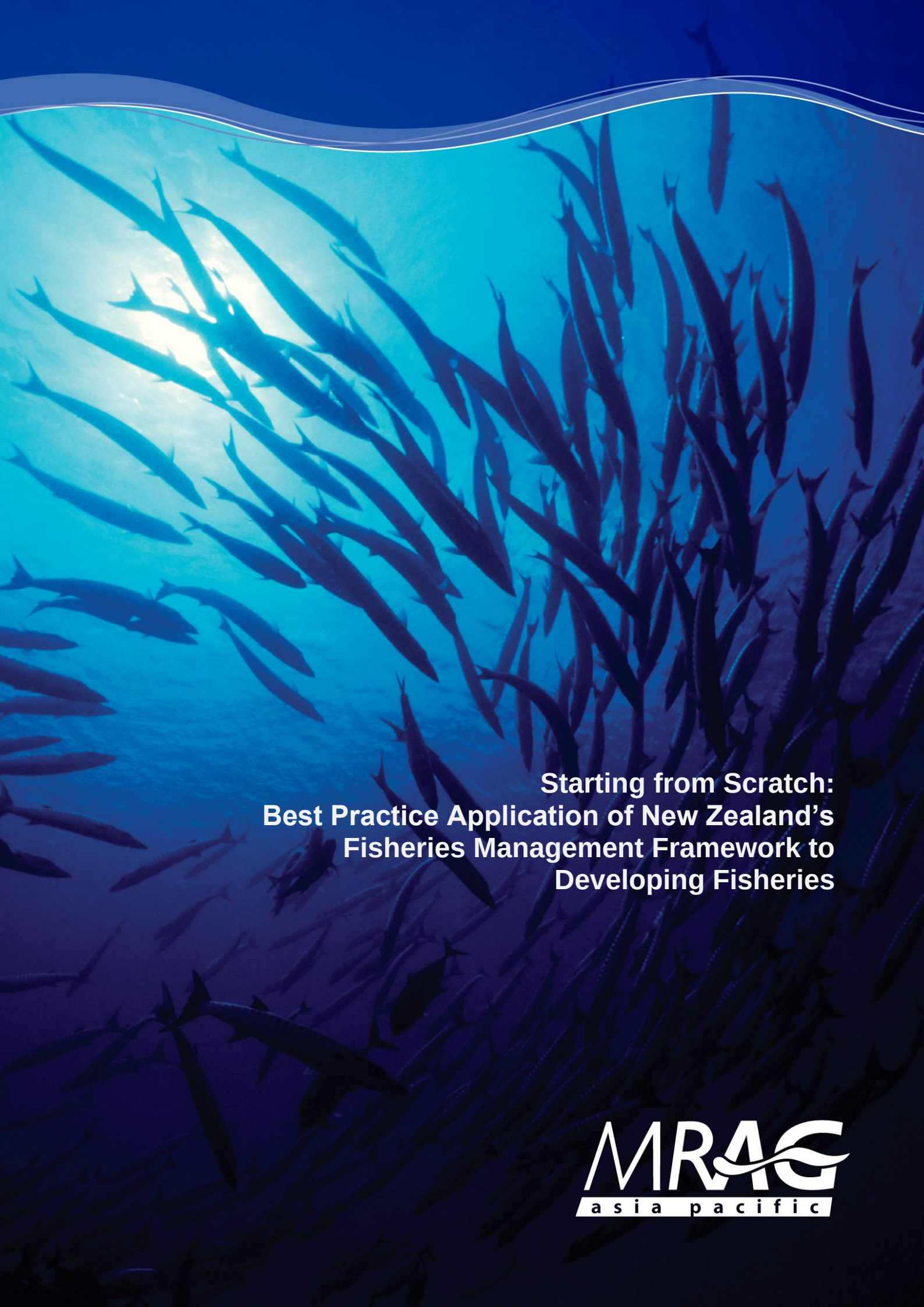

Starting from Scratch: Best Practice Application of New Zealand's Fisheries Management Framework to Developing Fisheries

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Level 3
345 Queen Street
Brisbane Qld 4000 Australia

PO Box 732
Toowong Qld 4066
Australia

P: +61 7 3371 1500
F: +61 7 3100 8035
E: info@mragasiapacific.com.au

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Executive summary

While common wisdom suggests that most of world's major wild catch fisheries have been developed, new fisheries – mostly smaller "boutique" fisheries – have continued to emerge in recent times. These have been driven by a growing need for fish-based protein, changing consumer preferences and an increasing use of bycatch amongst other things. Historically, the development of new fisheries has been reactive, with most fisheries following a typical 'boom and bust' cycle, characterised by rapid initial development and overcapitalisation, followed by overfishing and stock decline. More recently, there has been a growing recognition of the benefits, both biological and socio-economic, in 'catching fisheries early' – that is, identifying emerging or potential fisheries early in the development cycle and putting them into an orderly development process.

The situation in New Zealand mirrors the global pattern, with most of the major fisheries having been developed but smaller, mostly shellfish, fisheries continuing to emerge. These fisheries have the potential to create valuable jobs and revenue but also pose unique management challenges, mostly driven by a lack of information upon which to support management decisions consistent with the legislative objectives of the New Zealand Ministry of Fisheries (MFish). New Zealand's system of fisheries management has a number of unique characteristics that require a tailored approach to new fishery development. Central to this is the preference for management under the QMS.

The overarching purpose of this research was to provide advice about best practice approaches to the management of new and emerging fisheries within New Zealand's existing management framework. In developing this advice we undertook three main tasks:

- A review of approaches to the development of new stocks used internationally and lessons learned;
- A review of New Zealand's existing arrangements for the management of new fisheries, their recent experiences with new fisheries development and a comparative analysis of New Zealand's arrangements versus those used internationally;
- An examination of the New Zealand geoduc fishery as a "live test case" to explore in real time the challenges and opportunities for new fisheries in the New Zealand management system.

The approach to new fishery development taken by 13 jurisdictions were reviewed under the first task, including five in Australia, two in the United States, Canada, South Africa, Namibia, the European Union, Falkland Islands and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) . The jurisdictions chosen were largely in developed world countries with a relatively defined set of rights holders to ensure relevance to New Zealand. For each jurisdiction the main elements of the policy/management framework for new fisheries are described, as well as any particular lessons learned in new fishery development. These were largely nominated by the jurisdiction themselves as part of a survey distributed for this study. Six case studies of recently developed or developing fisheries are also included to illustrate particular approaches taken by some of the jurisdictions in proving up new fisheries.

Of the jurisdictions surveyed, a number of commonalities were evident. Most undertake the developmental stages of new fisheries in an environment of non-transferable, temporary rights, using a phased approach with further development linked to the acquisition of new knowledge, mostly about the biology of stocks. Most believed the existence of a clear government policy/framework for the development of new stocks is an important pre-requisite in encouraging new fishery development, and stressed the importance of a high level of interaction between fisheries managers, scientists and industry in the proving up process. The most common incentive for new fishery development used is to recognise the 'rights of

pioneers' through preferential treatment in access or allocation in the transition from developing to developed fishery. A common impediment to new fishery development identified was the prohibitive upfront costs associated with biological and other research support assessments of biological potential and commercial viability. Many jurisdictions adopted 'research while fishing' approaches (i.e. industry is allowed to fish in accordance with a predetermined research and/or data collection plan to generate necessary biological and other knowledge, while using the proceeds of the catch to offset costs) to overcome this. A clear need for adequate cost recovery was identified, with many jurisdictions nominating the absence of adequate resources to support new fisheries (particularly when competing for funding with more established, socio-economically important fisheries) as a particular challenge.

In the second task a comparative analysis was undertaken of the arrangements for new fishery development in New Zealand versus those used internationally. New Zealand's existing arrangements were reviewed including relevant legislative and policy frameworks, as well as new developments such as the establishment of the new purpose special permits to allow for exploratory fishing. A fundamental difference between New Zealand's approach and that used elsewhere is the timing of the allocation of permanent, transferable rights. Whereas the majority of other jurisdictions undertake their fishery development within a framework of temporary, non-transferable rights, much of NZ's new fishery development is undertaken in a framework of permanent, transferable rights under the QMS. This difference has significant implications across a number of policy and operational areas. In particular, the risks for potential investors are different (i.e. investors are asked to purchase permanent rights before the fishery's potential has been proven), the transition from 'developing; to 'developed' fishery is less clear, the Crown is unable to impose a range of 'encouragements' to develop new fisheries used in other jurisdictions such as minimum participation requirements and the early entry of stocks into the QMS, together with the approach of tendering Crown quota to the highest bidder, means there is little incentive for 'pioneers' to develop non-QMS stocks (except for Maori who are guaranteed 20% of future quota). Nevertheless, many of the tools required for the orderly development of new stocks are in place. The QMS provides an effective framework to control overfishing and overcapitalisation which have plagued other jurisdictions, and the new purpose special permits provide a mechanism for exploratory fishing within a structured framework.

New Zealand's recent experiences with new fishery development were also reviewed to examine lessons learned and any implications for future management. This review focused on the deepwater crab fishery and the surf clam fishery as the two most prominent examples of recent fishery development. Both of these fisheries have adopted a similar development approach, central to which is the establishment of a joint venture company – Crabco Ltd and Surfco Ltd respectively – to manage the process of proving up the fisheries on behalf of all quota holders. Surfco have adopted a conscious approach of proving up the biological potential of the fishery before the post harvest aspects in order to increase the TACC and maximise quota value. Crabco have similarly focused on proving up the biology of the fishery but at the same time have dedicated resources to marketing and technical issues such as pot design. While neither fishery could yet be considered developed, and hence it is difficult to draw conclusions about their success, the approach of having a single entity coordinating the proving up process on behalf of all participants has a number of inherent benefits. These include the ability of the group with pooled resources to undertake biological and other research on a scale unable to be undertaken by individuals alone (potentially delivering better biological information faster), the ability to reduce overall input costs by coordinating and collectively bargaining on key services such as harvesting and processing, the ability maximise outputs by controlling market supply to the extent possible, improving compliance, eliminating free-riding and facilitating coordinated industry input into management planning and other processes.

In the third task we worked with the New Zealand Geoduc Co. (NZGC) to examine in real time the challenges and opportunities to the development of new fisheries in New Zealand's current framework. The NZGC is in the early stages of proving up a geoduc (*Panopea zealandica*)

fishery commencing initially in PZL7. The NZGC's approach to development is described, along with progress to date in harvesting, processing and marketing in the first year, key costs and impediments to development and future needs based on the first year's experiences. The NZGC's approach provides contrast to the approaches taken by Crabco/Surfco in that they have chosen to prove up the "business" aspects of the fishery first (harvesting, processing, marketing) before the biological potential of the fishery. General lessons applicable across all new fisheries are identified, most notably that development approaches are likely to vary considerably between fisheries based on characteristics of the species, the mix of shareholders and shareholder objectives, the extent of pre-existing knowledge about the fishery and the maturity of markets. The main implication for New Zealand's framework is to ensure sufficient flexibility to allow industry to choose an approach they believe provides the best chance of successfully proving up the species based on the unique characteristics of the fishery (while obviously remaining within the bounds of acceptable biological and ecological risk).

From the above tasks considerations for MFish in the future management of New Zealand's fisheries are identified. The main need is for a clearly articulated policy and operational framework which spells out the New Zealand government's goals and objectives for new fisheries and provides operational guidance to stakeholders (industry, managers, scientists, NGOs) on the process by which new fisheries will be developed. Options on the key considerations within this framework, such as the timing of entry of new stocks into the QMS, and operational details of new purpose special permits are discussed. A high level of interaction between industry, managers and scientists in the early stages of fishery development is recommended, with the existing scientific working group process appearing to be an appropriate forum to facilitate interaction. The benefits of adaptive management in generating important biological information rapidly within a comparatively low risk environment are highlighted. Finally, in the absence of a recognition of the rights of pioneers, the need for appropriate short term incentives to encourage development of new stocks is discussed.

List of abbreviations and acronyms

ABC	Acceptable Biological Catch
ACE	Annual Catch Entitlement
ACL	Annual Catch Limits
AFMA	Australian Fisheries Management Authority
AMA	U.S. Arctic Management Area
AMP	Adaptive Management Programme
CCAMLR	Commission for the Conservation of Antarctic Marine Living Resources
CM	Conservation Measure
DCP	Data Collection Plan
DFO	Canadian Department of Fisheries and Oceans
DFP	Oregon Developmental Fisheries Program
DNF	Developing New Fisheries (Framework of Western Australia)
DPI&F	Queensland Department of Primary Industries and Fisheries
DPIPW&E	Tasmanian Department of Primary Industries, Parks, Water & Environment
DV	Deemed Value
EAFM	Ecosystem Approach to Fisheries Management
EC	European Commission
EFA	Experimental Fishery Areas
EFP	Exploratory Fishing Program
EU	European Union
FIG	Falkland Islands Government
FMP	Fishery Management Plans
FRDC	Fisheries Research and Development Corporation
ITQ	Individual Transferable Quota
MFish	New Zealand Ministry of Fisheries
MSY	Maximum Sustainable Yield
NMFS	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
NOAA	National Oceans and Atmospheric Administration
NTFDOC	Northern Territory Fisheries Development Opportunities Committee
NZGC	New Zealand Geoduc Company
PFARP	Pacific Fisheries Adjustment and Restructuring Program
PIRSA	Primary Industries and Resources South Australia
PQ	Provisional Quota

PSCHA	Pacific Sea Cucumber Harvesters Association
QMA	Quota Management Area
QMS	Quota Management System
RP	Research Plan
RPUE	Revenue Per Unit Effort
SAFE	Stock Assessment and Fishery Evaluation
SARDI	South Australian Research and Development Institute
SC-CAMLR	Scientific Committee - CCAMLR
SFR	Statutory Fishing Right
SPARSC	Shellfish Pacific Stock Assessment Review Sub-Committee
SSRU	Small Scale Research Unit
TAC	Total Allowable Catch
TACC	Total Allowable Commercial Catch
TOKM	Te Ohu Kai Moana

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Chapter 1: Introduction

While common wisdom suggests that most of world's major wild catch fisheries have been developed, new fisheries – mostly smaller "boutique" fisheries – have continued to emerge in recent times (e.g. [1]). These have been driven by a growing need for fish-based protein, changing consumer preferences and an increasing use of bycatch amongst other things. Historically, the development of new fisheries has been reactive, with most fisheries following a typical 'boom and bust' cycle characterised by rapid initial development and overcapitalisation, followed by overfishing and stock decline (e.g. [2]). Often, management agencies have been slow to react, only moving to regulate new fisheries well after warning signs are evident (e.g. [3]).

In recent times, however, there has been a growing recognition of the benefits, both biological and socio-economic, in 'catching fisheries early' – that is, identifying emerging or potential fisheries early in the development cycle and putting them into an orderly development process. This change in approach has emerged in parallel with other modern fisheries management concepts such as the precautionary approach and the ecosystem approach to fisheries management. To this end, a number of jurisdictions have developed dedicated policies and approaches to 'prove up' new fisheries aimed at preventing overcapitalisation, providing adequate protection to the target stock and broader environment, as well as generating information upon which to base the long term management of the fishery.

The situation in New Zealand mirrors the global pattern, with most of the major fisheries having been developed but smaller, mostly shellfish, fisheries continuing to emerge. These fisheries have the potential to create valuable jobs and revenue, particularly for Maori who are provided 20% of the quota to all new quota management system (QMS) stocks. However, they also pose unique management challenges, mostly driven by a lack of information upon which to support management decisions consistent with the legislative objectives of the New Zealand Ministry of Fisheries (MFish). With this in mind, MFish has identified research to support best practice approaches to the development of new fisheries as an important priority.

New Zealand's system of fisheries management has a number of characteristics that make it unique in the world. Central to this the preference for management under the QMS and its associated measures such as the use of deemed values, annual catch entitlement (ACE), spatially separate quota management areas (QMAs). The implication is that while general lessons from developing fisheries in other jurisdictions can be applied, the unique characteristics of the NZ approach require the development of a tailored approach to new fishery development, consistent with the existing framework.

The overarching purpose of this research was to provide advice about best practice approaches to the management of new and emerging fisheries within this framework. In developing this advice we undertook three main tasks:

- A review of approaches to the development of new stocks used internationally, including approaches advocated in the scientific literature;

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[1] Perry, R.I., C.J. Walters and J.A. Boutillier. 1999. A framework for providing scientific advice for the management of new and developing invertebrate fisheries. Reviews in Fish Biology and Fisheries 9:125—150.
[2] Boyer, D. C., Kirchner, C.H., McAllister, M.K., Staby, A. and Staalesen, B.I. (2001). "The Orange Roughy Fishery Of Namibia: Lessons To Be Learned About Managing A Developing Fishery." South African Journal of Marine Science **23**: 205-221.
[3] Hilborn, R. and Sibert, J. (1988). Adaptive management of developing fisheries. Marine Policy. April 1988. p112-121.

- A review of New Zealand's existing arrangements for the management of new fisheries, their recent experiences with new fisheries development and a comparative analysis of New Zealand's arrangements versus those used internationally;
- An examination of the New Zealand geoduc fishery as a "live test case" to explore in real time the challenges and opportunities for new fisheries in the New Zealand management system.

Structure of report

This report is structured into four broad chapters, following this introduction.

Chapter 2 reviews the policies, approaches and experiences in the development of new fisheries over the past decade amongst a number of developed world fisheries jurisdictions. A number of case study fisheries are identified from within these jurisdictions, and the process used to prove up these fisheries is described. A brief review of approaches to prove up new fisheries advocated in the scientific literature has also been undertaken. Chapter 2 concludes with a discussion of the main conclusions arising from the review.

Chapter 3 reviews the existing legislative, policy and administrative arrangements for the development of new fisheries in New Zealand. Recent experiences in the development of new fisheries are also reviewed, focusing on the two most prominent examples: the deepwater crab fishery and the surf clam fishery. Chapter 2 concludes with a comparative analysis of NZ's management arrangements for new fisheries versus those used internationally.

Chapter 4 examines the progress towards proving up a 'live test case' fishery – the geoduck fishery. This fishery is currently in its early stages of development, and its approaches to governance and commercialisation, key costs and impediments, and next steps are discussed. General lessons from the geoduck fishery that might be applied more broadly are identified.

Chapter 5 outlines the key considerations identified by this study for the future management of developing fisheries in New Zealand, and provides advice on possible management approaches.

Chapter 2: International approaches to new fishery development

Introduction

The first objective of this study was to identify best practice approaches to proving up new fisheries, including reviewing the new fishery development policies and recent experiences of a number of jurisdictions internationally. Where possible we have focused on developed world examples with a defined set of rights holders to ensure relevance to New Zealand. Case study fisheries, selected to illustrate particular approaches used to prove up new fisheries and lessons learned in the process, have also been identified and described. In addition, a number of approaches to the development of new fisheries advocated in the scientific literature have been reviewed.

A number of approaches were used to gather information to support the review. These included:

- Searches of publicly available policy and administrative documents relating to the management of developing fisheries in developed world jurisdictions;
- Literature searches to identify approaches to new fishery development advocated in the scientific literature;
- Distribution of a survey (Annex 1) to approximately 30 developed world fishery jurisdictions seeking information on their policy and operational approaches to new fishery development;
- Following-up promising leads identified through literature searches and surveys via phone and email contact with relevant authors.

The following section outlines the policy approaches of 14 jurisdictions internationally. The general framework for fisheries development is described, together with any unique features and valuable lessons learned. Six case studies of new fisheries are also included to highlighting particular approaches taken to new fishery development across a number of jurisdictions. For comparative purposes a summary analysis of each jurisdiction's approach against 11 common policy features identified during the review is included at Table 4.

Australia

Australian (Commonwealth) Government

The management of new and developing Australian Commonwealth fisheries is undertaken by the Australian Fisheries Management Authority (AFMA), an independent government Commission. AFMA's existing policy for the management of new fisheries is outlined in their Fisheries Management Paper No. 5 – Exploration of Fisheries Resources[4]. The paper outlines the purpose of the policy - to support the 'the objective of achieving optimum utilisation of living resources within the Australian Fishing Zone' – as well as the process for applying for a permit, the process by which AFMA reviews and progresses applications, the costs involved and other key considerations. Under the policy, proposals for new fisheries are initiated by industry proponents who must provide information that "demonstrates the

[4] http://www.afma.gov.au/information/publications/fishery/fmp/fmp05_2005.pdf

existence of a resource that may support a sustainable fishery" and ways in which they plan to limit the impact of the proposed fishery on the environment and other fisheries.

A key difference between AFMA's approach and that of most other jurisdictions is the policy of undertaking exploratory fishing under a statutory plan of management using transferable statutory fishing rights (SFRs). Under AFMA's approach, following receipt of a new fishery application, a public notification is issued calling for all industry parties to register their interest in the proposed Exploratory Fishing Program (EFP). A statutory management plan is then developed, based on an Exploratory Fishery Management Report (which collates information on the new fishery, discusses management measures to apply during the exploratory fishing program and the considerations in assessing whether a longer term fishery can be established), and SFRs are allocated to participate in the EFP using a competitive auction or tender. Should the fishery transition to an ongoing fishery following the EFP, participants in the EFP ('pioneers') are granted an 'initial access allocation' of rights in the new fishery. This is the primary incentive for new fishery development offered in Commonwealth fisheries.

EFP's are designed to take a 'research while fishing' approach, with research plans developed by AFMA in consultation with industry, relevant scientists and other stakeholders. Information requirements are similar to those in developed fisheries, as well as being influenced by the Australian government policies on harvest strategies and bycatch. Fishery-independent surveys are unlikely in the initial stages. No incentives (e.g. higher catch in return for more information) are offered to industry to provide additional information.

Only one fishery has been assessed under the policy in the past decade – the Norfolk Island Offshore Fishery (demersal trawl and line). An Exploratory Management Report was developed in 2000, which outlined the current state of knowledge about the fishery, details of the EFP, (limited) research requirements and minimum conditions of access (50 days fishing within the 3 year length of the EFP, and at least one trip per year)[5]. Seven permits[6] were granted, however little ongoing activity has occurred. This fishery has not progressed to a fully developed stage.

At the time of writing, AFMA's policy was being revised to reflect the requirements of the Australian Government's new Harvest Strategy Policy (HSP) for Commonwealth Fisheries[7], endorsed in 2007. This policy and associated operational guidelines outline the government's preferred target reference point (maximum economic yield) and limit reference points and provide guidance on how they are to be achieved. In the case of developing fisheries, five generic steps are to be followed upon confirmation that a developing fishery opportunity exists[8]. These include:

- *Review available information.* Draw on information for similar species and fisheries from other jurisdictions to help inform decisions about the appropriate development of a fishery and minimise duplication of scientific research efforts and their associated costs;
- *Conduct a risk assessment.* Based on available information, highlight risk levels comparative to other species and indicate important gaps in knowledge that should be addressed in data collection plans for the fishery;

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[5] AFMA, 2000. Norfolk Island Offshore Demersal Finfish Fishery – Exploratory Management Report. Accessed at: http://www.afma.gov.au/fisheries/ext_territories/norfolk/publications/offshoreexpmgt.pdf

[6] This EFP granted access through fishing permits, having commenced before the 2005 policy change to operate new fisheries under SFRs

[7] Australian Government Department of Agriculture, Fisheries and Forestry (2007) Commonwealth Fisheries Harvest Strategy and Guidelines. http://www.daff.gov.au/fisheries/domestic/harvest_strategy_policy

[8] Ibid, Australian government p. 46.

- *Set an initial conservative catch / effort trigger.* This trigger should be demonstrably precautionary to provide an early warning of a stocks negative response to new fishing pressure and may provide a mechanism to stop or reduce further fishing activity for the remainder of the year;
- *Ensure adequate monitoring and control of development.* The ability to continue to take a species under the initial catch trigger should only be allowed if a minimum level of information is collected by those involved in the fishery. Fishing should be ceased in any one year upon reaching the initial catch trigger; and
- *Link any increased development allowances to further data analysis and knowledge.* Any increase in allowable catches or effort should only be allowed if a minimum level of analysis (of available data) is performed. The established trigger limit should not be exceeded in any one year until length and age data are formally analysed and reviewed.

The HSP approach has not yet been applied to a developing fishery in practice.

Western Australia

The WA Government's policy and administrative framework for the development of new fisheries is outlined in Fisheries Management Paper 130 – Developing New Fisheries in Western Australia ("DNF Framework")[9].

The DNF framework is designed to meet the utilisation objectives of the *Fish Resources Management Act (FRMA) 1994* and outlines three overarching principles that will guide development of new fisheries:

- *ecologically sustainable development*, including adopting an ecosystem-based approach to new fisheries;
- the *precautionary principle*, including taking a risk-averse and consultative approach to the development of new stocks; and
- recognition of developers (or pioneers).

Within this framework, the development of new fisheries is divided into three stages:

- the *developing fishery* stage, which ends when predetermined benchmarks are reached and management changes are triggered (generally a three year period);
- the *interim managed fishery* stage which is, at maximum, three years in duration and may be less if participant-initiated 'triggers' move it towards managed fishery status; and
- the *managed fishery* stage which sees long term access allocated through either a management plan, or other subsidiary legislation.

The process and timing of new fisheries development is controlled by WA Fisheries who issue a call for expressions of interest in new fisheries. Respondents in fisheries deemed suitable for development by the Minister are required to, among other things, provide a detailed business plan outlining their proposed activities, including suitable development milestones. As part of the process applicants are required to undertake consultation with interested

[9] Halmarick (1999). Developing New Fisheries in Western Australia: A guide to applicants for developing fisheries. 40pp. Accessed at: http://www.afma.gov.au/fisheries/ext_territories/norfolk/publications/offshoreexpmgt.pdf

parties. Failure to meet development targets can result in suspension or cancellation of permits.

The DNF framework was adopted in 1999, although it was suspended in 2001 following an "overwhelming response" to past calls for applications from fishers"[10]. Of the "hundreds" of expressions of interest received, only two – blue swimmer crabs and octopus – progressed through to the initial developing fishery stage. These fisheries continue to operate and will shortly be moved towards more formal management arrangements, including transferable rights. It is worth noting that the permits of two operators in the blue swimmer crab fishery were cancelled after failing to operate consistently with their business plan[11].

Scientific information to support management of these fisheries comes entirely from fishery-dependent information, although staff from the WA Fisheries research wing are reportedly in close contact with each of the permit holders.

The key challenge nominated by WA Fisheries in the development of new fisheries in WA is resourcing. Under the legal structure used to provide access to new fisheries, WA Fisheries is unable to directly recover the costs of fisheries management from industry, and as a result is unable to dedicate significant time towards the management and development of these fisheries. Given the relatively small scale nature of new fisheries, and the often high initial investment with little initial return, they also tend to receive a lower priority in funding and other resourcing allocations at the agency level. The lack of funding has been a central reason behind the suspension of the DNF process since 2001. WA Fisheries do not envisage recommencing the DNF process until formal management arrangements for the existing developmental fisheries are bedded down[12].

Northern Territory

The Northern Territory's approach to new fisheries development is outlined in its "Policy for the Appraisal and Administration of Northern Territory Development Fishery Applications"[13]. This framework lists species which will or will not be considered for new fisheries and outlines the planning required to launch an exploratory fishery operation and the basis upon which such operations are monitored and assessed. It also provides definitive timeframes for operators to demonstrate a viable commercial fishery and for scientists to gather data required to assess the impacts of the fishery and its sustainability.

