards

EU fisheries policy is very much a political process. The Common Fisheries Policy (CFP) is intended to streamline that political process to ensure the stability and sustainability of EU fish stocks that are currently a shared resource between 28 Member States (MS).

Upon joining the EU, MS relinquish national sovereignty over their traditional 200nm EEZ and instead have exclusive ownership of waters up to 12nm from their coastline. All other waters that make up the EU’s collective EEZ are common waters that can be accessed by any EU fishing vessel with the appropriate licence and quota holdings. These common EU waters are separated into regional zones with different TAC allocations for each. MS each receive an allocation of quota for these common zones on an annual basis.

Although multi-stakeholder input occurs throughout the annual TAC allocation process, under article 43 of the EU treaty, TAC allocations are the exclusive competence of the EU Council that is made up by each MS's minister for fisheries (K. Stack, pers. comm. 23rd Oct. 2014). A flow chart depicting the process of quota allocations from the International Council for the Exploration of the Sea through the EU Commission, EU Council, MS and fishers can be seen in Figure 8.

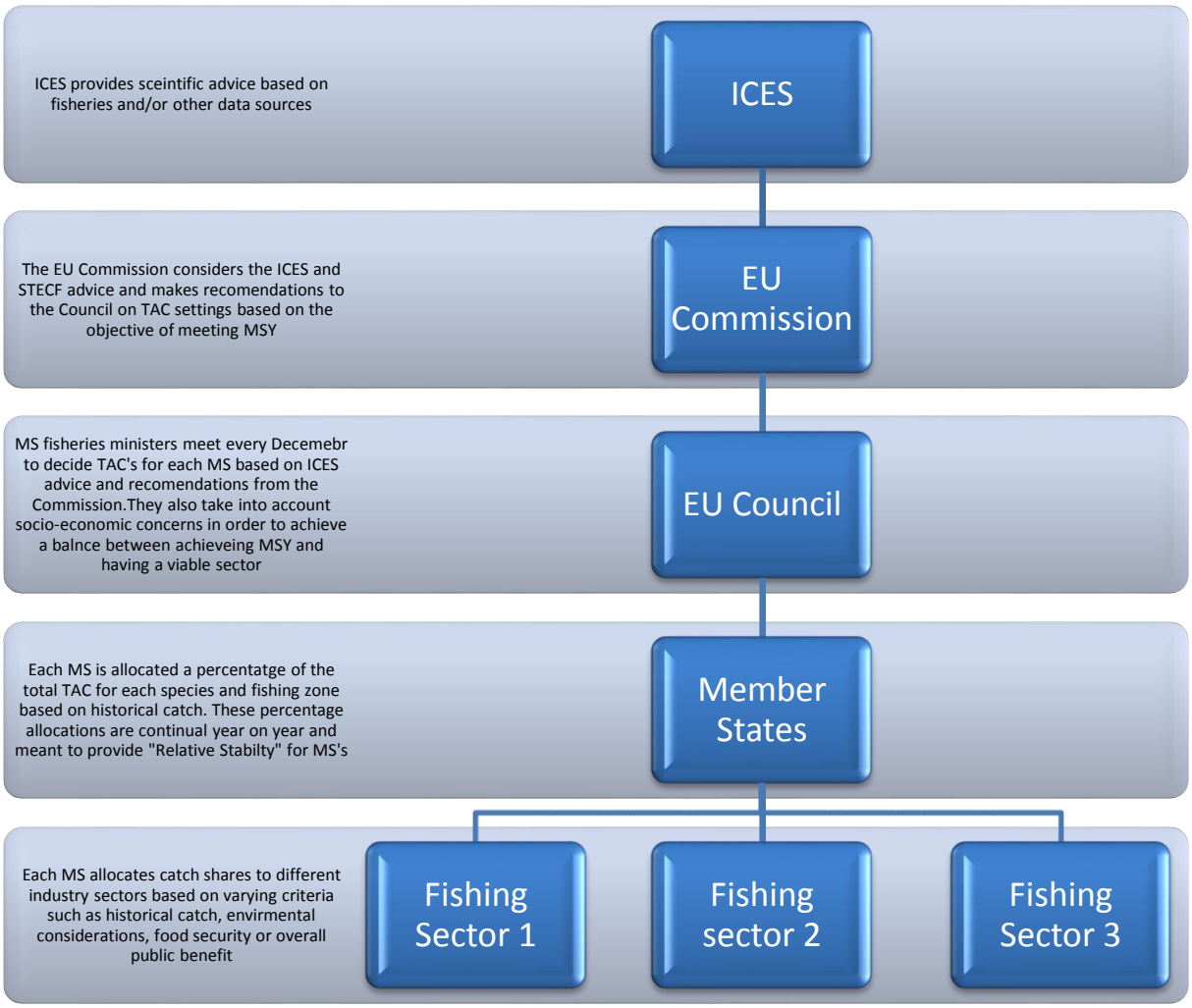

Figure 8: Flow Chart demonstrating the legislative processes involved with the CFP and MS quota allocations

The relative stability TAC allocations received by MS are set to ensure no single MS has the ability to procure disproportionate ownership of the EU's common fishing rights. However, fishing rights can be transferred between MS on an annual basis through commercial transactions or reciprocal agreements that allow fishers from one MS to enter the territorial waters (12nm) of another (K. Stack, 20th Sep. 2016). This relative stability is intended to

remove competition between MS for fishery access given that each MS is ensured their percentage of any allocation.

In addition to quota allocations the CFP stipulates what input controls or technical measures fishers can use and are applicable to every MS as per the fishing zone they are operating in (K. Stack, 20th Sep. 2016). These technical measures are meant to be revised by the EU Commission and Council every five years. Despite constant lobbying by industry, who believe many of the technical measures are outdated, inhibiting innovation and productivity, the Commission and Council have tended to put the issue in the too hard basket and there has been little to no change in these regulations. Even if a fishing sector wishes to work with a local fisheries management authority to implement new practices in order to reduce environmental impact, these initiatives often still need to be approved by the Commission and Council, resulting in a return to a far removed political process (K. Stack, 20th Sep. 2016). The Scientific, Technical and Economic Committee for Fisheries in fact states, "In general, Technical Measures relating to gear selectivity have no clearly defined objectives and, following the EU decision-making process, the measures finally adopted often differ from what was initially proposed and tested" (Europeche, 2014).