Central to the NT's approach has been the establishment of the Northern Territory Fisheries Development Opportunities Committee (NTFDOC) in 1998 to assess applications to trial new fishing gear or target new species[14]. The membership of NTFDOC includes an independent chair, representatives from commercial, recreational and indigenous stakeholders and NT Fisheries, and was set-up to provide informed and impartial advice to NT Fisheries on the issuance of development permits and licences and review performance of such permits as required.

The proving-up stage of a new fishery in NT is undertaken using non-transferable permits. These are subject to customised performance criteria and milestones to ensure adequate development work is undertaken during trials to obtain data required for further assessment of

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[10] Department of Fisheries, Western Australia - Media Release, 27 September 2001, (http://www.fish.wa.gov.au/docs/media/index.php?0000&mr=41).
[11] Pers. comm. Natalie Moore, W.A. Department of Fisheries (2009)
[12] Pers comms, WA Department of Fisheries (2009)
[13] Department of Primary Industry, Fisheries and Mines (Updated July 2006) Policy for the Appraisal and Administration of Northern Territory Development Fishery Applications. Fishery Report No. 60. Accessed at: http://www.nt.gov.au/d/Fisheries/Content/File/FR60_JULY06.pdf
[14] Ibid, DPIFM (2006)

impacts and economic viability[15]. This may determine whether permits should be renewed and/or whether further management measures or conditions are required.

To date, nine fisheries have been introduced into this developmental framework. However, none of these fisheries have yet progressed through to become established fisheries. This has been predominantly due to operators finding these fisheries to be commercially unviable[16]. One fishery, the drop-net/lift-net and purse seine fishery for bait fish and squid, is anticipated to become developed in the near future, however the administrative arrangements to enable this to occur are still being determined by NT Fisheries[17].

The NT Fisheries developmental fishery program and policy was under review by the Department of Regional Development, Primary Industry, Fisheries and Resources at the time of writing and consideration may be given to suspending this program due to its demands on management[18].

Tasmania

The Tasmanian government has no formal policy framework for the management of new fisheries, however it can issue new access rights. Two fisheries – a hand collection based shellfish fishery (native oysters, pacific oysters; 10 permits) and pot fishery for octopus (2 permits) – have been developed in the past 10 years[19].

No formal research plans have been developed for these fisheries, however bi-annual fishery-independent surveys of shellfish beds (agreed between industry, management and scientists) are conducted in the shellfish fishery. Funds for research are cost-recovered from industry although the compliance costs are funded by the State.

A key challenge in the development of new fisheries has been the absence of a defined framework for the allocation of ongoing rights. In practice, the rights of pioneers have been recognised, however the Tasmanian Department of Primary Industries, Parks, Water & Environment (DPIPW&E) recognise this could be considered contrary to their Act[20]. Another key challenge has been the resourcing of management and research functions. The development of new fisheries has been 'resource hungry' with little tangible benefit to the State.

South Australia

No response to the survey was received from South Australia at the time of writing, however we are aware that Primary Industries and Resources South Australia (PIRSA) is currently reviewing their developing fisheries policy. Notwithstanding that, some approaches used in South Australia to prove up new fisheries have been documented in the literature. A case study of the South Australian abalone fishery is detailed below. In this example, the South Australian Research and Development Institute (SARDI) utilised commercial fishers to conduct scientific surveys to collect data to support the extension of the fishery, including setting TACs for a historically unexploited sub-population of abalone[21].

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[15] Personal communication with R. Davies, Aquatic Resource Manager, DRDPIFR, 2009.
[16] Ibid, pers. comm., R. Davies, 2009.
[17] Pers. comm.. NT Department of Regional Development, Primary Industry, Fisheries and Resources, 2009.
[18] Ibid, pers comm. NT Fisheries
[19] Pers. Comm.. Tasmanian Department of Primary Industries, Parks, Water & Environment (DPIPW&E), 2009.
[20] Ibid, pers. comm. Tasmanian DPIPW&E, 2009.
[21] Mayfield, S., McGarvey, R., Carlson, I. And Dixon, C. (2008) Integrating commercial and research surveys to estimate the harvestable biomass, and establish a quota, for an "unexploited" abalone population. ICES Journal of Marine Science, **65**:1122-1130.

Case study: Breaking new ground – setting TACs on an unexploited population of abalone in the Spencer Gulf

The South Australian abalone fishery is the State's third most valuable with a GVP of approximately $31m per year[22]. The fishery is based primarily on two species of abalone – greenlip (*Haliotis laevigata*) and blacklip (*Haliotis rubra*) – and is divided into three management zones: Southern, Central and Western.

Most fishing in the Spencer Gulf (Central Zone) has historically been directed towards a large consistently productive abalone reef (Tiparra Reef) on the eastern side, however interest was shown by industry and managers in extending the fishery to incorporate the Cowell area in the western gulf where sporadic catches had occurred since 1989. Mayfield et al (2008) describe the scientific approach used to support the extension of the fishery, including determining a TAC for the 'unexploited' area within a risk-based framework prior to the commencement of commercial operations.

Under their approach two integrated levels of survey were used: firstly, broad-scale surveys using commercial fishers were undertaken to determine abalone distribution and relative abundance in the 'unexploited' area; secondly, fine-scale fishery-independent surveys were then carried out in high density areas to refine distributions and determine "absolute" abalone density in designated plots within the survey region.

Based on a combination of these two surveys, estimates of absolute numbers of abalone in the surveyed area were able to be obtained – ~800,000 individuals, 530,000 of which were legal size – as well as estimates of mean harvestable biomass – 77t ±25t. Using bootstrap modelling, a risk assessment framework was also produced to determine the probability that the true value of harvestable biomass is equal to or greater than the selected risk level of biomass, and ultimately to assist in TAC setting. For example, a 90% probability existed that the harvestable biomass exceeded 46.3t and a 10% probability it exceeded 110.5t. Based on these results, PIRSA fisheries managers and industry adopted a 10% harvest fraction with an 80% confidence of harvestable biomass exceeding 55.26t. In practice this resulted in a quota allocation of 5.5t for the new area, an overall increase of 11% for the Central Zone.

Funding for the surveys was provided by industry, and strong cooperation was achieved by all groups throughout the survey process. Proceeds from sales of legal size abalone retained by commercial fishers during stage 1 surveys were pooled and used to reimburse fishers for their operational expenses during the surveys (fuel and accommodation), with any remaining funds going towards follow-up stage 2 surveys and data analysis[23]. The increase in quota added significant value to the fishery - ~AUD$550,000 – far outweighing the cost of the surveys themselves – AUD$200,000. The 5.5t quota was harvested in 34 days in 2006.

Mayfield et al (2008) note the two stage survey approach designed to estimate absolute abundance offers considerable benefits by facilitating the rapid implementation of a regulated fishery, with controlled risks of overexploitation and overinvestment, as well as permitting early, robust quota setting in developing invertebrate fisheries. The survey approach taken also capitalises on the targeting ability of fishermen and allows for the efficient exploration of large areas to identify regions suitable for harvesting.

[22] Knight, M.A. & Tsolos, A. (2009). South Australian Wild Fisheries Information and Statistics Report. Report to PIRSA Fisheries. SARDI Aquatic Sciences, Publication No. F2008/000804-1. SARDI Research Report Series No. 305. 70pp

[23] Pers. comm. Stephen Mayfield, SARDI.

Importantly, it also avoids the need to exploit a stock to determine its size.

Subsequent to the central zone abalone example, the methodology has also been used successfully to survey mud cockles (Cateliesia sp.) in South Australia and populations of Blacklip abalone in Victoria recovering from a disease die-off[24].

Notwithstanding the apparent success of the process described above, it is worth noting that more recent information suggests the abalone population has declined in the Cowell survey area since Mayfield et al (2008) was published. A recent PIRSA report notes that "sequential declines in mean daily catch, CPUE and survey-measured, legal-sized bled-meat-weight biomass suggest that the resource has weakened since exploitation re-commenced off Cowell in 2006".[25] Notwithstanding that, the benefits of the survey approach remain.

Queensland

Queensland's approach to new fishery development is outlined in its "*Policy for the management of developmental fishing*" (dated November 2006), administered by the Department of Primary Industries and Fisheries (DPI&F). The policy applies to circumstances where commercial operators seek to:

- target an existing commercial species in a new (previously unfished) area;
- take an existing commercial species using a completely different harvesting technique or gear; and
- take a previously unexploited species.

The proving up process for new fisheries is undertaken using specific non-transferable developmental fisheries permits. Permits are generally issued for five years while an assessment is made on the sustainability and viability of the operation, taking into account information obtained through data collection programs including observer programs and other scientific assessments[26].

Key policy considerations for the issuing of developmental fishing permits in Queensland include:

- The perceived sustainability of the proposed fishing activity in light of available biological and ecological information about the target resource, bycatch and environmental impacts;
- Impacts of the proposed activity on existing users (e.g. commercial, recreational, or traditional indigenous fisheries);
- Whether the application seeks access to a developmental fishery already underway and if so, the capacity of the resource to sustain additional operators; and
- The results of stakeholder consultations, including:
- Community values and expectations regarding the proposed developmental fishing activity, target species or area;

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[24] Pers. comm.Stephen Mayfield, SARDI.
[25] PIRSA, 2009. *Ecological Assessment of the South Australian Abalone Fishery*. Report prepared for the Australian Government Department of the Environment, Water, Heritage and the Arts. March, 2009. 40pp. (Accessed at: http://www.environment.gov.au/coasts/fisheries/sa/abalone/pubs/submission_april09.pdf)
[26] Queensland Department of Primary Industries and Fisheries (2006) Policy for the Management of Developmental FishinQueensland's Developmental Fisheries Process (http://www2.dpi.qld.gov.au/fishweb/12524.html)

- The perceived short and long-term community benefit of permitting the activity; and
- Relevant submissions from the public notification process and the responses of applicants to the submissions.[27]

Developmental permits may be subject to a range of conditions such as limitations on gear and vessel size, spatial and temporal restrictions, as well as monitoring (e.g. on-board observers) and reporting requirements.

At the expiry of the permit, DPI&F make a judgement, following input from relevant management and/or scientific advisory committees, about whether the fishery should progress to a managed commercial fishery. No detail is provided on the criteria upon which this decision is based, other than "all available and relevant ecological, scientific, economic and social information will be used" (p7).

Where a fishery progresses to a managed commercial fishery, DPI&F recognise the commitment, investment and performance of developmental permit holders.

No response to the survey was received from Queensland at the time of writing, hence little detail is available to assess the success or otherwise of this policy framework in practice. Notwithstanding that, one of the authors (Hundloe) is currently involved in a project to expand an existing Queensland fishery – the mud crab (*Scylla serrata*) fishery – at the time of writing. While this is unlikely to be considered a 'new' fishery for the purposes of the above policy, it provides useful insights into some of the processes and challenges in new fishery development and is discussed in the Case Study box below.

Case Study: Threading the political and economic needle - the Development of a Female Mud Crab Fishery

During the period in which this research was taking place, a start was made to develop the Queensland female mud crab (*Scylla serrata*) fishery. This occurred at a stage when the Queensland government was, and remains, in the process of evaluating and refining its developmental fisheries policy. As a consequence, the process involved in considering the potential of the female crab fishery was formulated specifically for the task at hand, rather than within the constraints of a set-in-concrete policy. There is the prospect that the approach adopted for the female mud crab fishery will break new ground. For this reason, if not for other interesting ones (discussed below), there are lessons to be learned from this exercise in fisheries development.

Background

Female mud crabs have not been harvested legally for approximately 100 years in Queensland. The rational for this government restriction was, and remains, the protection of breeding stock. In 1891, the first law pertaining to mud crabs was enacted. It established minimum legal weights for males at 3lb (1.4 kg) and 10lb (4.5 kg) for females. Next, in 1913 the government changed its law based on weight to one based on size, and rather than determine a size (carapace width) for females, the harvest of females was banned. Males were allowed to be taken at 5inches and above (12.7 cm). The prohibition on taking female mud crabs has remained ever since.

While this is the situation in Queensland, mud crab fisheries became well established in NSW and the NT. They are smaller fisheries than their Queensland equivalent and at present in the order of 68 percent of mud crabs sold through the Sydney Fish Market are from Queensland.

[27] Ibid, Queensland Department of Primary Industries and Fisheries (2006)

In both NSW and NT males and females are permitted to be harvested as long as size limits are met. There are also pot limits in all jurisdictions. WA has a mud crab fishery and females can be harvested. However, the other two jurisdictions are of most importance as their borders are contiguous with Queensland.

A whole folklore has developed in Queensland around the role of female crabs, not just mud crabs, as sand crabs (otherwise blue swimmer crabs) are subject to the same prohibition on taking females. This folklore has permeated politics and no Queensland politician has been willing to risk a backlash from opening up the female mud crab fishery. The scientific evidence from the NSW and NT fisheries suggests that sustainable catches do not depend on leaving females unharvested, but that is conveniently overlooked by those who want to believe in the folklore.

Towards an Experimental Fishery

Various calls for a review of the Queensland policy have been made over the years, however it was not until 2009 that the body responsible for most fisheries research funding in Australia, the Fisheries Research and Development Corporation (FRDC) took the initiative and sponsored a major workshop on the issue of the harvest of female mud crabs in Queensland.

The workshop was divided into two parts. The first was a scoping exercise where the participants (scientists, an economist, a social scientist, fisheries managers, fishers and a wholesaler) considered information on the other mud crab fisheries in Australia, the economics of mud crab fishing (including the market situation) and the likely outcomes from various new policies and laws, especially allowing the harvest of female mud crabs. The fundamental question was the sustainability of the fishery if opened up to the harvest of females.

The second stage of the workshop was to only occur if there was agreement to do so. That is, if at the initial stage the meeting considered the risks of allowing the harvest of female crabs was too great the process would terminate immediately. As it turned out the hurdle was overcome (with certain caveats in place) and the meeting moved to formulate a strategy that would provide:

"the greatest community benefit at a risk level that is realistically manageable, and...developing a communication strategy to ensure that the process would not be derailed politically as a result of conflicting advice from key stakeholder groups."

The second requirement was deemed to be very important given the folklore mentioned above.

This is where the proposition sits at the moment, awaiting feedback from the stakeholder leaders who were not at the workshop. While there was not, and at the time of writing is not, evidence of stakeholder agreement, preliminary discussions occurred at the workshop on the subject of HOW to undertake a trial harvesting and marketing female mud crabs.

A Trial to Ascertain the Biological and Economic Sustainability of the Fishery

This is where policies deemed relevant to a developmental fishery come into play. Both biological and economic considerations have to be developed into guidelines before the trials occur. From a biological perspective the age of maturity of female crabs and the age beyond which they are no longer productive are the fundamental variables. We are fortunate in this case because much is known about the animal in question from research and from the actual data gathered in those fisheries where female crabs are allowed to be taken. On this basis, it will be possible to set parameters based on carapace width (corresponding to the age of the animal) which will significantly reduce any risk of overfishing.

Probably of most concern in a trial fishery will be how many female crabs to put on the market at any point in time. The data available from the industry indicates that there exists a normal downward sloping demand curve for mud crabs. Price tends to reflect both seasonal demand and supply. There is a premium attached to female crabs. They are considered to have a sweeter tasting meat. The latter point suggests that as Queensland female crabs enter the market--even in relatively small numbers --the price of males will drop marginally. The former point suggests that an increase of females on the market will result in a drop in their price. Now, there is no advantage to the fishing industry if the drop in price is not compensated by a more than off-setting increase in the quantity sold. In other words, total revenue needs to increase with more product on the market. There is sufficient evidence available to suggest that with a small quantity put on the market this condition will be met .However, to arrive at sound advice on how many female crabs to put on the market -in a trial and, if the trial is successful, on the long term -is a question that cannot be answered without more detailed knowledge of price elasticities (the slope of the demand curve).

This discussion suggests that even when much is known about a species and, on biological grounds, we can use management tools to ensure biological sustainability, the economic sustainability of a new fishery needs to be assessed as a prerequisite to any costly biological research. Getting the economics right at the trial stage is important, particularly if the sale of the product caught during this period is to pay for the trial.

Canada

Of all jurisdictions reviewed, Canada has some of the most extensive experience in the development of new fisheries. Principally this is a result of the collapse of the groundfish fisheries in the east and the salmon fisheries in the west, and considerable government and community pressure to redeploy displaced fishermen and support existing land-based infrastructure[28].

Canada's approach to new fisheries is outlined in their New Emerging Fisheries Policy, administered by the Department of Fisheries and Oceans (DFO)[29]. The policy outlines an overarching vision "healthy and abundant fishery resources supporting sustainable uses" as well as a number of guiding principles:

- Conservation will not be compromised (precautionary approach);
- The impacts of the new fishery on target species, habitats and other users will be assessed;
- DFO will set conservation standards and conditions for harvest based on biological and ecosystem information and will monitor their application;
- DFO will give resourcing priority to existing fisheries; applicants for new fisheries should ensure sufficient funding is available to cover cost increases;
- Users will participate more in the management of the fishery.

Operationally, Canada's policy outlines three stages of fishery development:

[28] Perry, R.I., Purdon, R, Gillespie, G. & Blewett, E. (2005) Canada's staged approach to new and developing fisheries: concept and practice. Fisheries assessment and management in data limited situations. Alaska Sea Grant College Program.

[29] Department of Fisheries and Oceans (2001, revised 2008). New Emerging Fisheries Policy. Accessed at: http://www.dfo-mpo.gc.ca/fm-gp/policies-politiques/efp-pnp-eng.htm

Stage 1: Feasibility. The objective of this stage is to determine if harvestable quantities of the species/stock exist as well as gear and market testing. In practice, this stage may be separated into distinct 'information collection' (e.g. literature searches; analyses from local knowledge, other fishers etc; meta-analyses) and 'experimentation' stages (e.g. studies to fill information gaps on stock size, spatial scale, etc; evaluation of alternative management approaches).

Stage 2: Exploratory. This stage is reached if feasibility is determined in Stage 1. The objective of Stage 2 is to determine whether a species/stock can sustain a commercially viable operation and to collect biological data 'in order to build a preliminary database on stock abundance and distribution'.

Stage 3: Commercial. This stage is reached if it is determined a stock can sustain a commercial level of harvest. A formal Integrated Fisheries Management Plan is introduced at this stage.

Table 1: Canada's staged approach to new fishery development (as outlined by Perry et al 2005). Stage 1 and 2 in the below table are combined to form Stage 1 in the New Emerging Fisheries Policy.

Stage 1	Information	• Literature searches to identify biological and fisheries information on target (and similar) species. • Analyses of information from local knowledge, other fisheries, and other studies. • Meta-analyses to determine distributions of parameters. • Development of alternative management approaches.
Stage 2	Experimentation	• Studies to develop new information to fill critical gaps determined from stage 1, e.g., unit stock size, spatial scale and pattern of aggregations, metapopulations, habitats, densities and abundances, biological characteristics. • Evaluate alternative management approaches and recommend regulatory reference points.
Stage 3	Exploration	• Implement selected management approaches in a closely observed fishery. • Use information from the fishery to improve analyses conducted in stage 2; modify management strategies.
Stage 4	Establishment of a new fishery	• Develop a formal fisheries management plan. • Monitor the new fishery to provide information on outstanding questions, and for analyses of the performance of the fishery and stock responses.

DFO acknowledge that some of the above stages – most notably 1 and 2 – can occur simultaneously. In particular, they note that limiting a Stage 1 fishery to the minimum catch required for scientific data collection purposes may limit the ability of fishers to test markets and processing/distribution of new product. To this end, the policy notes that "a limited scale experimental fishery allowing for a modest harvest to explore the economics of the market would be considered where the request for such an experimental activity is supported by a clearly articulated marketing and product development plan indicating the amount of fish needed". Where scientific data collection and commercial viability testing occur simultaneously, two licences are issued: one to collect scientific data and one for an additional amount to test commercial viability.

Applicants wishing to enter Stage 1 are required to submit detailed applications including:

- Identifying the target species/stock, fishing area and method;
- Summarising current knowledge about the target species and indicating how other species/ecosystems might be affected;
- Providing a detailed fishing plan (e.g. harvest levels, vessels used, duration of activity etc);
- Providing information on product use;
- Proof of public notification/consultation;
- Preparation of a catch and effort record system (available to the public);
- Sources of funding.

Should the fishery enter Stage 2, DFO develop an exploratory harvesting strategy including number of licences and access criteria (e.g. regional/provincial distribution, catch monitoring and reporting strategy, bycatch limits, seasons, etc), and a protocol to support stock assessment. Participation criteria are then set and applications called, with applicants required to submit a proposed processing and marketing strategy, including product forms and market destinations. During this phase, all relevant information collected during Stage 1 is made available. Successful applicants are then licenced following a review of applications (and selection process – e.g. public draw – if necessary). Recognition of the rights of pioneers is given with licence holders in Stage 1 given priority for Stage 2 licences, and similarly Stage 2 licence holders are given priority in allocating Stage 3 'regular' licences. Successful Stage 2 applicants are subject to participation requirements.

Following the decline of the Pacific salmon fishery in the 1990's, 24 species or species groupings on the west coast were assessed under the framework between 1997 and 2003. Seven of these species stalled during Stage 1, five are still subject to experimentation under Stage 1, one is in Stage 2, eight pre-existing fisheries are at various states of Stages 2 and 3, and one has progressed through to a fully developed fishery. Most of the Stage 1 assessments were funded through the Pacific Fisheries Adjustment and Restructuring Program (PFARP), set up to offset economic impacts associated with the decline of the salmon fisheries[30]. The current status of assessed stocks is outlined in Table 2.

[30] Ibid, Perry et al (2005)

Table 2: Current status of species assessed under Canada's New Emerging Fisheries Policy framework (adapted from Perry et al, 2005).

Stage	Species	Comments/status
Stage 1	Venus Clam (Compsomyax subdiaphana); California mussel (Mytilus californianus)	Rejected at Stage 1 due to harvesting impact concerns
	Pacific hagfish (Eptatretus stoutii), brown box crab (Lopholithodes foraminatus), purple sea urchin (Strongylocentrotus purpuratus), inshore Tanner crab (Chionoecetes bairdi)	Stalled due to industry concern over development costs and lack of funding
	neon flying squid (Ommastrephes bartrami)	Stalled due to lack of interest by industry following drop in prices and changed environmental conditions making it less available
	horse clams (Tresus capax/nuttallii)	Initially stalled due to concerns about interactions with lucrative existing fishery, however now resolved and experimental stage underway.
	swimming scallops (*Chlamys hastata/rubida*), varnish clam (*Nuttallia obscurata*), coonstripe shrimp (*Pandalus danae*), and humpback shrimp (*Pandalus hypsinotus)*	Experiments to determine distributions and responses to fishing ongoing. The two shrimp species were previously bycatch in other target shrimp fisheries.
Stage 2	grooved Tanner crab (Chionoecetes tanneri)	Exploratory projects underway with joint participation of industry and DFO.
Stage 2/3	surfperch (Embiotocidae), surf smelt (Hypomesus pretiosus), northern anchovy (Engraulis mordax), Pacific octopus (Enteroctopus dofleini and Octopus rubescens), opal squid (Loligo opalescens), goose-neck barnacles (Pellicipes polymerus), and sea cucumber (Parastichopus californicus)	These species were subject to small, largely unregulated, pre-existing fisheries and have been subsequently placed in the developing fisheries framework.
Stage 3	Pacific sardine (*Sardinops sagax)*	Fully developed fishery

An assessment of the Canada's emerging fisheries framework by Perry et al (2005) revealed mixed results. These authors concluded that having a clear public policy and process for developing fisheries was valuable in that it allowed all participants to understand process requirements and allowed industry to prepare business plans with some certainty. Likewise, they concluded that the staged process with a strong focus on early information collection allowed for the collection of important biological information prior to and during the start-up phase of the fishery, as well as preventing overcapitalisation and unsustainable growth. Moreover, they noted that the structured process encouraged a high degree of interaction between industry and government in the experimental activities.

Nevertheless, the assessment also highlighted a number of challenges in the Canadian approach. These include:

The slow pace of development. This is largely driven by the need for DFO to process information, and for detailed fieldwork and experiments. Notwithstanding, Perry et al (2005) also note that slowing the pace of development can also bring benefits by forcing industry to take longer term views of product availability, pricing etc;

Costs. Canadian policy requires that development of fisheries be cost-neutral to government. As noted above, many Stage 1 assessments were funded through the PFARP, however with the expiry of that program, requests for assessments of potential new fisheries have slowed.

The process can be stopped at any time. That is, 'considerable investments can be made with no guaranteed return'.

Unrealistic expectations by both DFO and industry. Perry et al (2005) note that many new fisheries do not enjoy strong markets and high prices and hence are economically challenging in the establishment stages. Participants in Canada were attracted to new fisheries because of the opportunity to diversify, as well as by subsidies offered by federal and provincial governments. However when subsidies were gradually withdrawn and fishers were exposed to the full costs of new fisheries, interest waned. Perry et al (2005) also note that the "ability of industry to invest in and support the costs of (Canada's) approach ...requires a high level of organisation among proponents".

Prioritisation of DFO resources. Difficulties were experienced in prioritising DFO resources between government and industry priority species (i.e. species identified as priority species by government – those that were considered to have the best chance of supporting viable new fisheries –were not always the highest priority species for industry).

Apparent lack of success. Of the 24 species evaluated between 1997 and 2003, only one has progressed through to a fully developed fishery. However, Perry et al (2005) argue that this is not necessarily a good indicator of success in that, based on the assessments, many of the species should not become developed fisheries.

Perry et al (2005) also note that the Canadian approach requires a long-time horizon to allow for orderly development.

Case Study: Experimental approaches in the development of new species - the British Columbia Giant Red Sea Cucumber Fishery

The use of adaptive management and experimental approaches in the early stages of fishery development has long been advocated in the scientific literature (e.g. [31], [32]). The case of giant red sea cucumber fishery (*Parastichopus californicus*) in British Columbia provides a practical illustration of such approaches in proving up a small fishery. The history of the fishery and the experimental approaches applied are described in detail by Hand et al (2008)[33]. A summary of their work is provided below.

The fishery for sea cucumbers in British Columbia has operated on and off since 1971. The

[31] Walters (2007) "Is Adaptive Management Helping to Solve Fisheries Problems?" Royal Swedish Academy of Sciences, Ambio Vol. 36, No. 4, June 2007, pp. 304-307
[32] Hilborn and Sibert (1988)
[33] Hand, C. M., Hajas, W., Duprey, N., Lochead, J., Deault, J. and Caldwell, J. (2008). *An evaluation of fishery and research data collected during the Phase 1 sea cucumber fishery in British Columbia, 1998 to 2007*. Canadian Science Advisory Secretariat, Research Document 2008/065. 115pp. (Accessed at: http://www.dfo-mpo.gc.ca/CSAS/Csas/Publications/ResDocs-DocRech/2008/2008_065_e.pdf)

fishery initially went through a boom and bust phase typical of many new fisheries before increasing regulation (quota reductions, effort limitations and licence changes) were introduced progressively between 1980 and 1996. The management of the fishery is challenged by the life history characteristics of the animal, most notably that:

- There is no practical method of aging sea cucumbers;
- Rates of recruitment, growth and mortality are unknown;
- Animals are difficult to size given plasticity in body dimensions with seasons, feeding state etc;
- Juveniles are rarely observed in situ making estimation of recruitment and other parameters difficult.

The sea cucumber fishery entered Canada's phased approach to fishery development in the mid 1990s. A "Phase 0" review of all available knowledge was undertaken, knowledge gaps identified and recommendations to address the gaps made[34]. A major conclusion was that the current operation of the fishery was not providing sufficient information to allow for assessment of the impacts of the fishery on sea cucumber stocks[35].

In response, the Shellfish Pacific Stock Assessment Review Sub-Committee (SPARSC) recommended changes to the management of the fishery to support the collection of better information. This included restricting the fishery to 25% of the coast in 'static' areas to provide a time-series of data (supported by scientific surveys; a "Phase 1" fishery), and the allocation of a further 25% of coastline for experimental research. In the 'experimental 25%' of the coast, Experimental Fishery Areas (EFAs) were set up to test the response of the stock to different levels of fishing pressure. The remainder of the coast was closed to fishing until knowledge generated by fishers and the experimental fishing program was sufficient to establish a 'precautionary and sustainable fishery coastwide'.

Scientific surveys in the 'static' areas open to commercial fishing were funded by the Pacific Sea Cucumber Harvesters Association (PSCHA) and used commercial divers, with DFO staff present for each survey. These surveys, conducted every four years, aimed to map densities in open areas and were used to adjust the commercial TAC over time. They also aimed to track the impact on stocks from existing commercial fishing effort. As a result of this work, 'baseline' densities of sea cucumbers per meter of shoreline, used to set quotas, were revised upwards from initial estimates of 2.5 sea cucumbers per metre of shoreline to 5.08 sea cucumbers per metre of shoreline. Commercial quotas were also raised.

For the experimental program, four separate EFAs were established. Each EFA was divided into five sites, comprising approximately 10km of coastline each, and subjected to differing levels of fishing pressure: harvest rates of 0%, 2%, 4%, 8% and 16% of surveyed population size respectively. Harvesting was undertaken by commercial fishers in accordance with an agreed research plan. Surveys were also undertaken of mean weights of animals in each EFA/site to gauge the impact of harvesting on mean animal size (larger animals are more desired in the market than small animals).

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[34] Philipps, A.C., and J.A. Boutillier. 1998. Stock assessment and quota options for the sea cucumber fishery. In: B.J. Waddell, G.E. Gillespie, and L.C. Walthers (eds.), invertebrate working papers reviewed by the Pacific Stock Assessment Review Committee (PSARC) in 1995. Part 2. Echinoderms. Can. Tech. Rep. Fish. Aquat. Sci. 2215:147-169.

[35] Boutillier, J., A. Campbell, R. Harbo, and S. Neifer. 1998. Scientific advice for management of the sea cucumber (*Parastichopus californicus*) fishery in British Columbia. In: G.E. Gillespie and L.C. Walthers (eds.), Invertebrate working papers reviewed by the Pacific Stock Assessment Review Committee (PSARC) in 1996. Can. Tech. Rep. Fish. Aquat. Sci. 2221:309-340.

Hand et al (2008) concluded that "the data collected from Experimental Fishery Areas have proven to be highly valuable for examining the response of sea cucumber populations to a range of harvest intensities." Modelling from the experimental program indicated that the current rate of harvest – 4.2% of biomass, which was based on analyses in neighbouring Washington State, U.S. – was conservative and that the four EFAs could sustain higher harvest rates of 5.7%, 11.4%, 11.9% and 14.4% respectively. The data generated in the EFAs was also sufficient to recommend:

- The expansion of the sea cucumber fishery throughout the remainder of the BC coast using an annual harvest rate between 3.5% and 10.3%, or a standard precautionary rate of 6.7% if unproductive, low-density areas are avoided;
- A limit reference point – 50% B0;
- An upper stock reference point – between 60% to 80% B0;
- The extension of the EFA approach to continue to the time-series as resources permit;
- The establishment of no-take reserves ('control') sites throughout the coast;
- The exclusion of high exposure, low productivity or unfishable shoreline from estimates of fishable biomass

Data also indicated that a rotational harvest strategy of commercially available areas would deliver both conservation (a fixed rotation period of three or more years results in higher average animal weight, higher spawning biomass and higher yield than does an annual harvest strategy) and economic benefits (less travel, reduced overhead costs, fewer landing sites hence less staff).

While the authors acknowledge that gaps remain in our understanding of sea cucumbers – whether stocks replenish from deeper waters, juvenile habits – the structured information provided through the experimental fishing program provided considerable information upon which to base management decisions in the fishery in a comparatively short period of time. This is particularly so when compared against the relative paucity of information provided by the preceding 25 years of fishery operation.

United States

Oregon

Oregon's approach to new fisheries is notable for its establishment of a dedicated, government-funded program to support the development of new fisheries – The Developmental Fisheries Program (DFP). Similar to Canada, the establishment of this program followed the collapse of the Pacific northwest salmon fishery. The DFP was established by the Oregon Legislature in 1993 with the aim of providing for "controlled development to encourage those who might pioneer a fishery to invest their time and energy". Under the program a limited number of permits are issued to allow for testing of commercial viability while at the same time collecting "sufficient information to: 1) understand the effects of fishing, 2) determine sustainable harvest levels and 3) determine how to minimize impacts on other marine resources." The DFP is overseen by a Board made up of stakeholders including fishers, processors and managers.

Under the program, a list of potential new target species and harvesting conditions is published 'annually' by the Board. The most recent list (2005) contains 92 species, divided into three categories: A, B and C. Species in category A are the most likely to support viable

new commercial fisheries and are subject to both limited entry arrangements (between 1 and 25 non-transferable permits) and a minimum amount of annual landings to maintain access to permits. Limitation of permit numbers is designed to provide "incentives for experimentation and information gathering by safeguarding the investment of those who explore new ideas". Category B species are those less likely to support a viable fishery and category C species are those already subject to another state of federal management plan. No developmental fisheries permits are required to harvest these species.

Each of the category A species is subject to a (brief) 'effects evaluation' which assesses the impact of the proposed new fishery target stocks and the environment, existing users as well as evaluating the ability of management agencies to control and monitor catch. "Program objectives" are also specified for each category A species which guide areas for research and information collection. Objectives for giant octopus, for example, are to:

- Develop scientific information on the stocks and life history of octopus;
- Develop understanding of the effects of harvest on marine ecosystem;
- Develop improved fishing practices and equipment to protect the ocean resources;
- Identify and protect critical marine habitat and other important biological habitats for octopus; and
- Report research findings and data during annual review.

It is worth noting however that the most recent effects evaluation and program objectives for category A species were developed in 1994.

Despite the long term presence of a dedicated, government-funded body to facilitate the development of new fisheries, there appears little evidence that this approach has proven more successful than the more passive approaches adopted in other jurisdictions; in the DFP's 16 years of existence only two species (bay clams and Pacific sardines) have transitioned from 'developing' to 'developed' under the program. Using these two fisheries as case studies, Harte et al (2008) reviewed the effectiveness of the DFP and identified a range of impediments to fishery development. These included:

- Issues with free riders (e.g. in some fisheries permit holders met minimum landings requirements to best position themselves for a windfall gain on transition to a developed fishery, but undertook no development work themselves);
- Insufficient biological information was collected in some fisheries to establish stock biomass, growth rates and optimal yield;
- Little evidence of market development for some species (e.g. bay clams).

Based on the experiences in the bay clam and Pacific sardine fisheries, Harte et al (2008) suggested five areas for improvement of the DFP (most of which could reasonably be applied to developing fisheries programs in other jurisdictions). These included the need for:

- defined operational guidelines and timeframes to transition fisheries from developing to developed;
- adequate resourcing;
- incentives for development, tailored to each fishery; and
- management flexibility, adaptability and improvisation.

They also recommended the establishment of a neutral intermediary agency, which can play a constructive role in fishery development.

At the time of writing, Oregon Fisheries were in the process of dissolving the DFP due to loss of funding and staff[36]. A re-evaluation of the program was carried out from February 2008 to June 2009 with the future of the program to be considered by the Oregon Fish and Wildlife Commission in December 2009. The review proposed to refocus the DFP on currently active developmental fisheries and identify opportunities to manage the program on an extremely limited budget[37].

Alaska

Alaska has been a centre of considerable activity in the development of new stocks in recent years, with 42 new federally-managed fisheries developing over the past decade[38]. Of these, 33 have been groundfish fisheries and 9 have been crab fisheries.

Management objectives, policies and approaches for each new fishery/species are outlined in Fishery Management Plans (FMPs)[39], developed by the North Pacific Fishery Management Council (NPFMC), under the auspices of the US National Marine Fisheries Service (NMFS). FMPs are species (e.g. groundfish, crab, etc) and area based (e.g. Bering Sea/Aleutian islands, etc). Management policies and objectives are tailored to the relevant FMP, however remain consistent with overarching national standards for fishery conservation and management outlined in the Magnuson-Stevens Act (MSA). Under the FMPs stocks are either classified as a 'target' species or 'other' (ecosystem component) species. A baseline level of information is required by the NPFMC before reclassifying a stock from 'other' species to a target species.

Alaska's fisheries legislation is structured such that, unless a specific regulation limits the take of a species, the species can be harvested without limit. As a result most new fisheries have historically been identified through routine industry catch and effort reporting. Where limits do apply, Alaska's FMPs provide for 'exempted fishing permits' to allow experimental and exploratory fishing on new stocks in accordance with an agreed research plan (similar in effect to NZ's new purpose special permits). Compensation may be offered to fishers to offset the costs of participating research surveys.

Extensive assessments are undertaken of the potential ecological risks associated with any new fishery under the Federal Environmental Policy Act and Endangered Species Act. Annual reviews of ongoing environmental performance are also conducted through Stock Assessment and Fishery Evaluation (SAFE) reports. No incentives to develop new fisheries are offered by the Government or built into management arrangements. Management costs recovered from both the harvesting and processing sectors. Research and enforcement costs are shared equally by Government and industry.

A notable feature of Alaska's approach to management is the use of 'tiers' in setting annual catch limits (ACLs – essentially TACs) and other reference points (e.g. overfishing limits, or OFLs, and acceptable biological catches, or ABCs). Tiers apply to all species irrespective of whether they are developed or developing. Under the system, stocks are assigned into one of a number of tiers based on the availability of information about the stock. In essence, better information provides for OFL and ABC levels set on a less precautionary basis. New stocks typically enter the system in the lowest (and most precautionary) tier and get elevated as more information becomes available. NMFS' experience suggests that the tiered approach to TAC

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[36]Personal Communication with Gway Kirchner, DFP Manager, Oregon Department of Fish and Wildlife, 2009
[37] Exhibit J:http://www.dfw.state.or.us/agency/commission/minutes/09/12_december/index.asp
[38] It is likely that many, if not all, of these fisheries existed prior to the last decade, however have only recently been moved into formal management arrangements.
[39] http://www.fakr.noaa.gov/npfmc/fmp/arctic/ArcticFMP.pdf, http://alaskafisheries.noaa.gov/npfmc/fmp/crab/crab.htm, http://alaskafisheries.noaa.gov/npfmc/fmp/goa/goa.htm , and http://alaskafisheries.noaa.gov/npfmc/fmp/bsai/bsai.htm

setting – where default arrangements become less precautionary as more information becomes available - acts as a positive incentive for industry to invest in new knowledge about harvested stocks. They cite as an example the Bering Sea Pollock fishery where industry contributes considerable funding over and above that provided by Government to ensure that the species is managed as a tier 1 fishery. There is an economic argument to be made that the tiered approach will encourage the most efficient use of industry and government research funds, with available resources directed towards the species/stocks where there is the highest potential benefit to cost ratio. An example of the tier structure and guidelines for new species in the Arctic Management Area is outlined in section 3 of the Fishery Management Plan for Fish Resources of the Arctic Management Area[40].

In NMFS' experience, industry structures based around fishing cooperatives have proven most successful in developing new fisheries. Fishing cooperatives act to internally limit fishing activity to available allocations and serve to avoid a 'race to fish'.

NMFS nominate two lessons from recent experience that are critical to the successful development of new fisheries, namely:

- early and thorough involvement of the industry, of others that may depend on the marine resources, and of the Council to ensure fair, efficient, and enforceable programs are developed; and
- good monitoring programs and catch accounting are essential.

Case Study: New fisheries in a changing climate: the Fishery Management Plan for Fish Resources of the Arctic Management Area

Warming ocean temperatures, changing fish stock migrations and diminishing sea ice coverage driven by climate change has led to increasing interest in recent years of the potential for new fisheries development in the Arctic region. In response, NOAA's Alaska-based North Pacific Fishery Research Council (NPFMC) has developed a new framework (the "Fishery Management Plan for Fish Resources of the Arctic Management Area") for the orderly development of emerging fisheries in U.S. Arctic Management Area (AMA - all U.S. waters between the 3nm and 200nm limits – Figure 1).

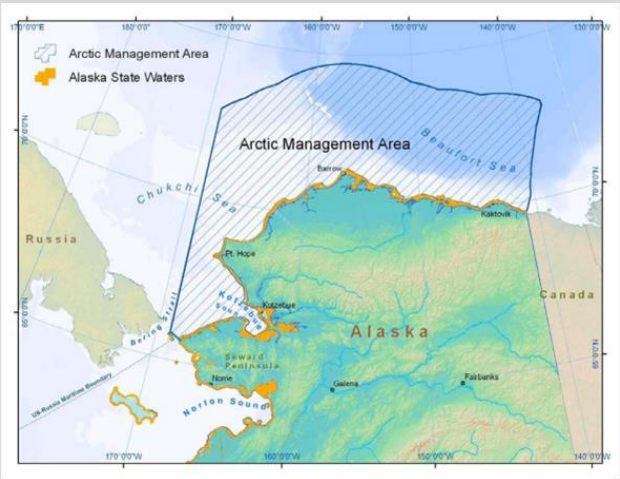

Figure 1: The U.S. Arctic Management Area (Source: http://www.fakr.noaa.gov/npfmc/fmp/arctic/ArcticFMP.pdf)

[40] NMFS, (2009). Fishery Management Plan for Fish Resources of the Arctic Management Area. 146pp. Accessed at: http://www.fakr.noaa.gov/npfmc/fmp/arctic/ArcticFMP.pdf

The NPFMC has taken a highly precautionary approach to the plan, consistent with the comparatively pristine and 'special' nature of the region. An overarching management policy for new fisheries is spelled out – "an ecosystem-based management policy that proactively applies judicious and responsible fisheries management practices, based on sound scientific research and analysis, to ensure the sustainability of fisheries resources, to prevent unregulated and poorly regulated commercial fishing, and to protect associated ecosystems for the benefits of current users and future generations" – together with a set of complementary goals and objectives (e.g. biological conservation objective, economic and social objective, vessel safety objective, etc).

Unlike the default position in the remainder of Alaska, where fisheries resources can be taken unless a regulation specifically prohibits it, the first step under the plan has been to ban all fishing unless specifically authorised. No allowance has also been made for foreign fishing in the area.

The next step was to identify potential target species. This process is based on an iterative bio-economic process involving:

- The definition of a threshold "revenue per unit effort" (RPUE) to benchmark commercial viability, based on assessments of other species in Alaska;
- Assessment of the CPUE of possible target species in the AMA using the best information available;
- Rejection of all species at the extremes of their distribution (i.e. the fishery should focus only on those species that have self-sustaining populations in the AMA);
- Computing of a 'breakeven' price for each of the remaining species necessary to achieve the threshold RPUE, and rejecting those species unlikely to meet the RPUE;
- Rejection of any remaining species for which markets appear to be non-existent.

Based on the above, only three species – arctic cod, saffron cod and snow crab – qualify as potential target species. All other species are classified as 'ecosystem component species' for which targeted commercial fishing is prohibited until information is available to support movement into the target species category.

The plan lays out the process for considering the establishment of a commercial fishery for the target species. The key element in this process is the preparation of a 'fishery development analysis' containing, amongst others things:

- A review of the life history of the target species;
- Initial estimates of stock abundance (biomass) and productivity (natural mortality);
- Evaluation of the vulnerability of any bycatch species and any ecosystem/trophic level effects;
- A plan for in-season monitoring;
- A plan for collecting fishery and survey data sufficient for a "Tier 3" assessment of the target species (i.e. reliable estimates of B, B40, F35, F40) within a defined period;
- Identification of specific management goals and objectives during the transition from unexploited stock to exploited resource; and
- Descriptions of the proposed fisheries arrangements and justifications for each.

Where this information will come from is not specified, however provision exists to allow commercial vessels to undertake experimental fishing under an 'exempted fishing permit' to undertake information collection.

The fishery development analysis is then reviewed by the Council, who may choose to initiate further reviews under the National Environmental Policy Act and/or prepare an FMP amendment specifying the proposed conditions under which a commercial fishery may operate. Based on various public and other reviews of the proposed amendments, the Council may then authorise the commencement of a commercial fishery, along with any relevant conditions (observers, additional research required, reporting requirements, etc). It is not clear from the plan whether access to the fishery would be non-transferable for a period.

Given the plan has only recently been adopted it is difficult to assess its value. Nevertheless, it represents one of the most recent attempts within the developed world to balance economic development aspirations and conservation within a potential new fishery. The need to ensure new and developing fisheries policies cater for the possibility of changes in species distributions and abundance as a result of climate change may also have wider relevance.

South Africa

Since the first democratic elections in South Africa in 1994, the South African Government has sought to provide greater access to marine resources, in anticipation of small-medium scale fishing industries providing important economic and social development in coastal areas[41]. South Africa's approach to developing new fisheries is outlined in "Policy Document: Establishment of New Fisheries in South Africa", introduced in 2006[42].

The policy outlines a range of guiding principles (e.g. ecologically sustainable use, the precautionary principle, economic feasibility, full consultation), a broad policy goal ("sustainable resource development through scientific integrity, sound management and responsible fishing") and a number of policy objectives. The operational protocol to support the policy (Figure 2: Three-phased operational protocol for the development of new fisheries in South Africa. (Source: Oosthuizen et al., 2007)Figure 2) is largely based on the 3-phase framework proposed by Perry et al. (1999)[43], incorporating information gathering, experimental fishery and commercial fishery stages. Additional elements have been incorporated to encourage participation by "historically disadvantaged individuals" in small-medium sized fishing businesses as a means of socio-economic development in coastal areas.

The information gathering stage (Phase 0) comprises four elements: (a) a desktop literature review including the identification of data gaps, (b) an optional stage of information gathering in the field using fishery-independent surveys or a small-scale exploratory fishery, (c) an economic feasibility study outlining the type of operation proposed and a basic financial and market analysis, and (d) the design of the Phase 1 experimental fishery and management plan.

The experimental fishery stage (Phase 1) aims to examine whether the species/stock exists in harvestable quantities as well as assess the impacts on target species and the environment and economic feasibility. Applicants wishing to participate in the experimental fishery must provide a work plan for the first two years of fishing, as well as meet other minimum requirements (proof of vessel ownership, previous involvement in fishing industry etc). Participants are required to provide high quality catch and effort data, provide biological samples and carry observers, generally at their own cost. Fisheries independent research may also be undertaken. Generally the experimental fishery will last four years, with annual

[41] Kleinschmidt et al. 2003 IN Oosthuizen et al (2007)
[42] Available through 'Documents' link on Department of Environmental Affairs and Tourism website (http://www.deat.gov.za/).
[43] Ibid, Perry et al (1999)

reviews of the performance of participants against their business plans, compliance with permit conditions and the like.

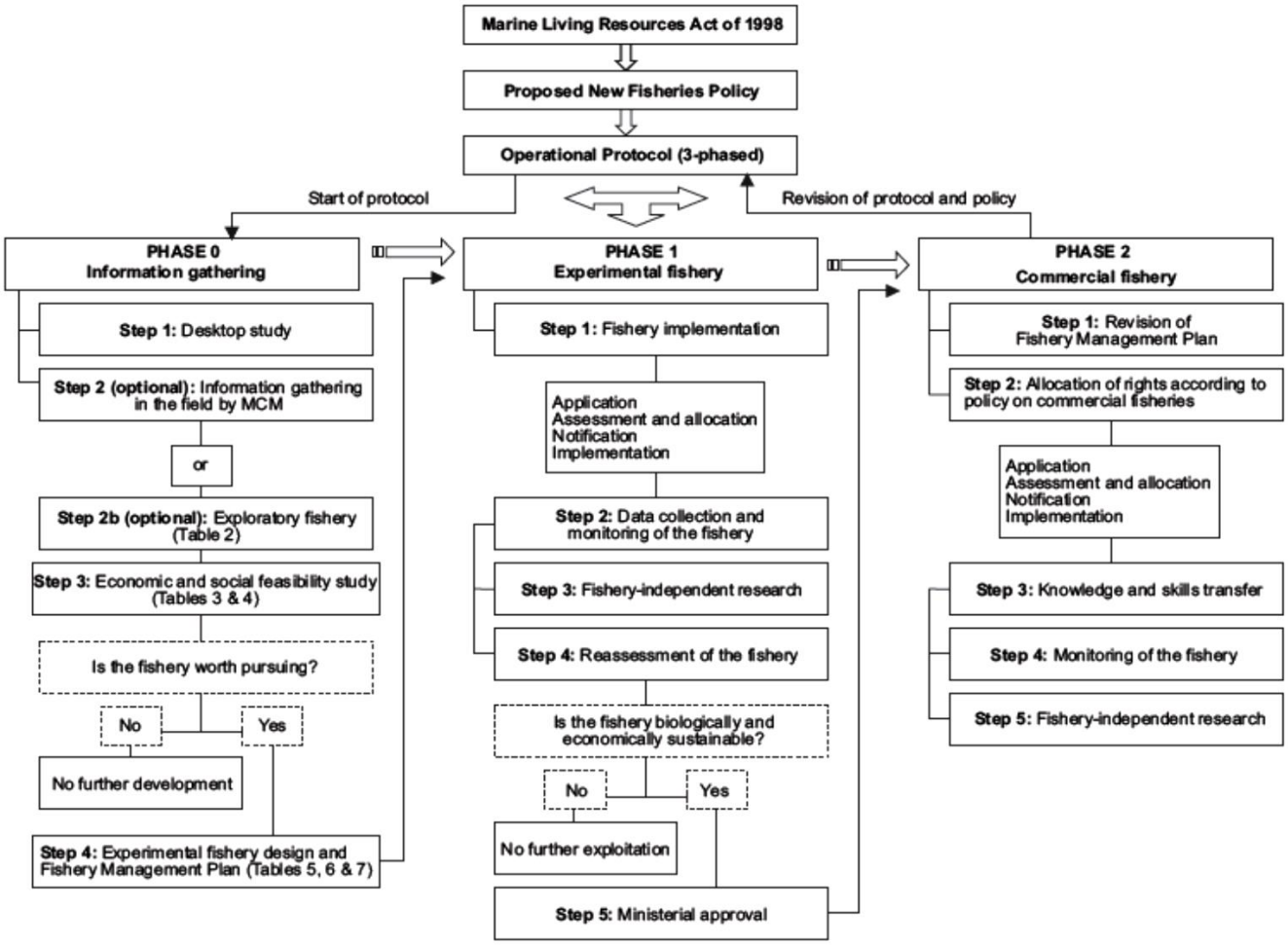

Figure 2: Three-phased operational protocol for the development of new fisheries in South Africa. **(Source: Oosthuizen et al., 2007)**

The commercial fishery stage (Phase 2) commences when sufficient information is available to set a TAC or precautionary maximum catch limit and commercial exploitation has been approved by the Minister. Transferable rights are issued at this point.

Whilst the South African example has been included here for completeness, the extent to which it has been applied and tested remains uncertain. Accordingly, limited conclusions can be made on its effectiveness. Nevertheless, Oosthuizen et al (2007) suggest that it responds to a direct need within South African fisheries for a structured, precautionary framework to guide development. They note that the absence of a structured program was an important factor in the failure of an experimental longline fishery for kingklip (*Genypterus capensis*) in the 1980's, and the more structured, precautionary approach taken in subsequent fisheries (e.g. Cape hake, *Merluccius capensis* and *M. paradoxus*) resulted in greater levels of success.

Namibia

Namibia's approach to new fishery development is outlined in their "Policy Statement on the Granting of Rights of Exploitation to Utilise Marine Resources and on the Allocation of Fishing Quotas". Although the policy applies to all new fisheries, in practice it is largely aimed at "Namibianization" of long standing fisheries following independence in 1990. Many of these fisheries had been severely overfished by foreign fleets during the previous decade/s, and the incoming government developed the policy as a part of a broader approach of 'wiping the slate clean' with existing and future fisheries. Under the new approach, all foreign licences were cancelled and the new framework for management was developed to promote both increased local participation in fisheries and a more precautionary approach to fisheries management.

Given the history of overcapacity, considerable attention is paid in the policy to capacity management. This is largely achieved by allocating individual vessel based quotas. Quotas are non-transferable except in association with the sale of the vessel, and with the approval of the Minister. Preferential rights are considered for innovative contributions to the development of the fishing industry, such as developing new products or export markets or where longer term rights are required to secure investments providing clear local and national benefits.

Although the policy provides little detail on the process of 'proving up' new stocks, some examples of fishery exploration in Namibia have been well documented in the scientific literature. The case study of the Namibian orange roughy fishery represents a sobering example of what can go wrong in the development of new fisheries, even when a logical, seemingly precautionary approach has been adopted to their development.

CASE STUDY: Things can go wrong, even when the process is right – the Namibian Orange Roughy Fishery

Boyer et al. (2001) provide a detailed overview of Namibia's experience with the rapid development and decline of its orange roughy fishery over a six year period from 1994 to 2000[44]. The crash of this fishery occurred despite the implementation of an apparently well planned and controlled management strategy and advanced research program supported by expert fisheries stock assessment scientists.

During the initial exploratory phase, catches were closely monitored and a research program launched to assess the state of the stocks, while management systems were being established. One vessel was granted the exploratory licence to explore fisheries for a number of deepwater species >700m depth. This licence was subsequently granted 50% of the total allowable catch when the fishery was opened to 4 other vessels in 1997. The exploratory company acquired catch records from eastern European companies who had previously fished in the region (targeting different species) to identify areas where orange roughy had been taken. The company also carried out surveys with side-scan sonar to identify areas of suitable habitat for orange roughy. Catches increased significantly in the 3rd year by which time the exploratory vessel had identified all areas of commercial fish abundance in the fishery. Figure 3 sets out the growth and decline of the Namibian fishery, along with other major fisheries for orange roughy elsewhere in the world.