This return to a political process for fisheries management is further complicated by MS without any commercial fishing interests still retaining voting rights over fisheries legislation. As such, lobby groups most frequently target MS without fisheries interests to support initiatives which ultimately will not affect them and trade these votes in order to meet other non-fishery related political objectives (K. Stack, pers. comm. 20th Sep. 2016).

Despite overarching fisheries policy being developed by the EU Commission, Council and Parliament, the question of compliance is left to MS which are responsible for ensuring compliance within their 12nm zone in addition to ensuring any vessel that offloads within their country has met with EU regulations.

Onboard monitoring and EM is a complicated issue in the EU because some MSs have privacy laws in relation to EM and/or ownership of the data it collects. Additionally there is opposition within industry of full disclosure of fishing activities as many fishers still see each other as competition and are concerned how fishing data could be accessed and utilised by other fishers or civil society organisations (J. Roullot, pers. comm. 1st Oct. 2014. K. Stack, pers. comm. Oct. 2014 – Oct 2016). As such, the question of EM has been left to MS despite the policy

recognition that EU fisheries are a common resource and that current inaccuracies in fisheries data have the potential to distort stock assessments (K. Stack, pers. comm. 20th Sep 2016). This lack of uniformity across MS in relation to accountability and compliance ultimately increases rather than decreases competition between MS fishing industries (K. Stack, pers. comm 20th Sep 2016).

Discards in European fisheries significantly increased with the implementation of quota management due to choke species, economic high grading and a failure of fishers to accurately report discarded catch (J. Roullot, pers. comm. 2014). These issues were most prevalent with multi-species, multi-method demersal fisheries very similar to Australia's SESSF and BC's IGF. Failures to accurately report discards distorted fisheries data used for stock assessment, ultimately undermining confidence in the way EU fisheries were managed.

At the time that much of this study was conducted, the CFP was going through its ten-yearly reform process. At the forefront of the reform negotiations was the issue of discards that was brought into mainstream public debate by celebrity figures and environmental and civil society organisations who saw the practice of discarding as wasteful and unsustainable.