[44] Ibid, Boyer et al. (2001)

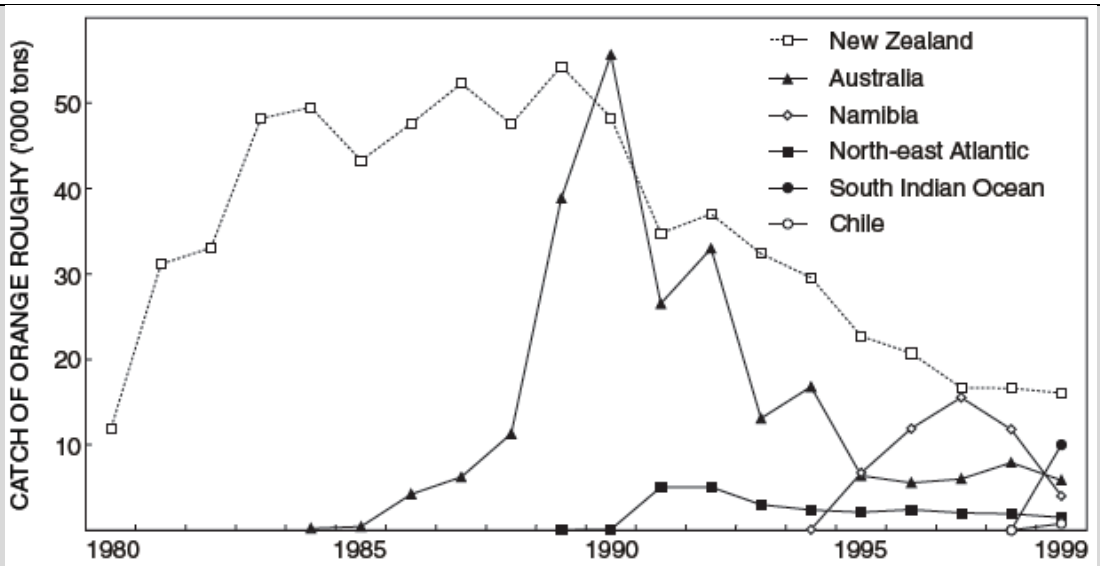

Figure 3: Growth and decline of the major orange roughy fisheries worldwide. (reproduced from Branch, 2001)

The management goal in Namibia was to fish the spawning biomass down to 50% of its pristine/pre-fished level. This was considered to be precautionary compared to targets of 30% used elsewhere[45]. However, initial stock assessments were overly optimistic and, despite limits on the number of vessels as well as the application of various aspects of precautionary management, by 1999, the aggregating biomass had dropped to 10-50% of pristine levels with the fishery in a state of collapse[46].

Boyer et al (2001) suggest the experience of the Namibian orange roughy fishery provides a number of lessons that may be applied to developing fisheries elsewhere:

- The application of advanced stock assessment models to attempt to determine precise estimates of key fishery parameters such as virgin biomass and spawning stock biomass, maximum sustainable yield and associated limit and target reference points in exploratory fisheries with limited historical catch data or biological data is generally fraught with uncertainty. Underestimating such uncertainties can mislead managers, industry and scientists when considering appropriate levels of risk to accept in regulating the development of a fishery. Requiring accurate determination of such parameters before commencing commercial fishing operations may therefore not always be prudent before suitable data is generated (through controlled fishing activities) from which to base such assessments, with acceptable levels of uncertainty. Alternative indicators and trigger points may therefore be considered more appropriate for monitoring new fisheries in their initial stages of development;
- There is a need to determine the full extent of a stock throughout the area of a fishery as quickly as possible, as well as control fishing targeting aggregations particularly where such species may be vulnerable to overfishing. In the case of Namibian orange roughy, little was known about the fish outside their aggregations, and the lack of knowledge of this component of the stock may have had severe consequences for

[45] Branch, T. (2001). A review of orange roughy *Hoplostethus atlanticus* fisheries, estimation methods, biology and stock structure. S. Afr. J. Mar. Sci. 23: 181-203.
[46] Ibid, Boyer et al. (2001)

the ability to assess abundance accurately.

- Target and limit reference points should be set conservatively in developing fisheries where there is generally much greater uncertainty in estimates of such parameters where very limited information is available to inform such parameters;
- Careful consideration should be given to the introduction of incentives to drive exploration of fishing grounds and the level(s) at which they are set to avoid effectively becoming drivers of over-exploitation, particularly when targeting potentially vulnerable species using destructive fishing gears;
- Added precautionary mechanisms may be built into quota allocations for new/developing fisheries for which high levels of uncertainty exist about stock productivity levels; and
- The effectiveness and utility of area closures may be significantly reduced when establishing a closed area after significant fishing removals have already taken place, i.e. to maximise the benefit of closed areas of a fishery, such areas should be closed from the commencement of the fishery or before any significant fishing activity occurs in those areas.

Based on the above experience, Boyer et al. (2001) recommend severely limiting catch levels until sufficient understanding of behaviour and stock dynamics allows stock-specific reference points, such as B_{MSY}, to be determined with confidence. Only then should a fishery become a fully operational commercial activity managed to attain optimal sustainable harvesting rates. This appears to be broadly consistent with the precautionary approach to new fisheries advocated in the Harvest Strategy Standard for New Zealand Fisheries.

Falkland Islands

The Falkland Islands are an Overseas Territory of the United Kingdom located approximately 400 miles off the east coast of Argentina in the south Atlantic. The revenue per unit effort (FIG) categorises new fisheries into two types based on the state of biological knowledge and/or economic development of a fishery and extent to which Falkland Islands based companies or individuals operate in the fishery[47].

New/Exploratory fisheries – i.e. those for which little is known about their biological potential - may be granted a 1-3 year exploratory licence. On expiry of the licence, the company applies for the exploratory catch to be allocated as Individual Transferable Quota (ITQ). In general, only one permit is issued for genuine new/exploratory fisheries for which little information is known about a new species[48].

In under-developed fisheries - i.e. fisheries for which the state of economic development is low and/or the level of Falkland Islander participation in the fishery is low - non-transferable provisional quota (PQ) rights owned by the Crown are issued for up to 5 years to generate catch entitlements (non-transferable) to provide a basis for future allocations. This policy is largely geared to provide for a transition of semi-established fisheries with foreign fleets to become owned or operated by Falkland Islanders.

[47] Pers. comm., John Barton, Falkland Islands Fisheries Director (2009)
[48] Pers. comm.. John Barton (2009)

In addition to a longline fishery for Patagonian Toothfish that transitioned from experimental to developed fishery in 1999[49], one new trawl fishery (single permit) targeting grenadier (*Macrourus* spp.and *Coelorhynchus* spp.) has successfully transitioned from an exploratory licence to become an established developed fishery in the last 10 years[50].

Before the grenadier trawl fishery commenced, the FIG Fisheries Department conducted extensive swept area trawl surveys throughout the area of the fishery to determine virgin stock biomass and potential fishery yields.[51] Surveys employed the commercial vessel that was to be operating in the fishery and catches not retained for scientific purposes during the surveys were sold to supplement the costs of carrying out this work[52]. In setting initial catch limits, the FIG accepted a 30% chance that total allowable catches may be exceeding the maximum sustainable yield.

These surveys also provided important data on bycatch with Toothfish (*Dissostichus eleginoides*) the main potential bycatch species in the Grenadier fishery. Surveys found toothfish catches increased with depth and the grenadier fishery was subsequently restricted to fishing grounds less than 900m depth. Important areas of deepsea corals were also found during the trawl surveys, which were also closed to trawling. Tori lines were also trialled during surveys and found to be highly effective in reducing seabird bycatch, and hence were made mandatory.

Consultees from the Falkland Islands highlighted the importance of ensuring a clear system is in place to control entry of vessels into exploratory fisheries as an important pre-requisite to success in the grenadier fishery, as well as the highly collaborative nature of the scientific surveys prior to the fishery commencement. The key obstacle was the high cost of scientific surveys. They also noted caution should be exercised in the presentation of preliminary survey results to the industry before proper stock assessment has been conducted, given the potential to generate excessive expectations about possible catches.

The European Union

No specific policy or framework exists for the management of new fisheries in EU member waters. Under EU arrangements, unless a specific regulation prohibits the take of a particular species, industry is able to exploit it at any stage. Historically, this has meant that the management of new fisheries has been reactive. Some discussion has taken place within the context of Common Fisheries Policy reform about reversing this default position, however no change has yet occurred. This is likely driven by the fact that the emergence of new fisheries is rare, with most fisheries in EU EEZs fully exploited and regulated[53].

Where the emergence of a new fishery is detected through routine industry catch and effort reporting, member states may choose to introduce regulation on their own fleets, or the EC may introduce Commission measures. Emergency provisions are also available to limit exploitation until regulation is in place.

No staged or phased approach to new fishery development occurs, and likewise, no formal process of stock or environmental impact assessment is in place prior to the establishment of a new fishery. There is also no formal transition between a "developing" and "developed"

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[49] Falkland Islands Government, (2009). Fisheries Department Fisheries Statistics, Volume 13, 2008: 72 pp Stanley, FIG Fisheries Department

[51] Pers comm., Ignacio Paya, Senior Stock Assessment Scientist, Fisheries Department, Falkland Islands Government, 2009

[52] Pers. comm., John Barton, Falkland Islands Fisheries Director

[53] Pers. comm., Dr Poul Degnbol, Scientific Adviser, European Commission

fishery. Data collection arrangements for new fisheries are the same as those for developed fisheries, and subject to the EC's data collection framework. There are no requirements for fishery-independent surveys.

EC consultees were unable to nominate any case study fisheries to illustrate the EC's approach to new fisheries, however they drew attention to the expansion of the deep sea fisheries two decades ago which initially occurred uncontrolled and has, ever since, been difficult to 'roll back'.

CCAMLR

The Convention on the Conservation of Antarctic Marine Living Resources (CAMLR Convention) was established under the Antarctic Treaty System to manage the marine living resources of the Southern Ocean south of the Antarctic Polar Front (c. 45ºS). The CAMLR Convention's precautionary and ecosystem approach[54] mandates regional management of Antarctic fisheries. The Commission set up under the CAMLR Convention (CCAMLR) therefore largely manages high seas resources while recognising the rights of coastal States with territory in the CCAMLR Area to manage fisheries in their waters in harmony with the CAMLR Convention's objectives. It has developed a robust approach to the development of new and exploratory fisheries to ensure that adequate information becomes available to evaluate the fishery potential of targeted stocks or the potential impacts on the target stocks of species dependent on them. This approach has been enshrined in two CCAMLR Conservation Measures (CMs) – CMs 21-01 and 21-02[55].

The development of CCAMLR fisheries is outlined in Figure 4. In CCAMLR terms, a 'new' fishery is one for a species and/or on a ground that has not previously been fished, or for an established fishery where there is an intention to use a new fishing technique. There is a requirement at the 'new' fishery stage to collect information on the target as well as dependent species. Catch or effort (or both) may be limited at this stage of development. A 'new' fishery is deemed to last one year. If no catch is taken, the fishery effectively retains its classification as "new" and requires a further notification that the fishery is being considered as a new fishery under CM 21-01 until such time that catch and effort data have been submitted to CCAMLR.

Once catch and effort information has been provided for a new fishery (i.e. in the second year after the commencement of a new fishery), the fishery is classified as an 'exploratory' fishery under CM 21-02. This phase allows for "continued regulation of the fishery while the scientific information required for its full assessment and an assessment of the stock(s) concerned is being collected"[56]. To support this, CCAMLR-designated, international scientific observers[57] are required to collect data in accordance with a Data Collection Plan (DCP). Provision and implementation of a Fishery Operations Plan is also required. Specific measures have also been promulgated to manage exploratory fisheries for particular species (i.e. CM 41-01 for Toothfish) and these not only detail DCPs, but also Research Plans (RPs) and tagging requirements if necessary. All such plans are reviewed annually by the Scientific Committee (SC-CAMLR). CCAMLR scientific observer coverage is set at 100% for all finfish fisheries. As a general principle, a precautionary catch limit is set for all exploratory fisheries to ensure that catches are not substantially over that necessary to obtain the information specified in the

[54] Miller, D.G.M. and de la Mare, W.K. Application of the precautionary approach – new and exploratory fisheries. In Understanding CCAMLR's Approach to Management", accessed at http://www.ccamlr.org/pu/E/e_pubs/am/toc.htm)
[55] Accessible at: http://www.ccamlr.org/pu/e/e_pubs/cm/09-10/toc.htm.
[56] Ibid, Miller and de la Mare
[57] The CCAMLR Scheme of International Scientific Observation is available at: http://www.ccamlr.org/pu/e/e_pubs/cm/09-10/obs.pdf

DCP[58] or fulfil the requirements outlined in Footnote 52 below. CCAMLR exploratory fisheries are thus managed with the key aim of ensuring that fisheries are not allowed to expand faster than the collection of information required to manage them in a manner consistent with the objectives outlined in Article II of the CAMLR Convention.[59]

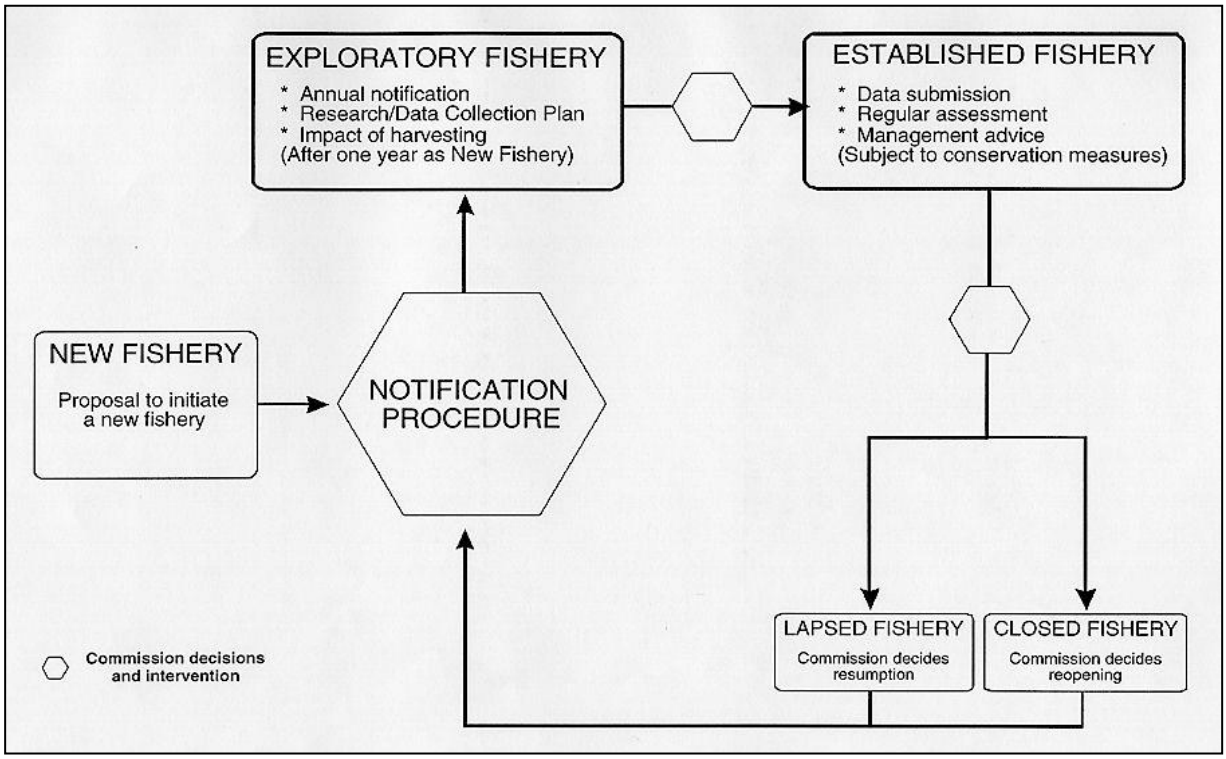

Figure 4: CCAMLR's process of new fishery development indicating Commission decision points. Note in practice that the notification procedure occurs before a new fishery is established. (reproduced from "Understanding CCAMLR's Approach to Management", accessed at http://www.ccamlr.org/pu/E/e_pubs/am/toc.htm)

The exploratory fisheries approach adopted by CCAMLR has been one of "no surprises" and its basic principles (particularly the need for prior notification) have been recently (2006) adopted for krill fisheries (CM 21-03). From, 2008 (CM 51-04), the general requirements for exploratory finfish fisheries have been applied to krill.[60]

The above approach has facilitated the collection, by the fishery, of valuable data and information necessary for the sustainable management of target resources. The objective accrual of such data has been largely attributable to the deployment of independent scientific observers, application of prescribed DCPs and RPs.

Tagging requirements for the study of Toothfish, and recently Skate, population demographics (CM 41-01, Annex 41-01C) have been in place for exploratory fisheries since the 2003/04 season. These requirements have been augmented by fine scale catch and effort reporting

[58] Ibid, Miller and de la Mare
[59] CAMLR Convention Article II essentially states that, (i) exploited populations shall not be allowed to fall below a level close to that which ensures their greatest net annual increase, (ii) ecological relationships between harvested, dependent and related species shall be maintained and depleted populations shall be restored to the levels defined in (i); and (iii) risks of changes to the marine ecosystem that are not potentially reversible over two or three decades shall be prevented or minimised. In this respect, paragraph 1.(ii) of CM 21-02 applies (see discussion below).
[60] Pers. comm., Dr Denzil Miller, Executive Secretary, CCAMLR

obligations (e.g. CMs 23-04), which in some cases are required daily (CM 23-07). They have also benefited by distributing catch and fishing effort through rigorously designed sampling protocols.[61] Such scientifically directed fishing in specific areas (Small Scale Research Units - SSRUs)(CM-41-01, paragraphs 41-01.(2), Table 1 and Fig. 1) has not only enhanced available knowledge it has tended to avoid the concentration of catch and effort.

Like other CCAMLR fisheries, new and exploratory fisheries have been subject to general environmental protection measures since 2006 (CM 26-01). In CCAMLR Subareas 88.1 and 88.2 (see Case Study below), the specific provisions of such measures prohibit dumping and the discharge of oil, offal, fisheries discards and poultry products (CM-26-01, paragraph 5.) Other environmental protection measures include the mitigation of fishing impacts on Vulnerable Marine Ecosystems (CMs 22-06 and 22-07), as well as on incidental mortality of seabirds and mammals (CMs 25-02 and 25-06) during longline and trawl fishing in the CAMLR Convention Area. In the Ross Seas, a trigger limit of 3 seabirds has been set (CMs 41-09 and 41-10, paragraphs 7) whereafter vessels are required to resume night setting of longlines in accordance with CM 25-02.

The transition from a CCAMLR 'exploratory' to 'established' fishery is essentially contingent on information availability. Under CM 21-02 (1.ii), fisheries continue to be managed as 'exploratory' until sufficient information is available:

- to evaluate the distribution, abundance and demography of the target species, leading to an estimate of the fishery's potential yield;
- to review the fishery's potential impacts on dependent and related species;
- to allow the Scientific Committee to formulate and provide advice to the Commission on appropriate harvest catch levels, as well as effort levels and fishing gear, where appropriate.

To date, no fisheries have been deemed to have met these information requirements[62].

While generally regarded as a world-leading example of ecosystem-based and precautionary fisheries management, the CCAMLR approach has not been without some difficulties. These have included[63]:

- inconsistent levels of information provided with notification proposals for new/exploratory fisheries. This has been resolved by developing standardized notification forms;
- problems associated with a lack of definitive information on the commercial viability of fisheries, including threshold catch levels to maintain economic viability. Equally, clarity has not been forthcoming on how much information is necessary to support acceptable assessments of stock yields in terms of their commercial viability and biological sustainability. Optimally, CCAMLR has strived to balance its setting of precautionary catches for new and exploratory fisheries in a way that neither of these two considerations is violated. However, the emergence of a substantial illegal, unreported and unregulated fishery for Toothfish in many parts of the CCAMLR area has substantially compromised this approach, particularly in the Subantarctic Indian Ocean[64], and

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[61] Pers. comm., Dr Denzil Miller, Executive Secretary, CCAMLR
[62] Pers. comm., Dr Denzil Miller, Executive Secretary, CCAMLR
[63] Pers. comm., Dr Denzil Miller, Executive Secretary, CCAMLR
[64] Miller, D.G.M. 2007. Managing fishing in the Sub-Antarctic. *Papers and Proceedings of the Royal Society of Tasmania,* 141.(1): 121-140.

- The absence of clear decision rules, or agreement, on when a notification for a new, or exploratory, fishery does not meet all the necessary requirements and should therefore not be allowed to go ahead.

The case study below describes the practical application of the CCAMLR developing fisheries framework to the Ross Sea Toothfish fishery.

Case Study: Harnessing the information collection capacity of the fishing fleet: The Ross Sea Fishery for Antarctic Toothfish (*Dissostichus mawsoni*)

CCAMLR's exploratory longline fishery for Antarctic Toothfish (*Dissostichus mawsoni*) in the Ross Sea (Statistical Subareas 88.1 and 88.2 – Figure 5) has operated between November and April each year since 1997/98.[65] Initially a New Zealand only fishery, this fishery now operates under competitive catch limit with 21 vessels from nine countries entitled to access the fishery.

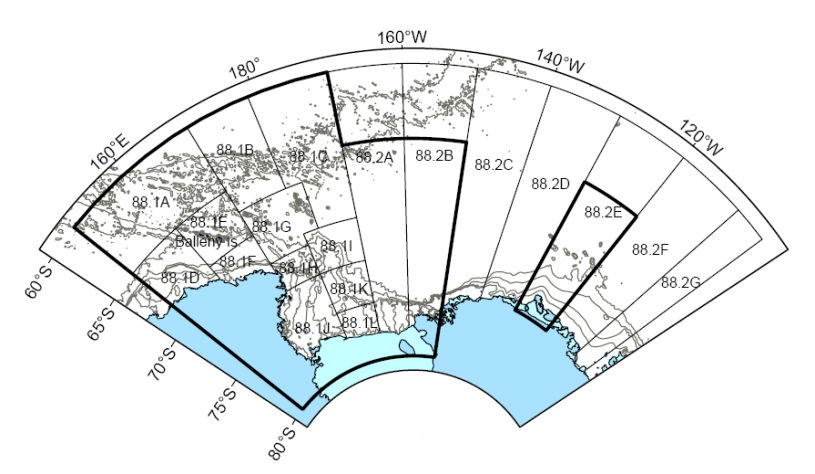

Figure 5: The area of the Ross Sea Fishery within CCAMLR Statistical Subareas 88.1 and 88.2.
(Source: CCAMLR, 2007 Fishery Reports)

Table 3 below shows the historical catch limits set for the fishery. Whilst catch limits are now based on advanced stock assessment modelling, initial catch limits were set on economic, rather than, biological grounds – i.e. at levels sufficient to support a viable commercial fishery, attract participants and promote exploration[66]. In these early years catch limits far exceeded actual catches with TACs geared to attract more vessels into the fishery.

[65]Fishery Report: Exploratory fishery for *Dissostichus* spp. in Subareas 88.1 and 88.2. (accessed at http://www.ccamlr.org/pu/e/e_pubs/fr/drt.htm)

[66] CM 112/XV, 1996/97 (accessed at http://www.ccamlr.org/pu/e/e_pubs/cm/96-97/112-xv.pdf)

Table 3: Catch history for *Dissostichus* spp. in Subarea 88.1. Reported catch includes catch from research fishing. **(Source: 2008 Fishery Report)**

Season	Regulated fishery						Estimated IUU catch (tonnes)	Total removals (tonnes)
	Effort (number of vessels)		*Dissostichus* spp.					
			Catch limit (tonnes)	Reported catch (tonnes)				
	Limit	Reported		*D. eleginoides*	*D. mawsoni*	Total		
1996/97	-	1	1980	0	0	0	0	0
1997/98	-	1	1510	1	41	42	0	42
1998/99	2	2	2281	1	296	297	0	297
1999/00	-	3	2090	0	751	751	0	751
2000/01	6	10	2064	34	626	660	0	660
2001/02	10	3	2508	12	1313	1325	92	1417
2002/03	13	10	3760	26	1805	1831	0	1831
2003/04	26	21	3250	13	2184	2197	240	2437
2004/05	21	10	3250	7	3098	3105	23	3128
2005/06	21	13	2964	1	2968	2969	0	2969
2006/07	21	15	3072*	12	3079	3091	0	3091
2007/08	21	15	2700	6	2253	2259	187	2446

* Includes 40 tonnes for research fishing (CCAMLR-XXV, paragraph 12.56).

Conservation measures in the early years were structured to spread fishing effort over as large a geographical and bathymetric range as possible, in order to maximise information collection to determine the potential of the fishery and to avoid over-concentration of catch and effort. Nominal catch limits were initially set for target and bycatch species in each small scale research unit (SSRU), with an initial restriction of one vessel operating in any SSRU at any one time. Some SSRU's are closed (e.g. CM 41-09, paragraph 2) with catch limits set at zero to effectively serve as "no take" areas within the fishery.

All vessels in the Ross Seas exploratory fishery are required to carry third-party scientific observers under the *CCAMLR Scheme of International Scientific Observation* and to fish in accordance with the DCPs outlined in CM 41-01 Annex 41-01A. A pre-agreed data collection plan is also required. Initially the implementation of research plans capitalised on the information collection capacity of the fleet, including for example, requirements to conduct 10 'research sets' upon first entering a new SSRU, before resuming normal fishing operations in that SSRU. Research sets required vessels to set their first 10 lines at least 10 nm (now 5nm) apart and record additional data on catches (CM 41-01, Annex 41-01B). However, from the 2008/2009 season, the fisheries in the Ross Sea have no longer been required to implement fisheries research plans[67].

Post-2007, the Ross Sea fishery has developed to the point where advanced stock assessment models are used to derive sustainable catch levels. However, the fishery is still managed as an exploratory fishery due to uncertainty attached to its full potential and sustainability.[68] Continuing to operate the fishery under exploratory management arrangements also enables CCAMLR to closely monitor and control the fishery's development in accordance with CM21-02 as well as to apply a high level of precaution to account uncertainties in stock projections.

[67] Pers. comm. Denzil Miller, Executive Secretary, CCAMLR
[68] Pers. comm. Denzil Miller, Executive Secretary, CCAMLR

Catch limits for the Ross Sea Toothfish fishery are now set on a highly precautionary basis. In the 2007/08 season these limits were 2,700t for Subarea 88.1 and 547 for Subarea 88.2. The limits were derived under a decision rule that, provides less than a 10% chance of the spawning stock biomass dropping to less than 20% of its initial level.[69] For 2009/10, the catch limits stand at 2850 tonnes (Subarea 88.1) and 575 tonnes (Subarea 88.2). Both Subareas are subject to effort limitations which restrict the number of vessels permitted to fish for each nofiying CCAMLR member (e.g. CM 41-09, paragarph 1).

Whilst the status of toothfish in the Ross Sea remains uncertain, models estimate current spawning stock biomass (B2007) at 82% of virgin biomass (95% CI 78–85%), indicating that the fishery has remained in good health during its first 10 years of operation.[70] As already indicated, CMs 41-09 and 41-10 detail the current management arrangements and catch limits for each SSRU in subareas 88.1 and 88.2.

Economically, the seasonal Ross Sea fishery now provides an important component of the annual work programs for many vessels operating in multiple fisheries (e.g. Toothfish in South Georgia and Heard and McDonald Islands and NZ Ling Cod). In this respect, the economic burden of commercial viability for vessels operating in the Ross Sea is shared between a number of similar fisheries in different jurisdictions, both within and outside the CAMLR Convention Area.

Important lessons of wider relevance in the Ross Sea case study highlight: (a) the benefits of harnessing the information collection capacity of the fishing fleet, particularly in the early stages of fishery development, to support management goals (e.g. robust stock assessments), and (b) the value of providing incentives for information collection (catches set at levels that allow commercial viability of the fishing operations being undertaken).

[69] CCAMLR, 2007. Fishery Reports 2007. Appendix I - Fishery Report: Exploratory fishery for *Dissostichus* spp. in Subareas 88.1 and 88.2. 29pp.

[70] Ibid. CCAMLR, 2007.

Table 4: Summary analysis of international approaches to new fishery development against commonly used policy features.