Originally the EU Commission did not seriously consider the inclusion of a discard ban in the CFP reform proposal (E. Lindebo, pers. comm. 8th Dec 2014). Following increasing pressure from civil society and environmental organisations, a political decision was made within a few weeks that a ban on all discards should be included in the text (E. Lindebo & K. Stack, pers. comm. Oct-Dec 2014). Over the following months, the proposed legal text emerged after very limited consultation, none of which was with industry (E. Lindebo, pers. comm. 8th Dec. 2014). Although all parties agreed there should be a gradual phasing out of discards it was the EU Parliament, supported largely by the green lobby, who pushed for very ambitious and detailed implementation. It has subsequently been up to industry and MS to argue that the timeline and technical details were not fit for purpose (E. Lindebo, pers. comm. 8th Dec. 2014).

In the end the discard ban was included in the CFP but concessions were given in relation to the timeframe in which it was to be achieved. A landing obligation is now being introduced that requires each fishery to be compliant by 2019. Under the landing obligation all fish must be retained on board, landed and counted against individual quota holdings. Any undersized fish caught cannot be sold for human consumption under a "no financial incentive" basis while all non-marketable product or fish not fit for human consumption, will be sold for fishmeal.

The theory behind the landing obligation is that it will be a driver for greater catch selectivity in fisheries and provide higher quality catch data for scientific assessment (European Commission, 2016).

While a certain degree of regulation can promote innovation (K. Heiss, pers. comm. 6th June 2014), it is unlikely to be the case with the CFP due to the lack of uniform monitoring and accountability measures being put in place. Despite the landing obligation, fishers, policy representatives and environmental groups all recognise that non-compliance is occurring throughout EU fisheries due to the unworkable manner in which the discard ban was introduced and lack of flexibility within the regulated technical measures that allow little room for innovation (K. Stack, pers. comm. 20th Sep 2016).

Given fishers are natural born problem solvers who can navigate around any rule (W. Erikson, pers. comm. 10th June 2014) the CFP's lack of accountability for catch through on board monitoring or EM means EU fishers will find ways to circumvent regulation that has been introduced without proper consultation. One such example seen at net factory in France is detailed below.

Example of CFP technical measures being circumvented:
In trawl fisheries varying the mesh size and angle the meshes work on, cod ends can be very selective in the size and quality of fish retained. If cod ends with larger meshes are used, then more juvenile fish pass through the net resulting in less overall catch per trawl. This also reduces compaction and damage to the retained fish in the cod end.

Under normal net making procedures, automated machines create "sheets" of mesh that are then stretched and run through a heat steamer in order to slightly harden the net material to increase the durability of it. The netting material is then cut and resewn to the specifications relevant to its use. An ordinary cod end allows for the meshes to open in response to water pressure being directed through the trawl therefore creating specific sized openings through which juvenile fish or fish too small to sell can pass through.

Due to an EU technical measure that required all trawl vessels operating within a particular region to use cod ends of a certain mesh size, fishers were losing a significant amount of catch of valuable species. In order to remain compliant they continued to order cod-ends of the regulated mesh size but requested they be run through a heat steamer twice. The result of this was that the netting material became so rigid that it failed to sufficiently open up enough to allow smaller fish to pass through therefore retaining their catch and circumventing the technical measure that regulated mesh size.

Such circumvention of the EU's Technical Measures is largely due to regulation that has been imposed without appropriate industry consultation or the result of new regulations that have

been introduced without previous ones being repealed. Fishers now argue that if they are compliant with the discard ban and respect quotas then why are they not permitted to freely alter practices in an attempt to be more selective of catch (K. Stack & J. Roullot, pers. comm. 2014-2016).

Interestingly, Saskia Richartz of Greenpeace commented that incidental MMIs were not a huge concern in Europe if those interactions did not pose an overall threat to the sustainability of the particular Marine Mammal's population abundance and that as an environmental organisation they were realistic that some degree of MMIs were unavoidable in the pursuit of ensuring food security. Greenpeace also considered gillnetting in Europe to be a relatively passive, selective and low impact form of fishing despite occasional MMIs occurring (S. Richartz, pers. comm. 6th Nov 2014).

Discussion and Conclusions

Mitigation Marine Mammal Interactions with Gillnets

The Coorong region off SA that has been most frequently associated with dolphin interactions in the SESSF is known for large aggregations of baitfish that result from the Bonney upwelling and dolphins are frequently observed feeding in this region. By contrast, fishers rarely report observing dolphins actively foraging in Bass Strait, eastern Victoria or other regions frequented by shark gillnet vessels. The increased rate of dolphin interactions in the Coorong region may support Kathy Heiss's theory that dolphins tune out much of their sensory perception when feeding in close proximity to each other, increasing the risk of them becoming entangled in gillnets. As such the use of ADDs may be of little benefit.

The use of different coloured monofilament nets could be beneficial in mitigating Sea Lion interactions however given the TEP status of Australian Sea Lions any such trials would likely pose an unacceptable risk.

Procedural mitigations appear to be the most effective measure available at this point in time.

Fishing Practices and Technologies

Carlos Moreno's observations indicating an increased CPUE resulting from a greater localised density of bait through longline practices employed by Chile are worth investigating for use targeting Gummy shark. This may be of particular significance to the fishery given Gummy shark do not typically form large aggregations like many other species targeted by longline fishers and the increased density of bait may act as a greater attractant. It is difficult to see how such a system could be even partially automated though.

Based on conversations with international fishers it seems there is a much broader international market for a semi-automated longline system than just the Australian GHaT fishery. Such a system would allow fishers to vary hook spacing for different operational circumstances and target species while providing an efficiency dividend in the use of auto-baiting. Although nothing presently exists there is some work being done to develop such a system and it will be worth monitoring this progress.

The SESSF could benefit from a much-expanded trap fishing sector. Presently only two permits exist within the fishery and given the low impact nature of trap fishing an increase in these

production practices could go a long way to increasing the industry's capacity to catch its TAC with decreased ecosystem impacts.

Fisheries Management

As demonstrated by BC's IGF, effective management allows fishers to operate in an adaptive manner that means industry can be responsive to changing environmental, economic and social circumstances while remaining 100% accountable for its actions to the consumer public and amongst all stakeholders. When all stakeholders are aware that their counterparts on other vessels or in other sectors are complying with precisely the same mandate, a much more cooperative and collaborative approach is taken toward managing fish stocks.

BC's IGF also demonstrates how a proactive industry can lead constructive regulatory reform and own the outcomes. Their implementation of EM and associated ownership of data is in contrast to the situation faced by Australian shark fishers where AFMA contracts Archipelago Asia Pacific to collect and audit EM data and passes the cost onto fishers through levies. This process means ownership of the data remains with AFMA and can be accessed through FOI laws under certain circumstances.

The ability of the IGF's different fishing sectors to exchange ITQs to cover choke species without having jurisdictional concerns between management authorities, eliminates conflict between fishers operating under different management authorities as the case is in Australia. It also ensures that fishers cooperate on the water in actively avoiding areas that contain a high abundance of choke species.

By contrast the management of EU fisheries and the revised CFP provides an insight into how heavily regulated fisheries respond to restrictive regulation that has been imposed without due industry consultation and for the purpose of meeting political or ideological objectives. The EUs zoning of sovereign and common waters and lack of uniformity in accountability, compliance and transferability of rights can be likened to Australia's OCS.

Despite all MS fishers operating under the CFP, the methods by which MS ensure compliance with fisheries regulation are not uniform, and legislative changes to fishery regulations are unresponsive to industry concerns or requirements. This leads to greater disconnect between policy formulation and practical implementation of fisheries regulation and increases, rather than decreases competition, resulting in a divided and un-collaborative industry often seeking to circumvent unworkable regulation rather than constructive reform of it.

Issues surrounding EM in the EU could be resolved if industry became proactive in implementing this reform. If EM was introduced by industry as an accountability measure, then data collected could be audited and reported on to the relevant authorities while ownership of the data remained with industry, therefore not making it subject to FOI laws nor being in breach of MS privacy laws. From an operational perspective, the implementation of EM by industry would be more efficient and executed better than by management authorities as occurred in the GHaT where everything that could have gone wrong has gone wrong (S. Boag, pers. comm. 14th Dec 2016).

MS exchanging of fishing rights is the reality of the global world in which Europe exists that relies upon free trade within the Eurozone (K. Stack, pers. comm. 2016). Despite conflict in other management areas, the arrangements permitting transferability of fishing rights appear to work well. MS allocations were initially based on historical catches and measures are in place to ensure fishing rights do not become consolidated to within a small number of fishing nations. The seasonal transfer of those rights permits different fishing sectors to operate in varying zones and target species that their practices are most suited for, increasing the productivity of the industry.