Jurisdiction	Number of new fisheries in past 10 yr	Dedicated policy/ framework for new fisheries	Phased approach to development	Assessment of risk to target species prior to exploratory fishing[a]	Assessment of risk to environment prior to exploratory fishing[a]	Exploratory fishing using non-transferable (NT) or transferable (T) rights	Dedicated research/ data collection plan[b]	Further development of fishery linked to acquisition of new information[c]	Full cost recovery	Recognition of rights of pioneers	Dedicated government assistance for new fisheries[d]	Minimum participation requirements
Australia												
Commonwealth	1					T						
WA	2					NT						
NT	Unknown					NT						
Queensland	Unknown					NT						
Tasmania	2					NT						
Canada	1					NT						
United States												
Oregon State	2					NT						
Alaska (NMFS)	42[e]					NT						
South Africa	Unknown					NT						
Namibia[i]	>10					NT						
Falkland Islands	1					NT						
EU	0					T[f]			[g]			
CCAMLR	0[j]					NT			[g]		[h]	

[a] empirical, in situ studies of risk undertaken prior to exploratory fishing - meets indicator; desktop assessment of risk undertaken, either by managers or applicant - partially meets indicator
[b] dedicated data collection plan incorporating research elements over and above standard logbook information - meets indicator; requirement for standard logbook information -partially meets indicator
[c] further development of fishery explicitly linked to generating new information - meets indicator; implicitly linked - partially meets indicator
[d] dedicated body to assist development of new fisheries - meets indicator; general government grants programmes that may assist - partially meets indicator
[e] uncertain whether these are truly 'new' fisheries, or pre-existing fisheries recently introduced into formal management arrangements
[f] exploration of new species undertaken using standard annual licences
[g] costs may be cost recovered by member states
[h] assistance may be provided to new fisheries by member states
[i] Namibia's case is substantially different from the other jurisdictions in that its policy is about the reallocation of resources in existing fisheries following independence
[j] No fisheries have progressed to the 'established fishery' stage, although a number are currently in the exploratory stage.

Key

- Meets indicator
- Partially meets indicator
- Does not meet indicator
- Not applicable

Approaches in the scientific literature:

In addition to national policies and practical examples, a number of different approaches to new fishery development are advocated in the scientific literature. A summary of papers that argue specific approaches to prove up new fisheries is included below.

Perry et al (1999)

Perry et al (1999) propose a framework for the provision of scientific advice for the management of new and developing fisheries that has been frequently used internationally and has been adapted to form the basis of the Canadian and South African national policies[71]. The framework explicitly endorses the precautionary principle and is based on three phases:

- 'Phase 0' – Collecting existing information

In this stage, all available existing information on the biology of the target species is collected. This should include information on similar species from the same area to be fished and similar species fished in similar areas elsewhere. If possible, formal analyses may be undertaken to estimate distributions for growth rates, natural mortality rates, catchabilities and maximum annual reproductive rates. The other main task in this stage is to identify possible approaches to regulating the fishery based on the accumulated information.

- 'Phase 1' – Collecting new information

The purpose of this stage is to collect new information to fill gaps identified as well as test alternative management approaches identified in Phase 0. Particular objectives should be to define the unit stock, determine spatial patterns and density and natural mortality. Evaluations of alternative management strategies should 'develop the regulatory conditions under which a fishery might take place' (p137).

- 'Phase 2' – Fishing for commerce

In this stage, management strategies developed in Phase 1 are implemented and data gathered during fishing to refine scientific information. The key scientific tasks are to design and implement a detailed monitoring system and to evaluate the effects of fishing.

In proposing this framework, Perry et al (1999) specifically highlight the need for reserve areas in new fisheries to buffer against the uncertainties of fisheries data and the implementation of ineffective management regulations, as well as providing control areas for ecosystem functioning. They also highlight a number of factors critical to the success of their framework and the ongoing management of developing fisheries, including:

- Identifying appropriate spatial scales for the assessment and management of new fisheries;
- Ensuring a high degree of interaction between scientists, managers and stakeholders;
- Ensuring management options chosen are commensurate with the high degree of uncertainty associated with developing fisheries.

Miller (1999)

Miller (1999) presents an alternative to the highly precautionary approaches to new fishery development advocated in much of the fisheries literature.

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[71] Ibid, Perry et al (1999)

During Phase I he recommends fishers be given the opportunity to demonstrate commercial viability with "minimal interference" through management restriction. This allows them to explore options of fishing locations, seasons, and gear types. The few controls needed during Phase I - described by Miller as "avoidance regulations" - include the need to:

- Avoid interference with established fisheries;
- Avoid the perception of major environmental impact;
- Avoid the rapid accumulation of wealth to ease demand for uncontrolled expansion of the fishery; and
- Avoid new fisheries targeting foraging species "or be prepared for a fight".

Phase I ends when the fishery has demonstrated commercial viability. Once the availability of a resource and markets has been demonstrated, Phase II should explore the full extent of the resource and develop appropriate regulations for the fishery. At this point, Miller encourages fishers to form a fishers' organisation and start to participate in the decision making process for the management of the fishery.

Miller (1999) argues that introducing catch quotas at this stage is counter-productive due to their indirect functions of increasing competition between fishers and encouraging them to concentrate efforts in the best areas. Seasonal closures are also discouraged, except where necessary to avoid user conflicts, to enable more information to be gathered for a future management plan.

A number of important regulations are however emphasised, including the need to:

- Ensure systems are in place to provide accurate records of all fish removals from the fishery (including recreational fishers, bycatch, poaching etc)
- Introduce fishing logbooks to provide accurate data on spatial distribution of catches and effort.
- Introduce experimental fishing approaches to require *fishing efforts to be distributed across the whole area of the fishery* where the stock is likely to be found.
- Implement *"use-it-or-lose-it" licence conditions* to require fishers to sell a minimum weight of catch each year to drive development of the fishery and discourage fishers accumulating licences for resale.
- Consider the impacts and complexities in the *management of gears* being used in the fishery and the possible need to introduce future gear restrictions and/or initiate directed research efforts to more accurately assess fishing gears.
- Regulate *fishing power per vessel* to a level between that required to break-even and a comfortable profit margin, providing appropriate incentive for fishers to improve efficiency with their methods, i.e. fishing smarter rather than harder.

By the end of Phase II, Miller (1999) argues that "fishers should have an organisation, and should be accustomed to providing data to develop a management plan, and be gaining experience in choosing among management options. The geographic extent of the resource should be known, as well as the spatial and seasonal variation in catch rates. Total catch from the fishery can be accurately estimated. Choices of gear type have been settled. Conditions onboard vessels ensure high quality product is landed and the range of income per unit of fishing effort is known".

After establishing that the fishery may have a future, the focus of Phase III is for further development of the long-term management regime through biological studies, adjust fleet size

if necessary, determine conservation objectives and fine tune regulations. Determination and implementation of a logically robust and inexpensive monitoring program must also be achieved early in Phase III.

The time required to complete Phases I to III may vary greatly, with Miller (1999) suggesting three years of dedicated effort as a minimum to complete Phases II and III. The development phase is complete with a long-term management plan in place.

The key function of Phase IV is to review the management plan as new information becomes available. Miller (1999) also stresses the importance of maintaining vigilance on the quality of landing statistics and monitoring of other stock indicators during Phase IV.

Hilborn and Sibert (1988)

Hilborn and Sibert (1988) argue for the use of adaptive management approaches in developing fisheries. They note that traditional fisheries management has aimed at achieving an optimal fleet size and fishing effort at MSY – the "mountaintop" as the authors call it – and regimes for developing fisheries have typically been designed to achieve a gradual build up of effort to the optimal level. However, optimal fishing effort can rarely be predicted until the fishery has exceeded its optimal size and sustainable catch, resulting in the need to reduce catches and revenues (the typical 'boom and bust' scenario). This uncertainty about predicting 'optimal' catch and effort is further complicated by the naturally dynamic nature of fish populations.

To counter these typical trends, these authors advocate the use of adaptive management approaches, together with stock assessment methods based on the principles of scientific experimental design. In relation to adaptive management, they argue that the key challenge in the early stages of fisheries development is not determining what the optimal catch is, but to put in place an adaptive measurement and response system that allows managers to track "the moving mountaintop and maintain an economically viable fishery in the process". Such a system should comprise (a) 'a monitoring system to measure efforts and catches and try to estimate the current status of the stock and its underlying production relationships" and (b) "a response system that enables us to increase or decrease effort as required to track the moving biological and economic variables". Monitoring systems should collect economic, as well as biological, data since the success of management actions 'will depend as much on economics as biology'. We note that most of these requirements – except perhaps the collection of economic data during early fisheries development - are met under the NZ's existing system of fisheries management.

On the use of experimental techniques in stock assessment, they note that most fisheries are spatially structured to some extent and that if some portions of the stock are "deliberately overfished as quickly as possible" while others are preserved in a lightly fished state (to serve as controls) a number of benefits can be gained:

- "Assessment of how the stock will respond to fishing will be more rapid, because the heavily exploited areas will provide information on what types of yields are sustainable and what symptoms appear as exploitation increases long before most fishing areas are being heavily exploited"; and
- "Lightly fished areas can serve as a reserve, where fishing effort could be directed when fishing pressure needed to be reduced in major fishing areas".

While we have been able to identify few examples in which these techniques have been applied in practice, some apparently successful examples do exist – see the British Columbia giant red sea cucumber case study.

Conclusions

The existence of a clear government policy/framework for new fishery development is valuable.

One of the most common pre-requisites to success in the development of new fisheries nominated by the jurisdictions surveyed was the presence of a clear, structured framework to guide development. Perry et al (2005) argued a range of benefits from Canada's framework including ensuring a common understanding of procedure and processes amongst all stakeholders and allowing industry to plan development activities with confidence.[72] Conversely, Harte et al (2008) identified the absence of defined operational guidelines and timeframes as an important failing of the Oregon DFP[73], and Oosthuizen et al (2007) noted the lack of a structured framework was an important factor in the collapse of the experimental kingklip fishery in South Africa[74].

Most jurisdictions take a staged approach to new fishery development

Of those developed-world jurisdictions with dedicated policies for the development of new fisheries, most take a staged or phased approach (e.g. Canada, Sth Africa, Western Australia). Frequently the first stage is an information collection exercise with all available knowledge both locally and from like fisheries elsewhere collated to provide a desktop assessment of potential risks to target stocks and the broader environment (see for example, Perry et al 1999 for a suggested list of information required). The second stage often involves a period of exploratory fishing or surveys that attempt to address important knowledge gaps identified during stage 1. The approach to this stage varies considerably between jurisdictions with some using purely fishery-dependent data – i.e. authorising a limited number of fishermen to fish and then analysing the catch and effort data (e.g. Western Australia), some using a hybrid approach that allows a limited number of industry participants to fish commercially, though in accordance with a pre-agreed research plan (e.g. CCAMLR), and others adopting fully fishery-independent approach based on scientific surveys (e.g. some Canadian fisheries). It is worth noting that those using the latter approach have identified the costs involved as a significant impediment to new fishery development (e.g. Perry et al, 2005). The final stage is the transition to a 'developed' fishery. This is typically characterised by the allocation of transferable rights, the development of a formal management plan and some form of ongoing TAC/E setting process.

Most jurisdictions undertake the developmental stages of new fisheries in an environment of non-transferable, temporary rights.

Of the jurisdictions with dedicated policies and approaches to the management of new fisheries, most undertake the developmental stages in an environment of non-transferable, temporary rights. Most frequently this is by way of annually renewable permit or licence, often linked to performance measures such as minimum landings (e.g. Australian Commonwealth, Oregon) or catches in accordance with a pre-agreed business plan (e.g. Western Australia, South Africa). The use of non-transferable temporary rights offers a number of advantages in the early stages of a fishery including:

- Acting to prevent overcapitalisation and overfishing, particularly when coupled with a legislative framework that prevents the harvest of a species unless in accordance with

[72] Ibid, Perry et al (2005)
[73] Ibid, Harte et al (2008)
[74] Oosthuizen et al (2007)

an approved licence or permit (many jurisdictions have the reverse structure in their legislation – i.e. a species can be harvested unless a specific measure prevents it);

- Allowing the fisheries agency some control over the pace of development through minimum landings provisions and the like. (This is important where the agreed jurisdictional goal is to develop new fisheries since it ensures those with permits take active steps to develop the fishery);
- Avoiding the allocation of permanent, transferable rights in a fishery that may prove to be non-viable in the long-term (this is particularly important in jurisdictions where cost recovery arrangements have not been bedded down by avoiding committing fisheries agencies to resource 'basket-case' fisheries).
- Allowing a clear demarcation between 'developing' and 'developed' fisheries for policy and other purposes.

By contrast, the majority of New Zealand's stocks showing development potential are already managed under the QMS – i.e. in an environment of permanent, transferable rights. While both systems can be used effectively to prevent overfishing and overcapitalisation, the use of permanent, transferable rights early in the development cycle has important implications. These are discussed further in Chapter 4.

Most jurisdictions link the further development of new stocks to the acquisition of knowledge

In most jurisdictions the progression of a new stock through the various phases of fishery development is linked either explicitly or implicitly to the acquisition of new knowledge. The Australian Government's new Harvest Strategy Policy for Commonwealth Fisheries, for example, requires managers to link *"any increased development allowances to further data analysis and knowledge"*, while the tiered approach to TAC setting used by NMFS in Alaskan (and other) fisheries reduces the default 'precautionariness' around new stocks as more information is available. Likewise, progression from an 'exploratory' to 'established' fishery under the CCAMLR system is contingent on information availability. This linkage of fishery progression with the acquisition of new information provides a potent incentive for private investment in scientific and other surveys of new stocks, particularly when the 'pay-off' is the allocation of permanent, transferable access rights, and is consistent with the precautionary approach to fisheries management[75].

There is benefit in a high level of interaction between fisheries managers, scientists and industry in the early stages of fishery development.

A number of jurisdictions surveyed nominated a high level of interaction between stakeholders – most notably the industry proponents of the new fishery, fisheries managers and scientists – as a prerequisite to the successful development of new fisheries. Perry et al (2005) noted the direct involvement of industry proponents in experimental activities as a benefit in the Canadian approach, while Harte et al (2008) point to a lack of interaction as a key reason for the absence of success in new fisheries development in Oregon. A high degree of interaction ensures a common understanding of each other's needs and constraints – managers and scientists are aware of industry's commercial pressures and imperatives, while industry gains a better appreciation for the legislative and policy drivers influencing managers and scientists – as well as encouraging responsiveness to new information. This is particularly in new

[75] Garcia, S.M. (1994) The precautionary principle: its implications in capture-fisheries management. *Ocean and Coastal Management*. 22: 99-125.

fisheries where the information base may be changing rapidly. A high degree of interaction may also facilitate trade-offs and efficiencies that results in benefits for both parties – e.g. managers agreeing to slightly higher catches as long as they are taken in accordance with an agreed research plan.

Adaptive management strategies can play an important role in new fisheries development.

The bulk of new fisheries are based on species for which knowledge of key biological parameters such as stock size, natural mortality, resilience to fishing pressure and MSY are largely unknown. In many historical cases, parameters such as MSY have only been identified retrospectively well after MSY had been exceeded in practice (e.g. Australian orange roughy). Adaptive management approaches, incorporating the principles of scientific experimental design, have long been advocated in the scientific literature as a means of comparatively rapidly and safely identifying the parameters above. Hilborn and Sibert (1988) argue, for example, that deliberate overfishing of small portions of new stocks (while retaining other areas in a lightly exploited state to act as controls) can provide valuable insights into how a stock will respond to heavy fishing pressure, without the need to apply pressure to the whole stock. While true adaptive management approaches appear to have been applied in practice in only a handful of new fisheries worldwide, some of the initial results are encouraging (see British Columbia giant red sea cucumber case study).

There is a need for adequate cost recovery.

One of the most common impediments to the development of new fisheries amongst the jurisdictions surveyed for this study is a lack of dedicated resources within management agencies. Most fisheries agencies in developed world jurisdictions have a (often large) suite of already established fisheries that come with their own challenges and resourcing needs. These fisheries are frequently larger, more valuable and more socially and politically important and new fisheries struggle to compete in agency resourcing rounds. This disparity has probably only increased with the advent of the precautionary principle, EAFM and an increasing community consciousness of the need for sustainable fisheries. Several interviewees for this study noted "we have enough trouble with our existing fisheries, let alone new ones!" The implication for industry participants wanting to develop new fisheries is that governments are unlikely to redirect resources from established to new fisheries (except in exceptional cases of stock collapse – e.g. Atlantic Canada groundfish, Pacific Canada salmon), and adequate cost recovery arrangements to support management needs are crucial. For governments, the implication is that, despite the temptation to be overly precautionary in the face of the new demands of EAFM and the like, given the industry is paying the costs of development, it is important not to "set the bar too high" such that cost becomes an insurmountable impediment to development. This of course assumes that development of sustainable new stocks is a policy objective of governments.

The success of government assistance has been patchy.

A number of developed world jurisdictions have established dedicated schemes to explore and develop new fisheries, many following the collapse or decline of established fisheries and significant political pressure to redeploy displaced fishermen. However such schemes appear to have met with only limited success. In Canada's west coast, only one of 24 new species assessed using funds from the PFARP, aimed at redeploying fishermen displaced from collapsed salmon fisheries, has progressed through to developed status. Likewise, despite Oregon's establishment of a dedicated body to develop new stocks – the DFP – only two of 92 species nominated as potential stocks have been developed (ironically, one of which – Pacific sardines - is the same stock as the only one developed in Canada's west coast).

Notwithstanding, Harte et al (2008) argue that the now $2 billion Alaska surimi industry benefited significantly from the involvement of the independent Alaska Fisheries Development Foundation[76], itself the recipient of a large number of NOAA grants. While there are clearly potential benefits of government involvement, the main message arising from recent history is that success of new fisheries will ultimately be dependent on the long-term commercial viability of the species, not in the level of government assistance.

Most jurisdictions recognise the rights of 'pioneers'.

The most common incentive for the development of new stocks offered internationally appears to be rewarding 'pioneers' – i.e. those who invest private capital in proving up new stocks. Most frequently the reward comes as a form of preferential access, such as reserving a guaranteed proportion of the quota or licences, when the fishery transitions to a limited entry 'developed' fishery. The incentive is grounded in the assumption that a right to a new limited entry, viable fishery will have substantial value. The important implication for this study is that NZ's system of Crown quota 'allocation' for new stocks, has recently changed away from history-based allocation to an open tender. This leaves little scope for recognising the rights of pioneers and the implications of this are discussed further in later chapters.

[76] See http://www.afdf.org

Chapter 3: NZ's Existing Management Framework and Experiences

The second task in this study was to examine New Zealand's existing arrangements for the development of new fisheries with a view to providing advice on how 'best practice' might be applied within the New Zealand framework, taking into account the unique circumstances of the QMS and other relevant measures. The approach taken has been to review the main existing policies and frameworks governing the development of new fisheries in New Zealand and undertake a comparative analysis of these with international best practice identified in Chapter 2 above. Recent experiences of developing fisheries in New Zealand were also investigated for any insights that could be applied more broadly.

In order to support these assessments, reviews were undertaken of relevant documentation outlining existing arrangements for new fisheries. Interviews with a range of stakeholders interested in new fishery development were also undertaken including MFish policy, scientific and socio-economic staff, SeaFIC representatives and industry members with direct involvement in recent fishery development ventures. A full list of people contacted is provided at Annex 2.

NZ Legislative, Policy and Management Framework

This section provides an overview of the main legislative and policy instruments relevant to the management of developing fisheries in New Zealand.

Fisheries Act 1996

The principal piece of legislation governing the management of New Zealand's fisheries is the *Fisheries Act 1996* ('the Act'). The overarching purpose of the Act is to "provide for the utilisation of fisheries resources while ensuring sustainability". Consistent with other similar national fisheries legislation, the Act provides broad powers to manage fisheries including establishing the Quota Management System (QMS) framework, processes for consultation, obligations in relation to record keeping, powers of inspectors, offences and penalties and cost recovery arrangements amongst others.

The Act requires all persons exercising duties and powers to take into account a range of environmental and information principles, as follows:

<u>Environmental principles:</u>

- associated or dependent species should be maintained above a level that ensures their long-term viability
- biological diversity of the aquatic environment should be maintained
- habitat of particular significance for fisheries management should be protected

<u>Information principles:</u>

- decisions should be based on the best available information
- decision makers should consider any uncertainty in the information available in any case
- decision makers should be cautious when information is uncertain, unreliable, or inadequate

- the absence of, or any uncertainty in, any information should not be used as a reason for postponing or failing to take any measure to achieve the purpose of this Act.

In doing so, the Act gives practical effect to the need to adopt both an ecosystem-based and precautionary approach to fisheries management.

The Quota Management System

The QMS is MFish's principal administrative mechanism for managing New Zealand's fisheries. The QMS has been progressively expanded since its introduction in 1986, and now covers approximately 97 species (divided into approximately 629 separate stocks). Under the QMS, a total allowable commercial catch (TACC) for each stock is set after allowances for customary, recreational and other users are deducted from an initial total allowable catch (TAC). The initial TAC is set based on the best available science and in accordance with MSY objectives of the Act. TACs and TACCs are reviewed periodically.

Quota shares represent the individual property right issued under the QMS. One hundred million quota shares are allocated for each quota stock. Ownership of quota shares is subject to aggregation limits at either the stock or species level.

Quota Management Areas

Each species under the QMS is divided into a number of separate stocks defined by Quota Management Areas (QMAs - Figure 6). The number of QMAs for each species is determined upon entry into the QMS. In proposing QMAs for new species, MFish must consider two statutory obligations set out in the Act, namely that:

as far as practicable, the same QMAs should be maintained for different species; and

a separate QMA may be set for the waters surrounding the Chatham Islands if the stock can be managed effectively as a unit.

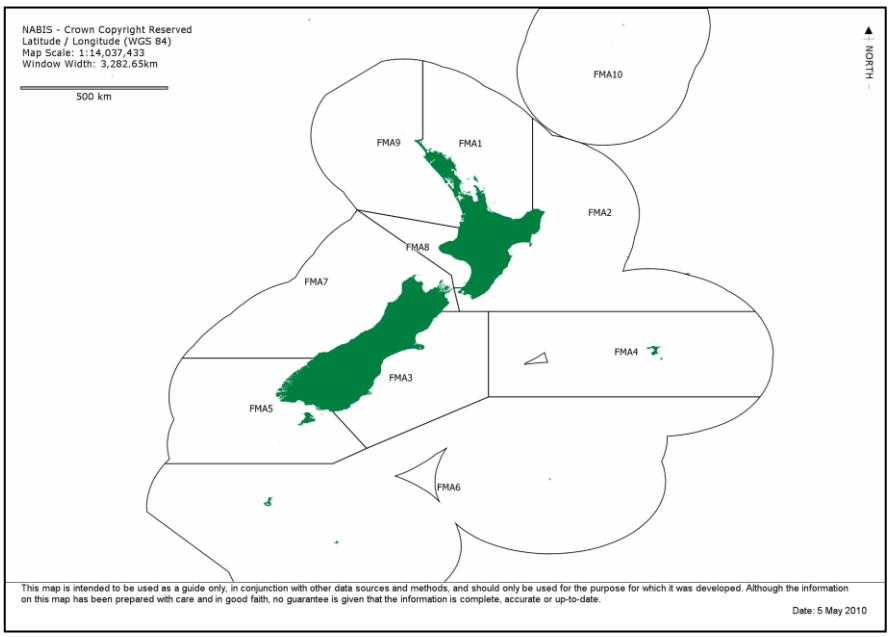

Figure 6: New Zealand's Fisheries Management Areas.

Annual Catch Entitlement

The Annual Catch Entitlement (ACE) is the 'catching right' generated each year by holding quota. ACE can be bought, sold or leased in isolation to quota and is not subject to aggregation limits. ACE is generated at the start of each fishing year, based on the operator's quota shares and the TACC. A number of stocks are subject to minimum ACE holdings.

Deemed values

Under the QMS, all catches of quota species must be landed to ensure an accurate basis for TAC setting and other fisheries management purposes. Fishers are required balance their catches of quota species with ACE. Where a fisher is unable to balance quota with ACE, they are required to pay a "deemed value" (DV) – essentially a monetary demand on fishers charged by the Crown for fish taken in excess of their ACE holding.

Interim and annual DVs are placed on each quota stock based on a range of factors including the market value of the species and the need to encourage fishers to acquire and maintain sufficient ACE to cover catches in each quota year. DVs increase exponentially with the amount of catch taken in excess of ACE.

Management of non-QMS species

Approximately 100 species of marine life are currently commercially harvested in NZ waters outside the QMS[77]. Fisheries for these species are essentially open access[78], managed under condition of permit using the techniques outlined in s11 of the Act (e.g. spatial and temporal closures, gear restrictions etc).

Between 1992 and 2004, a moratorium applied to the issuance of new permits to commercially harvest non-QMS species. The moratorium was designed to prevent expansion of non-QMS fisheries prior to their introduction into the QMS, as well as to prevent overcapitalisation and a 'race to fish' to generate catch history. While the moratorium appears to have largely succeeded in these aims, relevantly for this project, it also had the adverse effect of stalling development and exploration of new fisheries during this period.

In October 2004, the Act was amended to remove the moratorium for most species. In effecting these changes, two new schedules were created – 4C and 4D. Species listed on Schedule 4C were deemed to be subject to a sustainability risk in an open access environment. For these species, the moratorium on new permits was continued. Species listed on Schedule 4D (seven species, one family) were those that had previously been subject to commercial fishing – and hence subject to allocation arrangement based on provisional catch history if introduced into the QMS before 1 October 2009 (see 'allocation of quota for new stocks' below) - although with no substantial sustainability risk. For these and all other species, the moratorium on new permits was removed.

Entry of New Species into the QMS

Periodically, non-QMS species are considered for entry into the QMS. For the purposes of comparison, non-QMS species can be grouped into two broad categories – those species on Schedule 4C of the Act and those that are not. The primary difference is a streamlining of the process for entry of Schedule 4C species into the QMS.

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[77] MFish (2005) Introduction of new stocks into the Quota Management System on 1 October 2007

[78] under s91 of the Act the Chief Executive must issue every person who applies for one an appropriate fishing permit

For species not listed on 4C, the Fisheries Minister must consider whether existing arrangements for the fishery are achieving the Act's purpose – namely ensuring sustainability and providing for utilisation. For the Minister to proceed with the introduction of a new species, he must satisfied that at least one of these objectives is not being adequately met by the existing arrangements. For species listed on 4C, the Minister is not required to make this determination. Thereafter, the process is consistent between 4c and non-4C species.

Allocation of Quota for new QMS stocks

Arrangements for the allocation of quota for new stocks (added to the QMS) are set out under part 4 of the Act. Of the 100,000,000 quota shares generated in each new fishery, 80,000,000 are allocated to the Crown and 20,000,000 are allocated to Te Ohu Kai Moana Trustee Ltd on behalf of Maori (see Treaty of Waitangi [Fisheries Claims] Settlement Act 1994 below).

Arrangements for the allocation of the Crown's shares have been the subject of a number of very recent changes. Perhaps most notably, prior to 1 October 2009, allocation of shares in new fisheries was based on each fisher's 'provisional catch history' during the fishing years commencing 1 October 1990 and 1 October 1991; after 1 October 2009 disbursement of the Crown's share will occur through an open public tender with shares going to the highest eligible bidder, subject to quota aggregation limits.

The effect of both of these measures – the automatic allocation of 20% of new quota to Maori and the changes to Crown allocations – are significant in the context of developing new fisheries. The allocation of 20% of quota not only guarantees TOKM entry into all new fisheries, it effectively ensures they will be a significant player. Holding a base level of 20% of quota also means that TOKM Trustee Ltd need only make a comparatively small investment in the Crown's quota to take what can be a dominant interest in new fisheries. This arrangement has undoubtedly influenced the recent history of new fisheries ventures in New Zealand – with TOKM being a driving force behind Crabco and Surfco – and will likely continue to be the case into the future as new fisheries are developed.