Australian Fisheries' need for "Blue Sky" reform

A recent draft report by the Australian Productivity Commission (2016) into the nation's marine fisheries and aquaculture raises some salient points. It states Australia is not at risk of food insecurity as there is no lack of fish available due to global fish production outstripping global population growth. However this assessment does not take into consideration many of the factors driving that production growth and where the consumer competition for seafood will be in 10, 20 or 30 years' time.

Ewan Colquhoun made the point during a FRDC workshop in 2014 that the domestic consumption of SE Asia's emerging middle class is expected to exceed their projected seafood production by the mid-2030s and that it was unknown how these changing demographics would play out for nations such as Australia who have increasingly become dependent on seafood imports. The Productivity Commission also failed to recognize that a continued loss of production in Australia's capture fisheries would equate to diminished consumer choices for those wishing to consume Australian product.

Despite the best efforts of some fishery managers and industry representatives, Australia has

seen an increase in politicisation of fisheries policy since the beginning of this research project. These political objectives have resulted in outcomes that have been detrimental to Australia's commercial fishing industry and have not been pursued out of environmental or sustainability concerns.

Given management authorities in Australia have had a previous tenacity for taking extreme measures to protect vulnerable fish stocks, despite those measures coming at an economic cost to fishers, it is a damning indictment of those same management authorities to fail in pursuing serious OCS reform. The case for OCS reform is clear from an environmental, economic and social sense, the reality is that such reform of the OCS does not meet current State or Commonwealth political objectives. Given the OCS directly causes discarding of high value consumable fish (by Commonwealth and State vessels), this lack of political will to rectify the situation will inevitably come at the expense of commercial fishers' social licence. Furthermore, the continuation of current jurisdictional arrangements is in direct contradiction to ecosystem based management of Australia's marine resources and is inhibiting the ability of fishers and fishery managers to achieve outcomes that all stakeholders wish to see. This process of unobtainable outcomes is depicted in Figure 9.

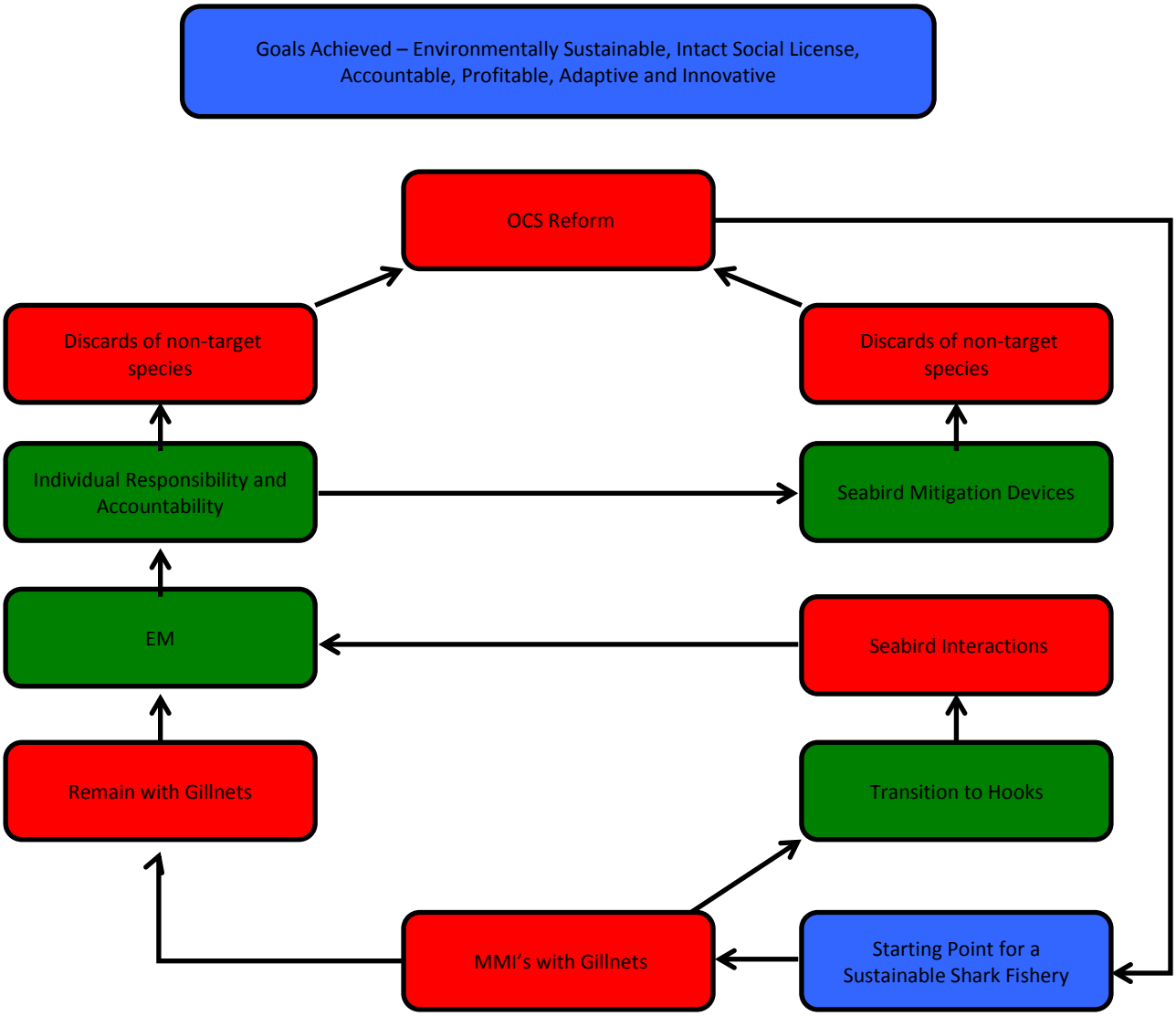

Figure 9: Flow chart demonstrating the outcome if OCS reform is not pursued

Europe's lack of uniformity between MS's compliance measures, legislative detachment from production practices and resulting discards ban provides an example to Australia of what can occur if OCS reform continues to be neglected and States pursue objectives that are contrary to the overall national interest.

The inherent lack of resolution to OCS issues, coupled with onerous input restrictions within the Commonwealth SESSF and State fisheries, is inhibiting innovation and acting as a deterrent to investment in production amongst Australian fisheries. Considering the majority of large volume fisheries in Australia are output controlled, and are being harvested at or below MSY, any argument against reform of technological restrictions holds very little weight. BC has shown that with 100% accountability, monitoring and uniformity across fishing sectors the need for technological restrictions very much ameliorates itself.

When all of BC's initiatives are put in place they do not act in isolation but in conjunction with each another and are responsive to many other external forces. Australia has, for some time, been tinkering at the edges of reform without taking the final step. The lack of overall cohesion between fishing sectors and management authorities has resulted in many measures being put in place that lack the support of others. A prime example of this in the SESSF is the requirement that shark gillnet vessels be subject to 100% EM while trawl vessels are not. Therefore, it is impossible for a gillnet fisher to be certain that a trawler is complying with all regulations despite both harvesting from the same resource. This disparity in accountability compounds an existing lack of trust between fishing sectors leading to less collaboration towards common objectives.

The case for more centralised fisheries policy in Australia by having a single management authority extends beyond conflict issues between fishing sectors or other resource users. Centralised fisheries policy requires uniform monitoring that better streamlines data collection by improving its accuracy, resulting in a more cost effective and defensible industry. Consolidating data collection for Australian fisheries using a model such as IQMI would reduce the costs to industry and improve the efficiency and accuracy of stock assessments. This is not to say that regional management is ineffective or not required, but that regional management authorities must act in accordance with clearly defined national objectives and utilise common data and communication platforms.

Both the EU and BC had fisheries operating within their jurisdictional zones that did not experience interaction or conflict with fishers operating under within CFP or IGF. These fisheries were localised in nature, generally single specie fisheries and not part of a multi-sector fishery. Similar examples exist within the geographic range of the SESSF such as rock lobster, crab, abalone, sea urchin, wrasse, scallop, prawn and inland estuary fisheries. Such fisheries do benefit from regional as opposed to centralized management given the fish stocks are less transient and regional monitoring can be more effective and responsive at noting changes in the fishery. However, given many of these state fisheries have common species, centralised data collection coordinated by a single management authority would benefit all stakeholders. Such an extensive database on a single platform would, in time, allow fishery managers to assess the ecosystem effects of fishing more accurately.