The recent change in allocation method for the Crown's quota shares is designed to deliver it, and through them the NZ public, the best possible return for the sale of its assets. Nevertheless, the change also has a range of significant implications for the incentive structure in the development of new fisheries. In particular, the change serves to dampen the incentive for fishers to invest in the development and 'proving up' of non-QMS stocks. They can spend their money on research and development yet be outbid if quota is put-up for auction. While it could be argued that the knowledge gained while 'proving up' the new fishery will better position the pioneer fisher to bid a realistic price for quota in the public tender (and indeed, anecdotal evidence suggests this has been the case on a number of occasions), this is by no means a guarantee of success. Indeed, that fisher's knowledge may lead him/her to tender low, while another's lack of knowledge may lead him/her to tender high, thereby securing quota. The net result of this may well be inefficiently and/or unused quota in the short term, and this could continue until the quota is sold on to a more efficient or better capitalised fisher. TOKM are an exception to this as they can invest in the development of new non-QMS stocks with some confidence, knowing that they are guaranteed of at least 20% of the assets in any new QMS stock.

Administrative options to allow for the exploration of new species

Fish stocks with development potential in New Zealand can be separated administratively into two broad groups:

- stocks currently managed under the QMS that have a TAC set below their likely optimal sustainable level (and for which there is no cultural, social or ecological reason preventing development); and
- stocks currently managed outside the QMS for which markets and fisheries may develop in the future.

The administrative arrangements to allow for the exploration and proving up of these species are different and are detailed below:

QMS Stocks

Broad agreement suggests that the bulk of any new fisheries, at least in the foreseeable future, will come from QMS stocks. Of the approximately 633 stocks currently managed under the QMS, approximately 109 stocks categorised as target species have TACCs set at 10t or less. Of these, 58 have no nominated customary or recreational allowance indicating few impediments, other than lack of knowledge, markets or cost-effective fishing techniques, to further development.

Two main administrative arrangements to allow for the exploration of new stocks, over and above that allocated under the TACC, have been used over the past decade: the Adaptive Management Programme (AMP) and special permits under s97 of the Act.

Adaptive Management Programme

The AMP framework was established in 1991 as a "basis for varying the Total Allowable Commercial Catch (TACC) levels of fish stocks for which the Ministry of Fisheries has limited information on stocks size". [79] AMPs allowed industry an opportunity to develop a stock by providing for TACC increases for a defined period, while at the same time requiring rigorous reporting and other criteria that provided better information to improve analyses of stock status and estimates of sustainable yield. TACC increases were granted on the understanding that most fish stocks are 'resilient enough to sustain a level of fishing effort for a short time that may prove unsustainable in the long term' and that the higher level of catch would enable better assessments of the sustainable productivity of the stock.

While there was broad agreement to the concept of the AMP, a number of practical challenges occurred that led to its discontinuation in 2008. Firstly, MFish had significant difficulty in obtaining from industry the research information collected while harvesting the increased level of catch. Secondly, a key feature of the AMP was that TACC increases be 'temporary'. In 2008, a New Zealand court held that the Act did not provide the power to revert a TAC back to its original level following the completion of an AMP. Without this power stocks may have been placed at risk, and the programme was discontinued.

Special permits

Following the move away from AMPs, MFish has recently developed new administrative arrangements to allow for the exploration and development of new fisheries under the 'special permit' provisions (s97) of the Act. In essence, a new purpose has been added that allows the Chief Executive of MFish to issue a special permit "to allow persons or organisations to take fish from stocks in excess of their annual catch entitlement without paying deemed values, in conjunction with a research programme that is likely to provide sufficient information to establish a total allowable catch in accordance with statutory requirements."

[79] MFish (2004) Review of Sustainability Measures and Other Management Controls for the 2004-5 Fishing Year Adaptive Management Programme. Final Advice Paper. 6 August 2004.

The new arrangements, as stated, are designed to provide for the exploration and development of new stocks by allowing permit holders to take fish in excess of ACE without paying (often prohibitive) deemed values.

An important difference to the AMP is that the new purpose special permits do not apply to existing developed fisheries (e.g. hoki). Rather the scope of the permits is limited to:

- new fisheries – i.e. unfished or lightly fished stocks in a specified QMA; and
- closed fisheries – i.e. previously developed fisheries that were closed or sharply curtailed through TAC reductions, mostly due to sustainability concerns.

Within the above scope MFish has further limited the issue of permits to:

- target fisheries – i.e. permits will not be issued to cover bycatch; and
- fisheries with zero or nominal recreational or customary allowances (or those for which the increase in commercial catch will not have a significant effect on other users).

Figure 7 below represents existing QMS stocks potentially eligible for special permits as described above.

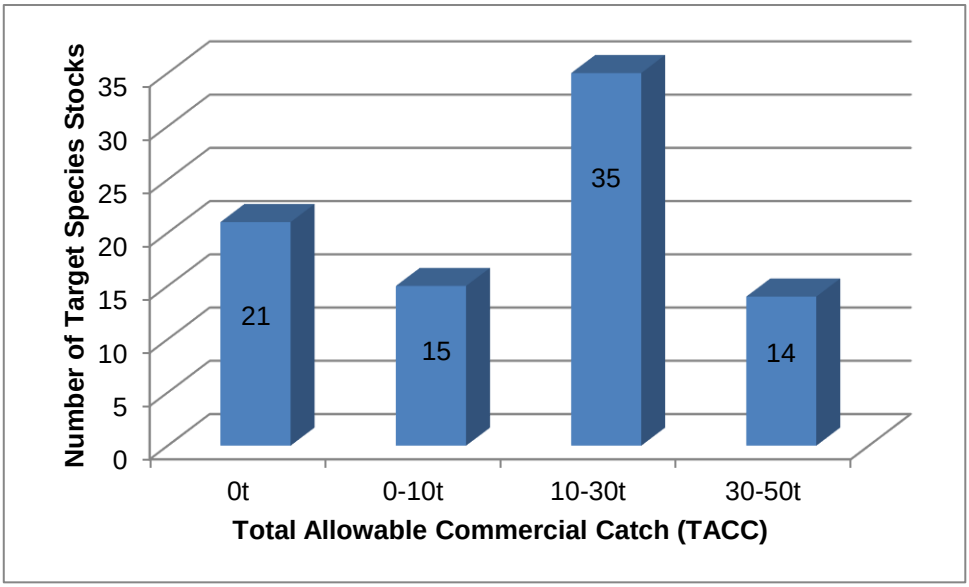


Figure 7: Indicative number of QMS target stocks eligible for new purpose special permits (n = 173). (Source: Data for the 12month period up to 30/09/2010 - http://fs.fish.govt.nz/Page.aspx?pk=91 – Follow: Our Fisheries-Stock Status-Catch)

Non-QMS Species

While conventional wisdom suggests that any new fisheries in the foreseeable future will likely arise from existing QMS stocks, the possibility that fisheries for non-QMS stocks will develop cannot be discounted.

Exploration of these species is provided for through permits issued under Part 6 of the Act. Except for those species listed on Schedule 4C, for which the moratorium on new non-QMS permits still applies, access is essentially "open". Fishing on non-QMS stocks is regulated by conditions applied to the permit, using the measures outlined in s11 of the Act.

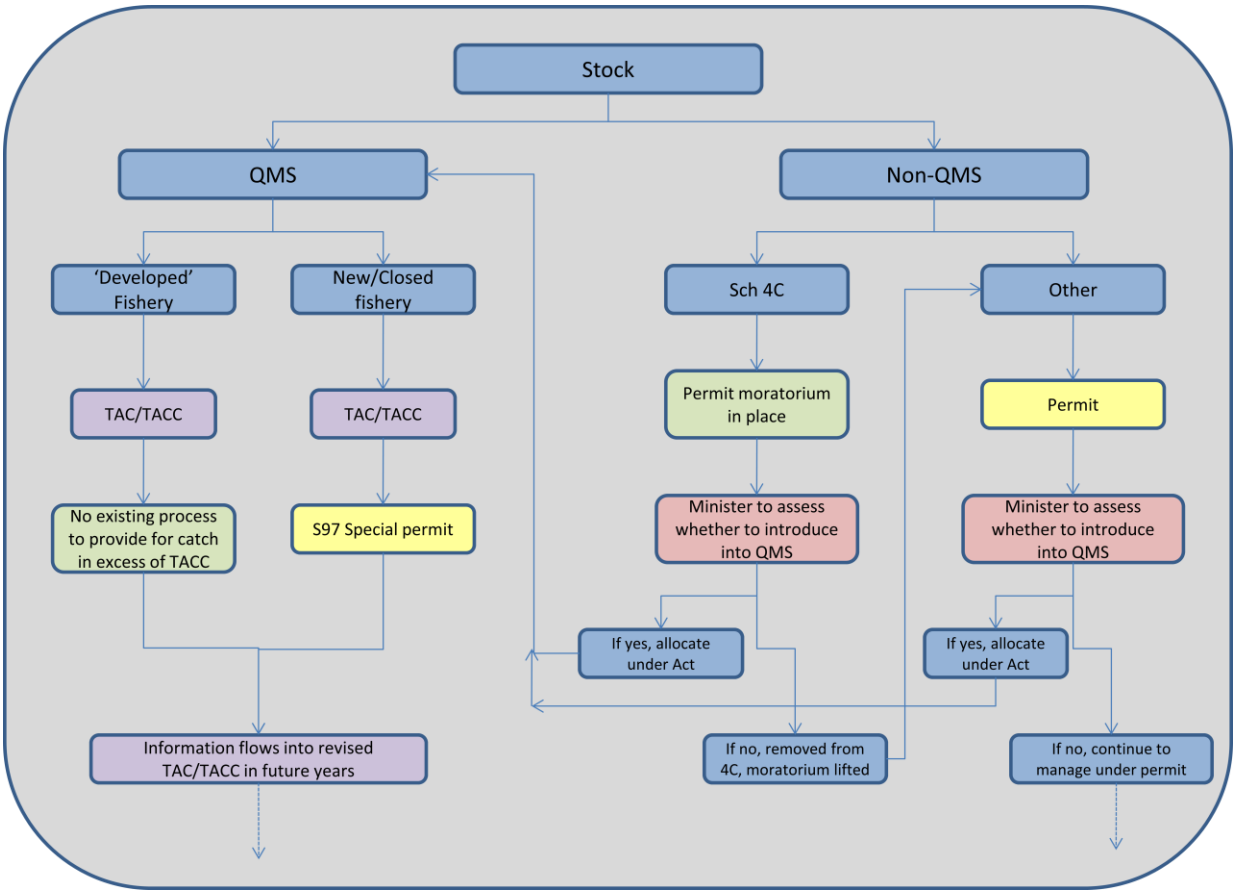


Figure 8: New Zealand's existing administrative process for the exploration of new fish stocks. For QMS stocks, special permits under s97 of the Act provide for catches in excess of the TACC without paying deemed values. For non-QMS stocks, permits may be issued to harvest species not listed on Schedule 4C.

TAC setting for developing fisheries

Under the Act, the Minister is required to set a TAC that maintains the stock at or above a level capable of producing MSY, having regard to the interdependence of stocks. Where MSY for a stock is not able to estimated reliably, the Minister must set a TAC that is "not inconsistent with the objective of maintaining the stock at or above, or moving the stock towards or above, a level that can produce the maximum sustainable yield". In practice, this has meant that for low knowledge and developing stocks, a nominal TAC is set (e.g. 10t) until better information is generated. This cautious approach for new and developing fisheries is reinforced in the Harvest Strategy Standard for New Zealand Fisheries.[80]

The Maori Fisheries Act 1989, Treaty of Waitangi (Fisheries Claims) Settlement Act 1992 and Maori Fisheries Act 2004

In addition to arrangements under the Fisheries Act 1996, a number of measures under related Acts giving effect to Maori claims made under the Treaty of Waitangi have particular relevance to new and developing fisheries. Of particular importance is the agreement under the *Treaty of Waitangi (Fisheries Claims) Settlement Act 1992* that Maori be allocated 20% of

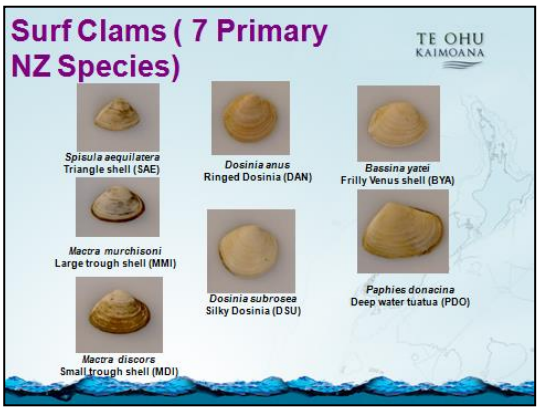
[80] Ibid. MFish (2008)

quota shares in all new stocks brought under the QMS, described above. The Maori Fisheries Act 2004 also establishes a number of governance structures to support Maori interests including Te Ohu Kai Moana (TOKM) "*to advance the interests of iwi individually and collectively, primarily in the development of fisheries, fishing, and fisheries-related activities*" and its trustee Te Ohu Kai Moana Trustee Ltd, who may hold quota and is exempt from quota aggregation limits. The Maori Fisheries Act 2004 also establishes Aotearoa Fisheries Ltd (AFL) to commercialise settlement assets. Directors of AFL are appointed by TOKM Trustee Ltd and, unlike TOKM, "must manage its assets in a commercial manner". Both TOKM and AFL have been significant players in recent fisheries development.

Recent experiences in developing fisheries

The two most prominent recent examples of developing fisheries in New Zealand have been the deepwater crab fishery and the surf clam fishery. The deepwater crab fishery targets king crab (*Neolithodes brodiei, Lithodes murrayi* and *L. Longispinus*), red crab (*Chaceon bicolour*) and giant spider crab (*Jacquinotia edwardsii*) using traps and has been the subject of exploration dating back, in some cases, to the 1960's.[81] The surf clam fishery targets a complex of seven species of bivalve using dredges in high energy surf zone environments (Figure 9). Both fisheries were introduced into the QMS in the 2005/6 quota year with initial TACs set at low levels to reflect the lack of knowledge about the biological potential of the stocks.

a



b

Figure 9: (a) Dynamic surf zone environment in which surf clams are harvested; (b) seven primary species of surf clam (photos courtesy TOKM)

Quota holders in both fisheries have adopted a similar development approach. Central to this has been the establishment of a joint venture company – Crabco Ltd and Surfco Ltd respectively – to manage the process of proving up the fisheries on behalf of all quota holders. This common approach is likely driven by the involvement of some of the same major players in both fisheries (e.g. TOKM, Aotearoa Fisheries Ltd; both companies also have the same Chairman).

[81] Soboil, M and A. Craig, (2008). Self governance in New Zealand's developmental fisheries: deep sea crabs. In Townsend, R.; Shotton, R.; Uchida, H. (eds). Case studies in fisheries self-governance. *FAO Fisheries Technical Paper.* No. 504. Rome, FAO. 2008. 451p

Under the Crabco/Surfco model, quota holders agree to transfer ACE to the company at the start of each fishing year. In return, the company aims to manage the collective pool of ACE to maximise individual and collective benefit for shareholders by undertaking:

- strategic and operational planning;
- liaison amongst quota holders and external agencies (e.g. MFish);
- contract management for harvesting, processing and marketing;
- quality assurance.

These services and relationships are outlined in Figure 10, and are more fully described by Soboil and Craig (2008).

Strategic and operational plans are signed off by quota owners, and any profit made is returned to owners in proportion to the amount of quota held. The underlying aim of the company is to maximise quota value by developing and commercialising the fishery.

Soboil and Craig (2008) outline a number of benefits in the joint venture approach including, amongst others:

- facilitating greater levels of industry self-management;
- allowed for collective decisions about fishing patterns and rules, enhancement projects, exploratory fishing and research;
- engendering greater levels of ownership amongst industry of difficult decisions (for example, quota owners have agreed to use pots only in the crab fishery, rather than trawling, to limit environmental impacts);
- enhanced levels of information flow supporting more informed management decisions;
- providing increased surety for long-term planning, thereby maximising quota value.

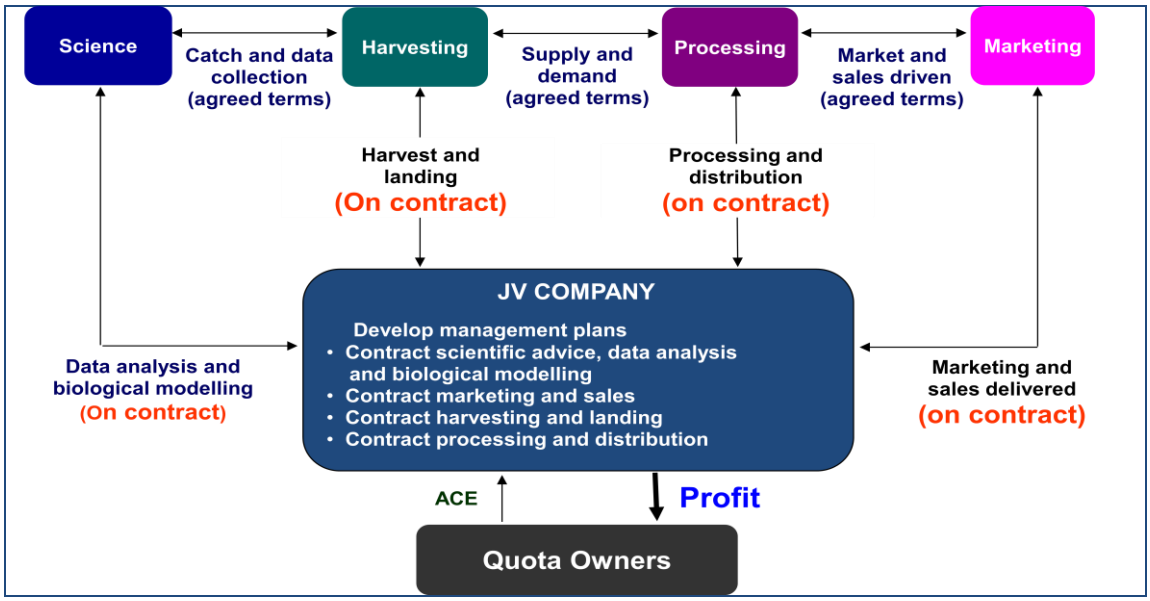


Figure 10: Crabco/Surfco organisational and service structure.

Surfco's primary focus to date has been on proving up the biological potential of the fishery, with harvesting, marketing and other post-harvest activities a secondary consideration. The thinking behind proving up the biology before the "business" was explained by Surfco representatives as:

- "you can't sell something you haven't got";
- "you need to convince shareholders there is a resource volume worth investing in";
- "generally there are markets for similar seafood in existence that one can use for comparative purposes"; and
- "once you know volume and market profile then it's about marketing your product to extract premium returns – a function of supply and demand. The advantage Surfco has is the company's ability to control supply to maximise price".

It is worth noting that exploration of the surf clam fishery has occurred for the past 20 years, much of it in refining harvesting technology.

Two levels of biological survey have been carried out to date, focusing initially on a known productive stretch of coastline in the Hawke's Bay area of QMA2. A broad scale survey was undertaken initially to establish the presence or absence of surf clams, and was followed up by a more detailed survey to establish target species density and biomass. Surveys were conducted by an external science provider for a total cost of approximately $263,600.

Initial results from the surveys have been positive, with high densities of surf clams found in several locations throughout the survey area. The results will be fed into the April 2010 round of TACC setting with an expectation that the TACC will increase to 700t from its current nominal level of 30t. This has the potential to translate into considerable capital gain for quota holders, thereby delivering on the central goal of Surfco

The other key cost for Surfco has been the design and operation of a sanitation program in probable harvesting sites within QMA 2 (Table 5). To date this has cost approximately $102,200. Surfco representatives interviewed for this study made the point that, particularly for inshore shellfish species requiring sanitation and/or biotoxin testing, this cost alone would likely be beyond the reach of individual quota owners operating independently and consequently prevent, or at least hinder, the development of new inshore fisheries in the absence of a Crabco/Surfco style arrangement.

Table 5: Major input costs and returns from Surfco and Crabco fishery development programs to date. The returns below represent only the value of sales and do not represent increases in quota value as a result of development activity.

	Component	Surfco Ltd	Crabco Ltd
Inputs			
	Quota purchase	$150k	$500k
	R&D (including research fishing)	$261k	$1,500k
	Sanitation	$102k	-
	Total	~$513k	
Returns			
	Catch/Sales	0t/$0	5t/~$190k
"Out of pocket" to date		**~$513k**	**~$1,810k**

Crabco has also focused heavily on proving up the biology of the fishery in the early stages, however it has also undertaken work on some of the technical aspects (e.g. developing efficient harvesting technology). Approximately $1.5m has been spent on R&D to date with the key costs being:

- the development of company legal structures and establishment;
- equipment purchase (pot design and build);
- initial desktop research studies and fishery profile;
- experimental harvesting;
- log book data recording design.

Unlike the Surfco approach where biological surveys were undertaken by external providers, Crabco has taken a strong 'research while fishing' approach. Fishing plans are developed between the company and their external science provider with harvesters paid to fish in productive as well as unknown areas to gather information on crab distribution and abundance. Data collected by harvesters is then overlayed on the service providers' swath mapping system to identify areas potentially supporting commercially viable populations of crabs based on depth, bottom type and other variables. It is worth noting that 'research only' fishing occurs only after a sufficient catch has been taken in known productive areas to enable fishers to be paid.

Crabco representatives noted that the nature of the company's arrangement with harvesters – a contract with a monopoly company – allows for more and better data to be collected about the fishery than would otherwise be the case in a multi-stakeholder, competitive fishery. Harvesters are required under contract to report catch and effort data at a finer spatial scale than that required by MFish, as well as deliver information in near-real time. This information has obvious value in resource assessment and setting TACs, but also provides considerable commercial and strategic advantage to the company allowing them to make rapid, evidence-based decisions to maximise harvesting efficiency while protecting stocks.

Another important area of work for Crabco has been the development and testing of pot designs to ensure efficient harvesting.

Surfco has no immediate plans to apply for a new purpose special permit, however Crabco may. Biomass estimation is more difficult and costly in the crab fishery and the company sees dual benefit in being able to collect information outside the constraints of existing TACCs as well as being able to offset some of the research costs through sale of the product. Crabco representatives also emphasise the fact that a special permit allocated to a joint venture company involving all participants should provide MFish with a level of confidence that conditions applied to special permits will be met.

Both companies argue the key future challenge for developing fisheries is the establishment by MFish of a regulatory regime that encourages investment. They argue that if the nation is to capitalise on its fisheries resources it has to put in place a legal framework that does not impede this goal. They note that the new purpose special permit is a 'good first step', however the important thing now is for MFish to develop a set of guidelines governing the use of these permits – in effect, the 'rules of the game'. These should be designed to encourage responsible development and provide clarity to potential applicants as well as other stakeholders. These issues are covered in more detail in Chapter 5.

At a company level, representatives argue that the key challenges are to:

- " keep expectations amongst shareholders realistic;

- undertake market development in such a manner as to maximise profits and shareholder wealth;
- ensure harvest levels are based on robust information;
- keep everyone under the one roof.

How do NZ's arrangements compare to the rest of the world?

Table 6: Analysis of New Zealand's existing management arrangements against common policy features identified in developing fisheries policies internationally.Table 6 provides a summary of New Zealand's current arrangements against a checklist of 11 common policy features identified during the review of international approaches in Chapter 2 (see Table 4).

The most immediate difference between NZ and many other jurisdictions is the absence of a dedicated policy/framework outlining the government objectives, principles and processes in relation to new fisheries development. While much of the architecture for the orderly development of new fisheries exists (e.g. QMS, new purpose special permits), no single document has been developed that outlines the government's vision for new fisheries and policy and administrative processes by which this is to be achieved.

A clear policy and framework for new fisheries development is valuable in ensuring all participants understand the process and required procedures, as well as allowing industry to make realistic estimates of the potential development timelines and costs involved.(e.g.[82]). In our review of the policies and practices of other jurisdictions it became obvious that a clear statement of government policies and mandatory requirements is necessary for a successful and harmonious relationship between fishers and managers.

Another fundamental difference between NZ and most other jurisdictions is the timing of the allocation of permanent, transferable rights within the development cycle. Whereas most other jurisdictions undertake exploratory fishing using temporary, non-transferable permits (as a means to prevent overcapitalisation and overfishing, and, particularly in jurisdictions without full cost recovery, to limit ongoing management costs if the fishery turns out to be unviable), NZ undertakes the bulk of its exploratory fishing after entry into the QMS, using permanent, transferable rights. Both of these approaches have important advantages and disadvantages. Under the general approach used internationally the process of proving up a new fishery can be lengthy and expensive with little certainty that a viable fishery with permanent rights will result. Once a fishery is proved up, however, there is typically a recognition of the rights of pioneers and greater confidence at the time of allocation in the long term profitability of the fishery. Under the NZ model, there is little certainty in the viability of the fishery at the time of permanent rights allocation (assuming early entry into the QMS), however there is certainty of access to a proportion of the catch for those who secure quota. Arguably the security associated with long term rights then creates incentives for rights holders to invest in proving up the fishery. This difference in approach has important implications that are discussed further below. General differences between the NZ system and the typical process followed in other jurisdictions are represented in Figure 11 below.

[82] Ibid. Perry et al (2005)

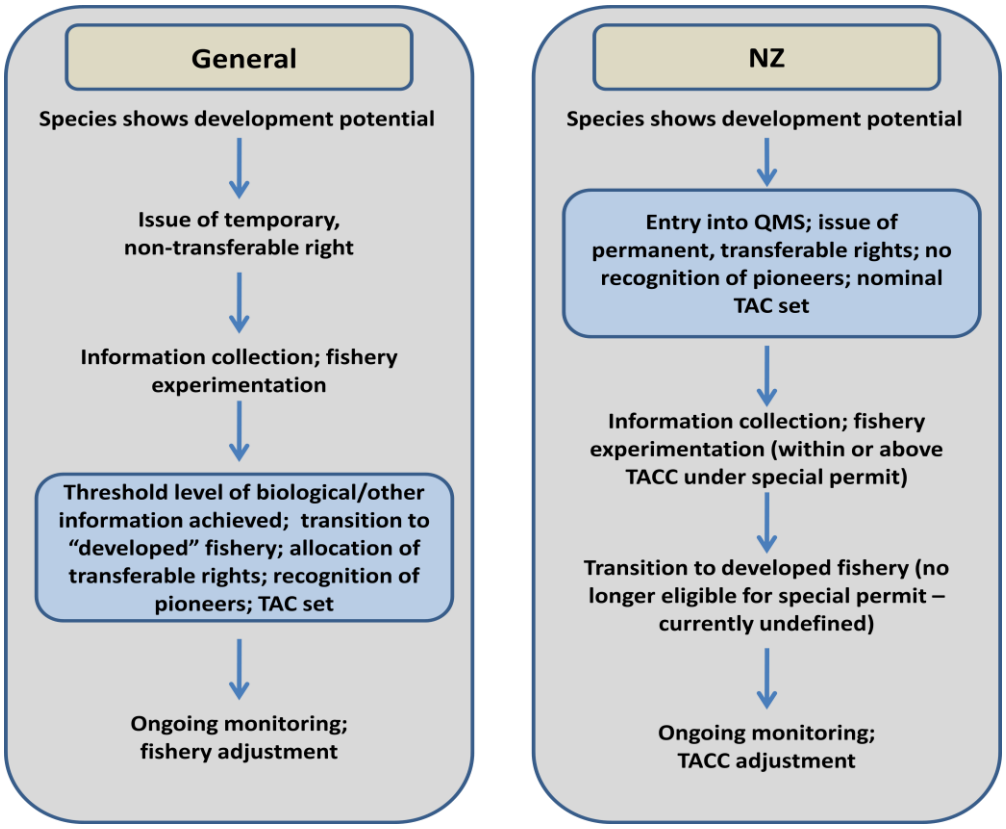


Figure 11: Comparison between a typical fishery development process used internationally and that used in New Zealand (assuming early entry into QMS). The blue boxes highlight the much earlier transition to permanent, transferable rights under the QMS.