One primary concern amongst fishers in Australia is the consolidation of ownership amongst fishing rights that make entry into the industry difficult for young people. While there are

arguments for and against a complete free trading system of fishing rights, both the EU and BC provide examples of how measures can be put in place to ensure all financial stakeholders are afforded some protection. Were Australia to embark on serious structural reform then industry would have the opportunity to make its case for limitations on ownership of fishing rights.

Despite sectorial quota allocations working in BC's IGF there is little argument for them in the case of the SESSF and GHaT. Given SESSF quota SFRs are already transferable between fishing sectors, little would be achieved in pursuing such a path. Reform of input restrictions regarding fishing methods and spatial closures would achieve more in allowing fishers to diversify their fishing practices so closed fishing grounds could be reopened for production.

The most significant choke SFR quota species within the GHaT is the conservation dependant School shark. Industry sources within Australia have continually claimed that despite the low reported stock biomass of School shark, the abundance of them is continually increasing. Shark gillnet vessels continually comment that its becoming harder to avoid catching them and prior to EM being introduced, a number of GHaT fishers confided that it was common practice for School shark to be retained and sold as Gummy shark due to a lack of available quota. Likewise trawl and ALL vessels have reported catching and discarding School shark along the continental shelf and not accurately reporting the discards for fear of additional spatial closures being put in place, further impacting on their fishing. If all sectors were subject to 100% monitoring and 100% accountability then not only would fishers cooperate more to avoid such choke species, but the accuracy of catch data would improve, potentially supporting fishers claims that the abundance of School shark is higher than presently being estimated.

Throughout the course of this study in excess of 100 fishing ports were visited with two standout observations made. First was when looking around fishing vessels, most operated in two to three different fisheries, at times simultaneously. By contrast, the licensing, quota and regulatory structures within Australia have directed the fishing effort of individual vessels and businesses towards single fishery operation thereby reducing the opportunities for individuals to diversify their businesses or spread their fishing effort across multiple sectors. This "monoculture" form of fishing is greatly reducing economic opportunities for fishing businesses and leaves them more exposed to single market risks.

The second observation was the distrust and disconnect that exists between fishers and fisheries management. In all countries visited other than Norway and Canada there was a reluctance by fishers to talk openly about issues they faced that were forcing them to operate in legal grey areas. In most cases the disconnect came from fishers never being properly consulted about proposed regulatory changes, such as the case in Europe, resulting in a relationship between fishers and management that meant they never interacted frequently enough or developed professional working relationships. As this disconnect worsened distrust became evident and the problem continued to compound. Individuals within Australian fisheries remarked that the complexity of management between State and Commonwealth meant open dialogue and appropriate consultation was rarely achievable due to the differing management authorities often having conflicting objectives.

Fisheries and how they are managed are complex environmental, economic and social ecosystems involving many stakeholders, all with different interests and desired outcomes, but most often with common objectives. The EU and BC demonstrate examples of fundamentally opposing outcomes despite sharing common objectives. Paradoxically, Australia's SESSF and related fisheries already exist in a manner that BC's CGIPP set out to achieve in 2006, inasmuch that they are considered environmentally sustainable and responsible industry practices are employed. Australian fishers and fishery managers are amongst the best in the world and have achieved what many other countries are aspiring to. However burdensome and constrictive regulation is inhibiting innovation while little has been achieved to reduce conflict and competition between different fishing sectors harvesting from the same resource. This is resulting in a continued decline in confidence about the future of the industry.

These present obstacles can be overcome through higher standards of industry accountability that EM and individual responsibility would bring. Once such measures are in place across all sectors, many previous input restrictions can be safely removed without the environmental integrity of Australia's fisheries being compromised and promoting a culture of innovation within Australia's fishing industry. This would increase the economic returns for the sector and, if communicated correctly, improve public confidence in Australia's fisheries. Any attempt at these reforms without concurrently addressing OCS, management and jurisdictional issues would only result in increased costs to industry without productivity gains and more burdensome regulation within what is currently an inherently dysfunctional

legislative and decision-making framework.