Phasing of fishery development occurs in NZ, however the process is different from most other jurisdictions. While the typical process used internationally is to have a clear transition between 'developing' and 'developed' fishery stages (usually marked by a transition from temporary, non-transferable rights to permanent, transferable rights – see above), the transition to permanent rights occurs earlier in NZ and the point at which the fishery becomes 'developed' is less clear. Under the NZ approach, stocks showing potential are frequently moved into the QMS early in the development cycle under a nominal TAC. Work to prove up the fishery is then undertaken within the 'mature' environment used for long term management, with no clear transition occurring between developing and developed states. This absence of a clear administrative point at which a fishery transitions from 'new' to 'developed' has important practical implications given the new purpose special permits are available to 'new' fisheries, but not 'developed' fisheries. The need for clear definitions of new and developed fisheries for the purposes of special permits is discussed further in Chapter 5.

Other key differences between the NZ approach and most other jurisdictions are:

- the absence of recognition of pioneers; and
- the absence of any minimum participation requirements to maintain permits in the proving up stage.

Both of these are relevant. The former is important because it is the primary incentive for new fishery development offered internationally. In the absence of any recognition of pioneers,

other incentives for new fishery development need to be considered (assuming the goal of government is to encourage sustainable new fisheries). The latter is relevant because it is the primary lever used by most jurisdictions to ensure active development of fisheries identified as having commercial potential. In the absence of an ability to remove "speculators" from the fleet (this is obviously not possible – or desirable - under the QMS system where rights are allocated permanently), government runs the risk of having potentially profitable fisheries remain undeveloped. Again, if the goal of government is sustainable new fishery development, other incentives to prove up new fisheries need to be considered.

Of the remaining policy features, NZ's arrangements is generally consistent with other jurisdictions:

- The requirement for a desktop assessment of risk to target species and the environment based on existing information prior to the commencement of exploratory fishing under special permits (and implicitly during the introduction of new stocks into the QMS) is consistent with the approach taken in most other jurisdictions. It is a fundamental advance on the EU, who undertake no assessment, and less intensive than the approach taken for some fisheries in both Canada and the Falklands where fishery-independent surveys are undertaken before the fishery commences;
- The condition that exploratory fishing under new special permits be undertaken in accordance with an approved research plan that contributes to TAC setting allows MFish to utilise the information collection capacity of the fishing fleet. This is consistent with 'best practice' approaches taken, for example by CCAMLR in developing the Ross Sea toothfish fishery, and allows for the type of adaptive management approaches taken in some Canadian fisheries (e.g. giant sea cucumber);
- The requirement that further development of a fishery be linked to the acquisition of better information offers a clear incentive to industry to invest private capital in research and development and represents a precautionary approach;
- Full cost recovery applied to NZ fisheries is consistent with many other jurisdictions and avoids the problems associated with a lack of resourcing identified by jurisdictions without cost recovery.

Table 6: Analysis of New Zealand's existing management arrangements against common policy features identified in developing fisheries policies internationally.

Indicator	Performance	Comments
Dedicated policy/framework for new fisheries		While many of the tools to support orderly development of new fisheries development is in place (e.g. QMS, new purpose special permits), no dedicated policy outlining Government objectives, principles and processes on developing fisheries exists.
Phased approach to development		Phasing occurs through the move from non-QMS to QMS, and from nominal TAC to an evidence-based TAC reflecting legislative MSY objectives.
Assessment of risk to target species prior to exploratory fishing[a]		No assessment of risk is carried out prior to issuing permits for non-QMS species. Implicit assessments of risk are carried out during the process of introducing new stocks into the QMS and setting initial TACs. Applicants for new purpose special permits will be required to outline the impacts of the proposed exploratory fishing program on target stocks and the environment.
Assessment of risk to environment prior to exploratory fishing[a]		As above
Exploratory fishing using non-transferable (NT) or transferable (T) rights	NT/T	Development of non-QMS stocks is undertaken using non-transferable permits; development of QMS stocks – by common consensus the group of stocks from which the bulk of any future development will come – undertaken using transferable rights.
Dedicated research/data collection plan[b]		Exploratory fishing under new purpose special permits will need to be in accordance with an approved research plan that has a reasonable chance of assisting in setting robust TACs.
Further development of fishery linked to generation of new information[c]		Introduction of new stocks into the QMS based on catch and effort patterns in non-QMS data. Any increase from nominal TACs will be based on new information (e.g. in accordance with an approved research plan under a new purpose special permit).
Full cost recovery		All NZ fisheries subject to full cost recovery.
Recognition of rights of pioneers		No recognition of the rights of pioneers exists under the system of Crown tenders for new QMS stocks.
Dedicated government assistance for new fisheries[d]		Some funding is available to new fisheries through, for example, Seafood Industry Limited grants, however no dedicated program of government assistance for new fisheries exists.
Minimum participation requirements		No minimum level of participation is required to access non-QMS permits, nor participate in Crown tenders for new QMS stocks.

Key

Meets indicator | Partially meets indicator | Does not meet indicator

Conclusions

NZ arrangements are unique

Perhaps not surprisingly, a key conclusion from the comparative analysis is that NZ's arrangements for the development of new fisheries are unique. Whereas the majority of other jurisdictions surveyed undertake their fishery development in an environment of non-transferable, temporary rights, much of NZ's new fishery development will be undertaken in an environment of permanent, transferable rights under the QMS. This fundamental distinction has significant implications across a number of policy/operational areas. In particular:

- the risks for potential investors are different; in most other jurisdictions decisions on whether to purchase rights in the fishery are made after a considerable period of R&D and much of the biological and market potential of the fishery is known. In NZ, where new species are introduced into the QMS, potential investors are required to bid to acquire permanent fishing rights in the absence of good biological and market information. Perhaps the most significant implication of the NZ approach is for the price of Crown quota. Were a fishery to be proved- up prior to its introduction into the QMS and demonstrate considerable long term commercial potential, the tender price could be expected to be considerably higher than if nothing of substance was known about it . The clear principle here is that the more that is known about the fishery the lower the risk premium an investor would need.However, the reverse is also true, in that fisheries which prove, after the necessary R&D, to be non-viable would attract lower tender prices than would otherwise be the case. Given the absence of clear implications for Crown quota prices, it makes sense to base decisions on whether to undertake the developmental phases of new NZ fisheries on other factors. These are discussed in the Chapter 5 below.
- transition from 'developing' to 'developed' fishery is different in NZ; whereas in most jurisdictions the transition to a 'developed' fishery is generally characterised by the achievement of a threshold level of biological and other knowledge and the allocation of transferable rights, in NZ this is reversed. Stocks showing development potential are either already included in the QMS or typically introduced in their early stages of development. The transition to a 'developed' fishery from there is much less clear, although has important policy implications: fisheries defined as 'new or developing' are eligible for new purpose special permits to harvest additional catch over and above the TACC; 'developed' fisheries are not. The need for a clear definition surrounding this transition under the QMS is further discussed in Chapter 5 below.
- the allocation of permanent, transferable rights under the QMS means the Crown is unable to encourage development by measures used in other jurisdictions such as minimum participation requirements (e.g. Australian Commonwealth, Oregon) and conditions requiring compliance with pre-agreed fishery development plans (e.g. Western Australia). This may mean that many stocks remain undeveloped for many years under the QMS.
- the early entry of stocks into the QMS, together with the approach of tendering Crown quota to the highest bidder, means there is little incentive for 'pioneers' to develop non-QMS stocks (except for Maori). Given this is the major incentive offered by most other jurisdictions for the investment of private capital in new stocks, this is an important consideration and is discussed further in Chapter 5.

Many of the tools to allow for best practice are in place

New Zealand's existing system of management already contains many of the basic elements necessary to allow for 'best practice' in proving up new fisheries. Assuming high levels of compliance and well-founded quotas, the QMS provides a strong mechanism to control both overfishing and overcapitalisation in the early stages of fishery development (hence avoiding the 'boom/bust' scenario). It also provides a range of other well documented benefits (e.g. incentives to invest private capital in research to illustrate the availability of higher catches and hence allow for an increase TACs and quota values).

The structure of the new purpose special permits appears to be sufficiently broad to allow for research approaches to be tailored to the characteristics of the stock in question, as well as allowing for innovative approaches used successfully internationally (e.g. adaptive management – BC giant sea cucumber fishery; 'research while fishing' – Ross Sea Toothfish). Moreover, the ability to undertake exploratory fishing over and above the TACC without paying deemed values also minimises cost impediments that have constrained fishery development elsewhere (e.g.[83]), while at the same time improving MFish's ability to set robust TACs (assuming catch is taken in accordance with an approved research plan).

Notwithstanding that, further information is needed on a range of issues to ensure that all participants in new fisheries – industry, scientists, managers, NGOs, etc - have a clear understanding of how the above tools will be used in practice. For example, how will 'additional' catch be set under the new purpose special permits - will it take into account only biological factors or will industry imperatives (e.g. volumes necessary to offset costs, justify initial costs, test markets and processing techniques, etc) be taken into account?, how long will permits be issued for?, how many permits will be issued?, what is MFish's position on development of potential new species under the QMS or non-QMS frameworks? The answers to these and other questions will have a critical bearing on the success or otherwise of New Zealand's arrangements and are discussed further in Chapter 5.

Benefits exist in having a coordinated, industry-wide approach to proving up new stocks

While the deepwater crab and surf clam fisheries are yet to demonstrate long term commercial viability, a number of notional benefits appear to exist in having a single collective entity coordinate the process of proving up new stocks. These include:

- The pooling of resources to undertake biological and other research on a scale unable to be undertaken by individuals alone. This ability to generate better biological information faster assists regulatory agencies in meeting legislative objectives (e.g. setting TACs), and has the potential to directly benefit individual quota holders if the result is an increase in TACCs and quota values;
- Increasing the coverage and quality of fishery-dependent biological information through competitive contracts with harvesters. Unless harvesters deliver catch, effort, bycatch and other information of a quality required by contract, other harvesters will be substituted. This is the beauty of competition in providing services. The collective nature of the fishery means that the companies can operate as monopolists, that is, single buyers of the services of harvesters. Fishermen cannot simply 'get another job' in the same fishery.
- The ability to reduce overall input costs by collectively bargaining on key services such as harvesting and processing, as well as being able to better balance initial capital

[83] Ibid, Perry et al (2005)

investment with the available resource (rather than, for example, each individual investing in his own harvesting and processing capability);

- The ability to maximise returns by reducing competition amongst individual quota owners, and coordinating collective marketing initiatives;
- Improving compliance (and hence reducing costs);
- Eliminating free-riding (to the extent that membership can be encouraged to be unanimous);
- Facilitating more effective and efficient governance of the fishery by promoting coordinated industry positions.

Some of these – for example, the ability to undertake more efficient large scale biological and other surveys through collective pooling of resources – are already evident in practice in both fisheries, while others – for example, extracting maximum product value through control of market supply – are yet to be fully tested.

While any decision to 'collectivise' in the development stages of a fishery is clearly one for industry, MFish can play a role in supporting collective action in matters such as the number of new purpose special permits it issues per stock. A single permit per stock for example would encourage unified approaches amongst the industry; multiple permits may facilitate competition. These issues are discussed in more detail in Chapter 5.

Chapter 4: A Case Study -The Geoduc Fishery

Introduction

The third objective of this study was to explore in real time the challenges associated with proving up a new fishery in New Zealand by working directly with an industry group - the New Zealand Geoduc Company (NZGC) - currently attempting to develop a new stock. The geoduc fishery represented a good model on the basis that (a) it is still in the very early stages of development (b) it planned to make considerable progress on development plans throughout the course of the study; and (c) its approach to development provides contrast to the largely 'biology' rather than economics first approach taken by Surfco, and to a lesser extent Crabco. The following sections provide background on the fishery and the NZGC, the company's approach to development, progress made in the first year, key challenges and impediments faced and general lessons that might be applied to other fisheries in New Zealand.

The Fishery

Goeducs are large, borrowing bivalves found in sandy and muddy substrates around much of New Zealand's coast. Two species of geoduc occur in New Zealand waters: *Panopea zealandica* and *P. smithae*. Although distributions can overlap, the species are largely spatially separated with *P. zealandica* occurring mainly in shallow waters (5-25m) while *P. smithae* occurs in deeper waters between 110-130m.[84] Geoducs are relatively long lived[85]; the oldest *P. zealandica* found in survey in Golden Bay was 34 years, with the mean estimated age of the sample being 12-13 years.[86] The age at first maturity is not known with precision, however all *P. zealandica* larger than 61mm shell length sampled during a research survey in Golden Bay were mature. Growth is thought to be relatively rapid until about 10 years of age. Natural mortality is thought to be around 0.2, roughly an order of magnitude higher than similar species (*P. abrupta*) which forms the basis of geoduc fisheries in North America.[87]

(a)

(b)

Figure 12: (a) New Zealand geoduc (*P. zealandica*) being held for export; (b) geoduc harvesting in British Columbia showing diver with water gun to liquefy sediment.

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[84] Anon. (2009) Report from the Fisheries Assessment Plenary, May 2009: stock assessments and yield estimates. Ministry of Fisheries Science Group. May, 2009.
[85] Gribben (2003) indicates that they can live "up to 86 years"
[86] Ibid, Anon. (2009). This is considerably less than the oldest Canadian geoduc which was aged at 160 years
[87] Breen, P.A. (1991) The deepwater clams (geoducs) *Panopea zealandica* and *P. smithae*. New Zealand Fisheries Assessment Research Document 91/5.

Geoduc are harvested by hand using underwater breathing apparatus and water guns to dislodge the animal from the substrate (see http://www.youtube.com/watch?v=loRecKIi48Y for footage of harvesting in British Columbia). These animals are among the largest, deep burrowing clams in the world. Their siphons can extend up to one metre to reach the surface. Adult geoducs are stationary and cannot reburrow once removed from the sediment. Although they have been recorded in New Zealand from each of the North, South and Stewart Islands, the main geoduc harvests have been in the Nelson/Marlborough Sounds area (mostly in Golden Bay) at the northern tip of the South Island (PZL7)[88]. Over 150t were harvested in PZL7 between 1989-1992, mostly under a special permit for research (or exploratory fishing). Subsequently catches have been minimal although a small amount of experimental harvesting also occurred in PZL7 during 2004 and 2005. There are no estimates for recreational and customary take, and these harvests are thought to be very small. Geoduc entered the QMS on 1 October 2006. Tenders for Crown quota were held in 2007.

Table 7: Recorded commercial geoduc landings between 1989 and 2008.

	PZL 1		PZL 3		PZL 7		Total	
Fishstock	**Landings**	**TACC**	**Landings**	**TACC**	**Landings**	**TACC**	**Landings**	**TACC**
1989–90	0.315	–	0	–	95.232	–	95.547	–
1990–91	0	–	0	–	29.293	–	29.293	–
1991–92	0	–	0.725	–	31.394	–	32.119	–
1992–93	0	–	0.053	–	0	–	0.053	–
1993–94	0	–	0	–	0	–	0	–
1994–95	0	–	0	–	0	–	0	–
1995–96	0	–	0	–	0	–	0	–
1996–97	0	–	0	–	0	–	0	–
1997–98	0	–	0	–	0	–	0	–
1998–99	0	–	0	–	0	–	0	–
1999–00	0	–	0	–	0	–	0	–
2000–01	0	–	0.146	–	0	–	0.146	–
2001–02	0.003	–	0.068	–	0	–	0.071	–
2002–03	0	–	0.001	–	0	–	0.001	–
2003–04	0	–	0	–	1.444	–	1.444	–
2004–05	0	–	0	–	2.944	–	2.944	–
2005–06	1.200	–	0	–	0	–	0	–
2006–07	0	1.2	0	1.2	0	23.1	0	31.5
2007–08	0	1.2	0.132	1.2	0.32	23.1	0.45	31.5

Geoduc are sold throughout Asia, although the main market is in Hong Kong/China where it is considered by some to be an aphrodisiac. The siphon and foot of the animal is either eaten raw as sashimi, or included as a component of 'hotpot' style dishes. Prices for premium quality geoduc may reach up to US$60/kg to the fisher. Initial market tests have brought a 'beach price' for New Zealand geoduc of approximately half that, driven by the smaller size and dark colour of the product.

[88] Breen (1991) notes that exploratory fishing permits have in the past been issued for the Bay of Plenty, Hauroki Gulf, Marlborough Sounds, Dunedin and Foveaux Strait/Stewart Island.

Figure 13: Geoduc being held in a tank ready for sale in Hong Kong. Prices are in HKD. (Source: Wikipedia)

The major producers of geoduc are the fisheries of western North America (British Columbia, Canada; Washington and Oregon, U.S.; Mexico). Most of these were developed through the 1970's and are now well-established. For example, the TACC for the British Columbia fishery for 2009 is 3,443,800lbs (or 1537t). Although they have long existed as wild catch fisheries, significant effort has been made in recent years to boost production through reseeding with hatchery reared spat.

The New Zealand Geoduc Company

The NZGC was formed in 2008 for the purpose of proving up the geoduc fishery and delivering maximum long term value on the investment of quota holders. The company is governed by a board elected by quota owners. The company adopted a similar structure to that of Crabco and Surfco, creating a single management entity with all quota owners as shareholders. Under this structure, all quota owners (except one small quota holder in PZL7) have agreed to contribute their ACE to the company. In return the company has agreed to manage the collective pool of ACE in a way that aims to deliver maximum value (in terms of appreciation in quota value and dividends) to all shareholders.

Similar to Crabco and Surfco, the NZGC operates as a non-profit management company. Services necessary to prove up the fishery and to deliver the product to market (harvesting, processing, distribution, marketing) are to be independently contracted. This has substantial economic benefits for the company, the prime one being that it does not have to invest in boats, gear and related resources which would be a significant upfront cost. The investment would be significantly diminished in value if the fishery proved to be unviable, whereas the only cost subject to loss in the contract-in model is the variable cost.

Any profits from sales, over and above the company's costs, are returned to shareholders in proportion to the amount of ACE contributed. Quota owners have agreed that for the first three years any profits should be reinvested in further developing the fishery. Figure 14 outlines the structure of the NZGC.

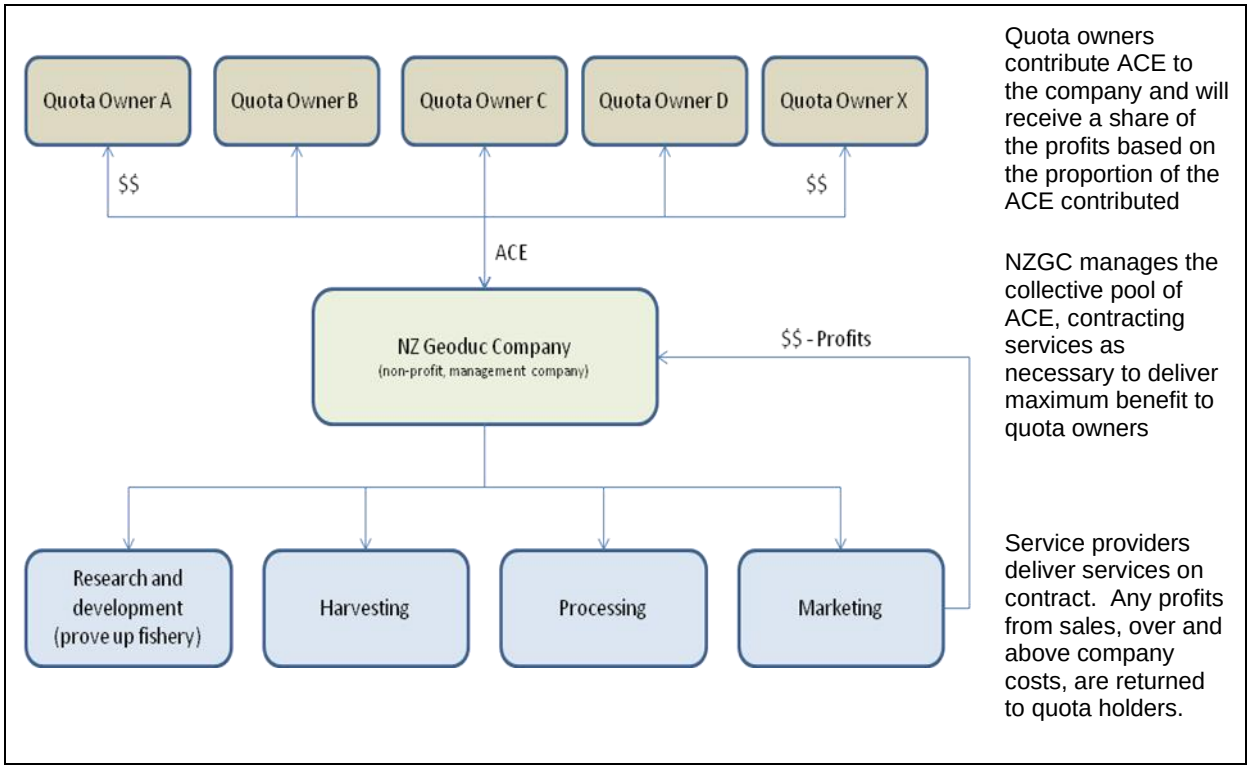

Figure 14: New Zealand Geoduc Company (NZGC) structure and operation.

Approach to proving up the fishery

NZGC's general approach is to develop PZL7 initially and use the lessons learned there to help prove up the remaining QMAs. PZL7 was chosen because:

- All current quota owners support development of the fishery
- PZL7 has a TACC of around 23 tonnes, compared to 2 tonne TACCs set in other QMAs
- Sanitation and biotoxin testing is established in PZL7, especially over areas to be targeted for initial development
- More is known about the existing beds in PZL7 than for any other QMAs
- Current quota owners are confident in being able to increase the PZL7 TACC as the fishery is proven up
- The cost of developing PZL7 is less than for any other QMAs (given the established sanitation and bio-toxin testing and the location of the fishery) and therefore the risks are minimised.

The Original Plan

The company initially adopted a very similar development approach to Crabco and Surfco, with the primary objective to secure a TACC increase as quickly as possible. This was to be achieved under a three phased approach to be completed by September 2011. The three phases were:

Phase 1: "Do and Learn" (Jan '09 – Sept '09)

The object of this phase was to commercialise fishing at a small scale using the existing 23t TACC in PZL7, and explore the most effective approaches to harvesting, processing and marketing. All three (harvesting technologies, processing methods and prices in overseas markets) were to be analysed in concert, allowing maximum flexibility and experimentation within each element. The TACC was to be put on the Asian market and any profits re-invested. Given the experimental nature of this phase (with the likelihood of significant changes occurring as deemed necessary) the ability to accurately forecast both costs and revenues would not be great. However at the end of the phase it was expected that a preferred harvesting technology would be resolved, processing methods selected and knowledge of expected prices obtained. Given the short time span allowed for this research, this was an ambitious undertaking.

Phase 2: Exploration (Oct '09 – Sept '10)

Phase 2 aimed to locate additional beds within PZL7 (outside of the three historically harvested beds in Mohua) and to assess the commercial value of these beds. In identifying potential new beds the company planned to draw on the expertise of divers built up during Phase 1 as well as relying on existing information from surveys conducted during the 1990's and early 2000's.

Phase 3: Stock surveys (Oct '10 – Sept '11)

This phase was to survey geoduc abundance in beds located during Phase 2. The results of surveys would be fed into MFish sustainability rounds and in an increase in quota sought if justified by the surveys. Phase 3 was to be undertaken in conjunction with NIWA (at a cost of $450,000), with 40% of survey costs to be offset by a grant from Seafood Innovations Ltd (SIL). Given the costs involved, Phase 3 would have only proceeded if sufficiently attractive beds were located during Phase 2.

The total cost of the three phases was estimated to be approximately NZ$700,000, the majority of which was attributed to the NIWA stock surveys in Phase 3. Parallel with this, NZGC planned to undertake detailed market testing of product primarily in Asia (China, Hong Kong, Singapore), but also to a lesser extent in markets within the region (e.g. the NZ domestic market and in Australia). This research would have refined the data on prices gathered in Phase 1 and extended the research into new markets (NZ and Australia). An ideal phasing of the proving up of the fishery would have entailed much of this detailed market research being done in Phase 1 rather than at this later stage. This was something recognised by the company and was a primary reason behind the subsequent change in development approach.

The Revised Plan

Based on experiences in Phase 1, NZGC moved away from an approach focused primarily on proving up the 'biology' of the fishery and increasing the TACC, to one focusing far more heavily on proving up the 'business end' of the fishery – i.e. optimising harvest techniques and efficiency, establishing processing and distribution systems that maintain the quality and safety of the product and testing market responses and preferences. This represents a significant departure from the approach adopted by Crabco and Surfco and was taken for a number of reasons:

- NZGC believed it was important to have confidence in the long term viability of the commercial aspects of the business (harvesting, processing, marketing) before proceeding with costly biological surveys. In other words, there would be no

commercial benefit in knowing that there were large stocks of geoduc around the country if their quality and, consequently market price, was not high enough to cover costs and return a viable profit;

- Refining the commercial aspects of the business will help to generate maximum value out of any future TACC increases, and could also help to improve quota value;
- Having external 'research' divers undertake biological surveys - would have meant the company would not have leaned from its experiences – for example how to harvest efficiently, how to market, how to improve the colour of product, etc.

Progress in the first year

Considerable progress in testing the various components of the business value chain has been made in the first year.

Harvesting

Harvesting is currently being undertaken by one dive team, with a further two teams gearing up. Most of these are experienced paua divers. Harvesting has been undertaken using underwater breathing apparatus (UBA) and high pressure water guns to dislodge animals from the substrate. The existing contractor has used a four man team comprising two divers in the water, one on the surface and a boatman. This level of manning comes with a cost but is a mandatory requirement for dive fisheries in New Zealand.

Beds have been located in Golden Bay, however harvest rates are low. Current harvest rates of approximately 100-250kg/day are substantially less than that achieved in similar areas in the early 1990's (approximately one tonne/day using a three man dive team). As a result, costs of harvesting have been higher than expected and average NZ$15/kg. In recent times a historically productive area known as the 'golden triangle' has been rediscovered and hopes are high that harvest rates will increase.

Processing

Processing has been linked to harvesting contracts, with dive teams also preparing and packing product for export. Harvesters deliver the export-ready animals to the freight forwarder.

A considerable number of shell breakages were experienced in early shipments, which resulted in the death of the affected animals and rejection by buyers. This has subsequently been resolved by bubble wrapping each animal. This initiative is expected to provide a positive benefit to cost ratio. If it proves too costly on a large scale other handling options can be tried. Problems have also been experienced in grading with a percentage of exported animals being below an agreed minimum weight (300gm). These problems are being resolved through more rigorous grading involving individually weighing each animal.