Extensive reform of Australia's fisheries is required and is possible but as BC has shown, it can only be truly effective and workable if industry is the primary advocate and driver for it. No major reform would come without cost to some stakeholders, both within industry and within Australia's management authorities. However, with production investment so low, a rapidly aging demographic amongst Australian fishers, the presently fragmented nature of fishing sectors and a lack of will amongst all stakeholders to pursue "blue sky" reform, we must consider what the eventual cost will be to Australia's fishing industry and Australian consumer choice if we do not.

Recommendations

1. All management authorities and industry stakeholders need to undertake a thorough and comprehensive review of the management structure of Australian fisheries to identify:
    - Areas of conflict between fishing sectors;
    - Jurisdictional conflict between management authorities;
    - Overlapping regulation between State and Commonwealth management authorities;
    - Regulatory provisions that inhibit the productivity of fishers without clearly defined environmental, economic or social objectives to support them;
    - Political processes that regress instead of advance fisheries policy; and
    - Industry practices that inhibit the ability of managers to make the most informed decisions possible.

    Such a review must identify tangible paths of reform and mechanisms by which they can be prosecuted.
2. AFMA and State management authorities must address jurisdictional conflict by creating a more innovative strategy for fisheries management through uniform centralised management administered by regional structures. In doing so, State and Commonwealth licenses should be consolidated under a single management authority where crossover species are frequent and result in unnecessary discards, loss of economic value from the resource and conflict between fishers.
3. Standardisation of data collection through a single platform for all fisheries and fishing sectors in order to increase efficiency and reduce costs. This would provide greater accountability of, and efficiency in, management authorities decision-making processes.
4. Introduce 100% EM requirements across all multi-species fisheries or fisheries that experience high bycatch, or marine mammal or seabird mortalities, which would enhance accountability and individual responsibility. The implementation of EM must be industry driven and innovative in ways that reduces costs to fishers and provides a productivity dividend to the industry.

5. Removal of sector, input, spatial or technological restrictions that do not serve a specific biological purpose to allow fishers and fishing businesses reduce costs, achieve greater efficiency and become more adaptive to changing circumstances and consumer markets.
6. Significantly greater onus must be placed on industry to be the driver of regulatory reform rather than being the victim or reactionaries of it.

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Project Title:	**Innovation and Accountability in Commercial Fisheries The case for reform of Australia's SESSF and related fisheries**

Project no: 1408

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Objectives

1. Identify fishing methods being used or developed and assess their viability within Australia's SESSF and GHaT Fisheries for targeting Gummy shark and/or other species.
2. Research ways in which other fisheries are managed with regard to conflict issues that exist between fishing sectors and management jurisdictions.
3. Identify the regulatory and legislative factors in Australia that are inhibiting industry from adopting new technology and discouraging investment in fisheries production

Background

Australia's Southern and Eastern Scalefish and Shark Fishery (SESSF) is a multi-species, multi-sector fishery with a total economic value (2014-2015) of AU$68 million. Within the SESSF, the Shark gillnet sector predominantly targets Gummy shark. Since May 2011 spatial closures covering 129,992 km^2 were implemented to protect Australian Sea Lions and reduce the incidence of Shark gillnets interacting with dolphins, these spatial closures greatly affected the economic viability of fishing businesses.

Many businesses believe that for them to become viable again alternative fishing methods must be found which can be used to target Gummy shark in areas closed to gillnet fishing.

Further complicating these issues are the conflicting manner in which Australian fisheries are managed between Commonwealth and State jurisdictions. Any hope of transitioning to alternative fishing methods is largely pointless unless combined with structural reform of Australia's management authorities.

Research

Research for this project was undertaken throughout 2014, 2015 and 2016. Multiple countries were travelled to and interviews conducted with fishers, fishery managers, industry representatives and technology providers. Published literature was widely used and cited.

Outcomes

Technologies are being employed elsewhere in the world that would be beneficial to Australia's commercial fishing industry and some fisheries have provided management and regulatory framework models that Australia can look towards to improve governance, accountability and productivity within Australia's commercial fishing industry and management authorities.

Implications

It is suggested that Australia needs to undertake a comprehensive review of its fisheries in order identify areas of conflict between fishing sectors, overlapping jurisdictions and management authorities. Such a review must identify tangible paths of reform and mechanisms by which they can be prosecuted.

Publications

Findings of this research project were presented in 2015 at the Nuffield Australia National Conference held in Albury, NSW, Australia.