Marketing

Marketing efforts have largely focused on traditional Asian geoduc markets. Initial tests suggest that demand for New Zealand product is high (orders of up to 250t have been received from buyers in China), although prices are less than those received for premium *P. abrupta* (approx. US$17/kg compared with up to US$60/kg). New Zealand geoduc is considered "sweeter" than its North American competitors, and its smaller size makes it suitable for marketing as a 'family' product. Lighter coloured animals are much preferred to

darker animals; buyer advice indicates animals should be graded into "creams", "yellows" and "blacks", the latter attracting very low prices[89].

Thus far marketing has largely occurred through one buyer in Hong Kong (who has been able to move all product), although efforts to diversify will be made in year 2 of the new phased approach. No significant investment in differentiating New Zealand product has been made, however indications are that a "New Zealand" brand may be well-received by the market and lift beach price.

The "high" New Zealand dollar against Asian and US currencies has impacted adversely on the profitability of initial shipments. The NZ dollar tends to track behind (at a lower rate) the Australian dollar. Considerable speculation affects the Australian dollar and it "jumps" around a lot. This makes predicting future demand in overseas countries difficult.

Other progress

Administratively, NZGC has been registered and the constitution and shareholder agreement accepted. All fees payable by quota holders to support development efforts have been received.

Anecdotal evidence suggests that in latest trades the quota price has roughly doubled from the Crown tender price. No new information on the size and productivity of the stock has been generated, although it could be argued the diver experience generated from the first year of operations stands the company in better stead to undertake accurate surveys of density and distribution in subsequent years. The TACC for all QMAs has remained the same for the 2009/10 quota year.

Table 8: Comparison of initial development progress amongst NZGC, Crabco and Surfco.

Indicator	NZ Geoduc Co.	Crabco	Surfco
Primary objective of early stages of development	To prove up commercial viability/business aspects of fishery – i.e. harvesting, processing, distribution, marketing	To increase TACC; maximise quota value	To increase TACC; maximise quota value
Expenditure to date	$50,000	$1.5m	$360,000
Amount of available quota harvested/sold	All available quota harvested and sold in 1st year (23t)	Total of 5t harvested since 2007	No product commercially harvested or sold
TACC	No change to TACC	No change to TACC	TACC expected to increase from 30t to 400-700t in April 2010
Quota price	Quota price increased[90]	Quota price increased[91]	Unknown

[89] The lighter coloured animals tend to be the younger animals. As geoducs age their siphons become darker. In NZ a few animals weighing in excess of 600gm have been harvested, but they are very old and dark (Gribben, 2003).
[90] Anecdotal evidence from NZGC
[91] A quota trade undertaken approximately 10 months after the Crown tender achieved a 75% capital gain (Ibid, Soboil and Craig, 2008)

Where to from here?

The key challenge identified by NZGC's in its first year of operation is to improve the commercial viability of business. In particular, harvesting costs need to be cut and revenues from product sales need to be lifted. Initial shipments to Hong Kong have cost $23/kg to land, while sales from products have only averaged about $17/kg. Achieving an increase in the TACC remains an important objective, but with the present cost and income results, it is now a longer term objective.

Reducing harvesting costs

A number of approaches are being considered to reduce harvesting costs. In the short term, greater efficiency is expected in the second harvest year using existing dive-based techniques. The first years' harvest was seen as an exploratory exercise, with divers building up knowledge on preferred habitats, areas of greatest density, best times and techniques to spot geoduc 'shows', most efficient extraction techniques and the like. It is expected that divers will be able to use the experience gained in year 1 to improve catch rates in year 2.

In the longer term, both re-seeding/enhancement with hatchery reared spat and changes to harvest techniques – e.g. harvesting on exposed tidal flats – offer potential. Geoduc reseeding is still in its relative infancy in North America, though has shown great promise. Aquacultured *P. abrupta* now make up a considerable proportion of the total Washington State geoduc harvest, while spat seeded approximately 10 years ago in British Colombia are now coming on line for harvest. Spawning and hatchery rearing techniques are now relatively well-established, and considerable progress has been made on methodologies to improve spat survival (much of which has been government funded (eg.[92],[93]).

A number of factors suggest re-seeding is worth investigating in New Zealand. The areas of known geoduc beds in New Zealand have similar habitat characteristics to those in the Pacific Northwest and a well-established culture of reseeding (scallops, paua) already exists. Gribben (2003) indicates *P. zealandica* is likely to be amenable to hatchery culture[94], and its biology indicates the possibility of a higher productivity than its North American relative (lower maximum age – 34 Vs 146; order of magnitude higher natural mortality[95]) which may confer some competitive advantage. Evidence also suggests that the quality and colour of animals – two characteristics that NZGC's initial market tests indicate play an important role in beach price – is easier to control in aquacultured product. If successful, re-seeding offers considerable economy of scale benefits to the New Zealand industry.

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[92] Washington Sea Grant – Geoduck Aquaculture Research Program (http://www.wsg.washington.edu/index.html)
[93] Centre for Shellfish Research, Vancouver Island, Canada (http://www.mala.ca/csr/)
[94] Gribben, P. (2003). Demography and life history characteristics of the New Zealand geoduck, *Panopea zealandica*. PhD Thesis. University of Auckland. 182pp.

[95] Ibid, Breen (1991)

Figure 15: Geoduc aquaculture on tidal flats in Washington State, US. (Photo source: http://www.dfo-mpo.gc.ca/aquaculture/shellfish-mollusque/geoduck-panope-eng.htm)

Notwithstanding the above, an important consideration in establishing any geoduc reseeding program will be ensuring community support. Despite their commercial potential, aquaculture operations in the Pacific Northwest have generated considerable controversy (including spawning a number of 'anti-geoduc aquaculture' community groups[96]), largely focused on loss of amenity value and impacts on intertidal habitats. Impacts on habitat in particular have generated considerable attention and, in Washington for example, has led to the local legislature commissioning a number of dedicated research studies to respond to community concerns[97]. Normal considerations in establishing reseeding programs, such as maintenance of natural genetic diversity, would also need to be addressed.

In addition to reseeding, harvesting geoducs on exposed tidal flats may offer potential to reduce harvesting costs. Current dive-based harvesting has proven less efficient than hoped and, notwithstanding expected improvement in efficiency in year 2, will likely remain a constraint on profitability. Geoducs have long been harvested on exposed tidal flats in the Pacific Northwest and the adoption of similar techniques in New Zealand may deliver a range of cost and safety benefits. The immediate unknown however is whether *P. zealandica* occur on tidally-exposed flats similar to *P. abrupta*, and surveys using experienced geoduc 'spotters' will be required.

Improving price

NZGC's primary focus in improving the beach price will be in differentiating New Zealand product in the marketplace. Initial market testing has shown that New Zealand geoduc is "sweeter" than its competitors and, as a smaller animal than *P. abrupta*, is well suited to a 'family' market. Some very preliminary efforts have been made to "brand" New Zealand geoduc (Figure 16), however the company plans to undertake more detailed work in the coming year.

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[96] E.g. http://www.saveourshoreline.net/help/help.htm; http://www.protectourshoreline.org/index.html http://www.kuow.org/program.php?id=15811;
[97] http://apps.leg.wa.gov/billinfo/summary.aspx?bill=2220&year=2007

Figure 16: Preliminary NZGC branding used in initial market tests.

Scope may exist also to increase overall value by optimising the trade-off between size and colour. Larger geoducs attract higher prices, though Gribben (2003) notes that siphons tend to darken as they age, reducing their value. While it is not clear at this stage what the optimum trade-off is (i.e. is the same volume of larger, darker geoducs worth more in total than smaller, lighter ones?), it may be possible to optimise the mix either through a post-harvest process to lighten flesh or through selective harvesting. On the latter point, while on the face of it, the burrowing nature of animal would tend to make selective harvesting difficult (the colour and size of the animal isn't known until pulled out of the substrate, and if not of the desired type, can't be reburied), the scientific literature cited by Gribben (2003) indicates some scope to differentiate between larger and smaller animals by habitat type; larger animals tend to be found in sand and mud/sand, rather than purely mud substrates.

Increasing wild-catch TACC

The company remains very interested in increasing the PZL7 TACC, as well as proving up the remaining QMAs in the longer term. Increasing the TACC will likely add to the capital value of quota shares as well as reduce the 'per unit' costs associated with expenses such as sanitation and biotoxin testing, and thereby improve the overall profitability of the fishery. Notwithstanding that, the objective of increasing the TACC is likely to be pursued only after the commercial aspects of the business are better understood and proven profitable. At present there are no concrete plans to undertake exploratory surveys outside PZL7, although when done in due course these are likely to be undertaken internally by experienced company divers, consistent with the company's 'learn by doing' philosophy. This should reduce the research costs significantly. Given the difficulties in locating geoduc in situ, NZGC also believe the use of experienced divers will help ensure the accuracy of any scientific surveys.

The company has expressed interest in the new purpose special permits as a means to facilitate exploratory surveys although would like additional detail on the operation of the permits before committing to their use. In particular, detail is sought on the necessary content and objectives for research plans as well as how extra catch limits under special permits would be set. NZGC has expressed a willingness to work closely with MFish and relevant scientists in the preparation of an appropriate research plan that meets company objectives, while observing any limits of acceptable risk to the stock or environment. Additional catch taken under an approved research plan will have ancillary benefits for NZGC such as reducing the per unit price of fixed costs such as sanitation and biotoxin testing in PZL7.

What general lessons can be learned?

The geoduc fishery has proven a useful case study to assess the current issues and challenges associated with proving up new stocks within the New Zealand management framework. It has provided real time insights into types of issues and pressures confronting industry members engaged in the development of new stocks, as well as illustrating the contrasting approaches taken by Crabco and Surfco. A number of general lessons can be learned:

Industry approaches to proving up fisheries are likely to be highly variable; there is a need for policy flexibility.

One of the immediate conclusions from an assessment of the NZGC approach versus those taken by Surfco and Crabco, is that industry approaches to proving up new stocks are likely to vary considerably. Even within the QMS, approaches will vary considerably based on the characteristics of the species, the mix of shareholders and shareholder objectives, the extent of pre-existing knowledge about the fishery and other matters discussed above. Surfco for example have invested heavily in the 'biology first' approach arguing that "you can't sell something you haven't got". NZGC on the other hand deliberately moved away from the 'biology first' approach in the belief that there is a need to have confidence in the long term viability of the business before proceeding with costly biological surveys.

Both approaches have pros and cons. NZGC's approach will generate cash flow faster (through the sale of animals harvested during the experimental phase) and provide a better understanding of the various components of the business value chain earlier than the traditional model (biology first). However, it also runs the risk of outlaying capital proving up the business only to find out later there is insufficient resource to make the business viable. By contrast, the Surfco approach will deliver better biological information faster and has more chance of leading to an increase in the TACC (and hence delivering a capital gain for quota owners), although it runs the risk of outlaying considerable upfront capital in biological surveys only to find out later the fishery cannot be operated profitably.

Given the early state of development of both fisheries it is too early to conclude whether one approach is better than the other. The reality may be that both prove equally successful – a case of horses for courses. In any event, the 'take home message' for MFish is that approaches are likely to vary between fisheries and that sufficient flexibility is needed in policy arrangements surrounding developing fisheries to allow to industry to adopt a development strategy that is appropriate for the fishery (while obviously still meeting the objectives of the Act).

Benefits exist in 'learning by doing' in the early stages

While they are yet to generate detailed biological information on the fishery, the NZGC approach arguably has them well positioned to assess the type of operation that is likely to be commercially sustainable in the longer term. By exploring the commercial aspects of the business early in the development stages under their conscious "learning while doing" approach, NZGC have been able to:

- Test and refine harvesting techniques, highlighting a number of current limitations;
- Explore and refine processing and distribution methods to maximise value;
- Test potential markets, generating important insights into product price, consumer preferences and relative competitiveness of NZ product.

Importantly they have also been able to reframe their research needs (and budget) around the priorities arising from a year of practical 'road testing' – i.e. reducing harvesting costs and

improving market price – rather than untested assumptions made before the fishery commenced. Amongst other things this has resulted in a significant reduction in upfront development costs. In addition, the year of internal development work arguably also has them better placed to contribute to future scientific surveys – both in their design and carrying out the work in situ.

Similar benefits are also likely to be available under the 'research while fishing' approach facilitated by the new purpose special permits. From an industry point of view, in addition to generating information to support the setting of TACs and other measures, involvement in biological research can deliver commercially valuable information on target species distribution, abundance, seasonality and the like to support efficient harvesting plans as well as providing product to test downstream components of the value chain (processing, distribution, marketing etc). From managers'/scientists' point of view, industry involvement capitalises on their harvesting ability in biological surveys (important for species such as geoduc that are hard to locate), builds their capacity to interpret and contribute to research outcomes, and all other things being equal will lead to higher levels of support for research outcomes.

Chapter 5: Where to from here?: key issues for consideration

Introduction

The evidence suggests the long term success or failure of a new fishery will ultimately depend on its commercial viability, rather than the policy and regulatory framework governing its management. Inherently viable fisheries will develop in spite of "poor" management, while marginal fisheries often fail to develop despite favourable management regimes and significant government assistance.[98] Nonetheless, there are undoubtedly things that governments can do to enhance the chances of a new fishery achieving viability as well as long term sustainability. This section discusses the major issues for consideration in the future management of new and developing fisheries in New Zealand highlighted by this study.

Key policy/management issues

Need for a clear policy/operational framework

The key need identified in this study is for a clear policy and operational framework to guide the management of developing fisheries. While many of the tools necessary for orderly development of new species are in place (e.g. QMS, new purpose special permits, cost recovery), no clear framework exists outlining for stakeholders the New Zealand government's policy objectives in relation to new fisheries as well as operational guidance on how those objectives will be achieved under New Zealand's management framework (for example, is MFish's preferred approach to develop potential new non-QMS fisheries through the QMS or outside of the QMS in their early stages?; at what stage should non-QMS species be brought into the QMS; what should a research plan under a s97 special permit look like and how will additional catch limits over and above the TACC be set?; should any recognition be given to the 'rights of pioneers'?).

Our review of international experiences suggests that the existence of a clear policy and operational framework setting out "the rules of the game" – usually in the form of a specific 'New and Developing Fisheries Policy' or similar – is an important plank in creating the conditions necessary for the sustainable development of new fisheries (see for example Perry et al, 2005). A clear, pre-agreed framework has a range of benefits including, amongst others, ensuring clarity for all stakeholders around the principles and processes by which new fisheries will be developed, allowing industry to make realistic assessments of costs and timelines involved in proving up new species, and promoting economic efficiency by reducing administrative and bureaucratic uncertainty. It is worth noting here that suggestions that a dedicated policy/operational framework for new and developing fisheries be developed were almost universally received well during consultations for this research.

While a number of example policies/frameworks for the management of new fisheries exist internationally (and may be of some value in structuring a New Zealand specific approach), an important conclusion of this work is that New Zealand's unique system of fisheries management requires a tailored approach. The key issues highlighted during this study as important in the framing of any policy/framework are discussed below. A suggested indicative process for the development of new stocks in summarised in Figure 17.

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[98] See for example Perry et al's (2005) assessment of success and failure of proposed new fisheries off the west coast of Canada.

Overall goal for new fisheries

A key component of any policy/framework should be a statement of the Government's higher level goals for new and under-developed fisheries (e.g. is it our policy to encourage the development of new fisheries? Do we not encourage new fisheries? Are there circumstances in which we do not support new fisheries – e.g. where they will compete with existing users, etc). These goals send a signal to industry, the finance sector and other stakeholders about the Government's intentions with respect to new fisheries as well as providing important context to MFish officials in interpreting the policy document.

In framing these goals, consideration should be given to the special features of new and developing fisheries (data poor, potentially competitive with existing users etc) as well as how the management of this sector can contribute to the Government's overall fisheries goals – e.g. the overall goal of the Fisheries 2030 process "New Zealanders maximising benefits from the use of fisheries within environmental limits".

QMS Vs Non-QMS?

While conventional wisdom suggests most new fisheries in New Zealand will come from QMS stocks, the possibility that fisheries for new non-QMS stocks will develop cannot be discounted. An important question is how long to allow these fisheries to develop under the non-QMS framework and at what stage to move them into the QMS. The available evidence internationally suggests there is considerable benefit in 'catching fisheries early' – that is, identifying new stocks with development potential early (either through a dedicated program or through industry catch and effort reporting) and getting them into an orderly development process[99]. The practical implication for New Zealand is to get new stocks showing development potential into the QMS as soon as possible. Entry into the QMS provides a degree of natural protection against problems that have plagued new fisheries in other jurisdictions – overcapitalisation and overfishing – as well as providing a structure for orderly development with a defined set of rights holders (each of which has an inherent incentive to improve the biological knowledge of the fishery to increase the TACC). It also avoids the problems associated with the non-QMS framework – for example, non-transferability and lack of asset value and absence of incentives to invest in better science given no improvement in asset value will flow. While this approach is not without its risks – entry of stocks into the QMS reduces the potential number of fishers who can explore new stocks – on balance the benefits far outweigh these downsides. In the absence of good biological information, new stocks should enter the QMS with nominal TACs, consistent with current practice. Importantly, this need not necessarily mean a 0 TAC; rather a TAC set on an appropriately precautionary basis taking into account previous catches, the life history characteristics of the animal and the like. It is also worth noting that early entry into the QMS ensures new fisheries are covered under NZ's cost recovery regime, serving to avoid the problems of lack of resources experienced in many other jurisdictions. Early entry into the QMS may also mitigate against the problems associated with sunken investment hindering collective approaches to proving up new stocks.

Operational guidance on new purpose special permits

The new purpose special permit arrangements appear sufficiently broad to allow 'best practice' approaches to the development of new fisheries, though they remain untested at present and

[99] e.g. Perry et al, 2005

greater levels of operational guidance on some of the key components. These are discussed below:

Objectives and content of research plans

A key condition of access to additional catch under new purpose special permits is that the catch is taken in accordance with an agreed research and data collection plan. This is a logical approach, however little detail is yet available on what a research plan should aim to achieve and what it should look like. Given existing special permits are available to answer purely biological questions, it seems clear that an economic dimension was envisaged in establishing the new special permit purpose. Guidance on the structure and content of a research plan would provide a clear signal from MFish about the expectations for research plans, as well as helping to avoid situations where considerable development work was undertaken by industry only to have it 'miss the mark'.

In developing guidance on the objectives and content of research plans, we suggest this be kept non-prescriptive. Given the diverse nature of possible new fisheries in New Zealand, approaches tailored to the unique characteristics of each new stock will likely be needed to answer the relevant biological and economic questions to prove up new stocks. In that light, we recommend that any guidance provided by MFish focus on the outcomes to be achieved by the research plan – for example, that it will substantially improve MFish's ability to set a TAC in accordance with their legislative objectives – rather than the method by which the outcome is to be achieved.

Setting additional catch

Another key question for potential special permit applicants is how the additional catch (i.e. the catch over and above the TACC for which DVs will not be charged) to allow for commercial exploration will be set. A longstanding purpose for special permits has been to allow for catch over and above the TAC to answer biological questions. The amount of additional catch under these permits has been limited to the minimum amount required to answer the biological question. However the new purpose has clearly been established to allow for an extra amount of take, over and above that required to answer biological questions, to offset the costs of biological research and to test the commercial viability of new stocks. The quantum of this 'additional' amount will be critical factor in determining whether an R&D program to prove up a new species is viable.

Operational guidelines on how the additional catch will be set would provide useful guidance for industry in determining whether to proceed with a permit application, and for MFish and the scientific community in both setting catch limits and ensuring rules are consistently applied across fisheries. Any operational guidelines are likely to be influenced by the objectives chosen for research plans above. While it is unrealistic – and almost certainly biologically risky – to set additional catch limits with a view to fully offsetting the costs of any R&D program, if the objective of the NZ Government is to encourage the sustainable development of new stocks, consideration should be given to ensuring appropriate incentives are provided to entrepreneurs to undertake development work (within acceptable limits of biological risk).

The biological and economic needs associated with each potential new fishery may vary considerably. Accordingly, we suggest that the general operational principles for setting additional catch be developed by MFish, with the details for new fishery to be agreed by MFish, scientists and industry in the development of the proposed research plan (see 'need for high level of interaction between industry, scientists and managers' below).

Length of permits

Experience internationally suggests that realistic timeframes are required to prove up new fisheries[100]. Acquiring necessary biological knowledge on new stocks is often slow, while industry frequently requires many years to adequately test harvesting techniques, markets and post-harvest processing and distribution systems. No guidance has yet been provided on the length of time new purpose special permits are likely to be issued for, other than that annual reporting requirements are likely at a minimum[101]. The implication from international experience suggests that MFish should not be averse to issuing permits for longer periods (say five years) where a solid biological and economic case can be made. This would give industry a level of security to engage in proving up a new stock, particularly where considerable investments are required, as well as allowing sufficient time to make genuine progress on the key biological questions. Notwithstanding that, longer term permits would obviously need a provision for annual review and adjustment based on research results to date, as well as to suspend or cancel permits in the event of serious risks to stocks or major non-compliance with permit provisions (see 'ability to cancel/suspend permits' below).

Number of permits

Considerable benefits have been highlighted by this study in having a single, collective entity, comprising all rights holders, coordinating the development of a new stock (i.e. the "Surfco/Crabco/NZGC" model). All other things being equal, combined entities have a greater critical mass to engage in biological and other research, potentially delivering better knowledge sooner, than individual entities operating independently and often in competition. Likewise, collective entities are arguably better placed to derive maximum economic benefit in the early stages of fishery development by optimising initial investments in harvesting technology, coordinating marketing and controlling supply to maximise price. Collective entities also address the problem of 'free riders' that has stymied new fishery development elsewhere (e.g.[102]).

While the decision to 'collectivise' in proving up a fishery is clearly one for rights holders, MFish can play a role in supporting such a decision by limiting the number of new purpose special permits it issues for each stock. Providing clear advice that, unless an exceptional circumstance exists, only one permit will be issued for each stock offers clear encouragement to industry coordinate exploratory activity (even if they don't go down the path of forming a Surfco/Crabco type company) and helps avoid the situation where two possibly conflicting fishing programmes are running in parallel.

Ability to cancel/suspend permits

A major 'quid pro quo' of the additional catch allowed under the new purpose special permits is the provision of research data to assist MFish set future TACs. Similar arrangements were in place under the previous Adaptive Management Program, however fell down when, in some cases, industry failed to provide the data. With the experience of AMPs in mind, there is a need to ensure strong powers are available to cancel or suspend new purpose special permits in the event that information is not provided (as well as in other circumstances such as unforseen risks to stocks and major incidents of non-compliance etc). Put simply, if the industry doesn't hold up its end of the bargain by providing information, it shouldn't be able to access the extra catch. This point was stressed by many of the MFish officials consulted for the study and accepted universally by the industry members consulted.

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[100] Ibid, Perry et al (2005)
[101] Ibid, MFish (2008)
[102] Ibid, Harte et al (2008)

Notwithstanding the above, given the possibly substantial investments involved in research programs under special permits, industry has understandably expressed a desire for clarity around the circumstances under which a permit may be cancelled. This could be addressed by pointing all applicants to the general power of MFish to cancel special permit under the Fisheries Act 1986, as well as spelling out as clearly as practically possible in the provisions of the permit the types of circumstances that might lead to suspension/cancellation (e.g. major non-compliance with permit conditions, failure to submit research data within agreed timeframes, etc).

Eligibility - when does a 'developing' fishery become a 'developed' fishery?

While seemingly an esoteric question the answer has important practical implications for the development of new fisheries, most notably because 'developing' fisheries are eligible for the new purpose special permits while 'developed' fisheries are not. Unlike most jurisdictions which have relatively a clear transition between developing (characterised by non-transferable rights) and developed fisheries (characterised by transferable rights), most of New Zealand's fisheries development occurs within a single framework – the QMS. Given the differences in special permit eligibility between 'developing' and 'developed' fisheries, there is a need for clear understanding amongst all stakeholders about when a developing fishery becomes a developed fishery and is no longer eligible for a special permit. The answer also has important implications for equity amongst fisheries: limitless access to special permits would allow 'developing' fisheries access to additional catch not available to developed fisheries and has the potential to distort quota markets.

While definitions for 'new' and 'closed' fisheries have been developed for the purposes of special permits[103], no guidance is provided about when a 'new' fishery becomes a 'developed' fishery. In most jurisdictions internationally the decision on this transition is left to the discretion of a nominated decision maker, most frequently based around whether sufficient information is available to provide robust TAC estimates and whether the fishery has demonstrated it can sustain (economically and biologically) a commercial level of fishing effort. In the New Zealand context, a number of factors could be considered in framing an effective definition including:

- Whether the fishery has achieved a threshold level of biological information commensurate with other 'developed' fisheries;
- Whether the full TACC is consistently being taken;
- The number of consecutive permits issued for a stock or the total time operating under a special permit (the purpose being to send a signal that access to special permits would not go on forever and form a de facto TACC increase).

Of these, the link to the acquisition of a threshold level of knowledge is the most consistent with other jurisdictions internationally and perhaps the most appropriate measure.

Need for high level of interaction between industry/managers/scientists during early stages of development

As noted in Chapter 1, a high degree of interaction between stakeholders in the early stages of fishery development – most notably industry, managers and scientists – has been highlighted by a number of jurisdictions as important to successful to new fishery development. High levels of interaction encourage a range of benefits including:

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[103] MFish, Ministerial Briefing Note: Decision on Purpose for Issuing Special Permits, Section 97(1)(C) of the Fisheries Act 1996. 23rd January 2009.

- Ensuring each of the parties is aware of each others' needs; managers and scientists are aware of the commercial pressures and incentives on industry, while industry is aware of the legislative and other requirements of government;
- Ensuring early R&D is focused on the main issues including, from industry 's point of view, those things that will drive quota value;
- Facilitating reasonable trade-offs to best achieve the overall objective of sustainable new fishery development;
- Assisting in highlighting and addressing unnecessary impediments to fishery development (e.g. unnecessary gear restrictions);
- Intangibles, such as providing all parties with a sense of ownership in the success of the new fishery.

In the New Zealand context, an appropriate forum through which to encourage interaction appears to be the scientific working group process. These groups are already structured around relevant fishery groupings and include many of the relevant management and scientific personnel to effectively contribute to proving up new fisheries. Industry applicants for new purpose special permits should be encouraged to develop research plans in close consultation with relevant working groups. This would ensure the main management and scientific issues were addressed and provide confidence about the scientific rigour of plans prior to being presented to the Chief Scientist for approval. Working groups would also then be well placed to undertake annual reviews of research plan progress as well as, in time, recommend longer term TAC/Cs. It is critical to the success of this process that all parties engage in good faith.

Adaptive management

Consideration should be given to incorporating adaptive management approaches into the early stages of fishery development. Adaptive management (for example, varying fishing effort across a stock to test responses to fishing pressure) has shown that it can deliver valuable information on low knowledge stocks at comparatively low risk.[104] For example, setting aside parts of the stocks as reserves and subjecting the remainder to varying levels of fishing pressure, may rapidly deliver good information on the symptoms of overfishing without jeopardising the entire stock. Adaptive management may also deliver economic benefits to industry by speeding up the process of information collection and delivering answers to key questions such as the rate of stock recovery after varying rates of fishing pressure, necessary to support efficient harvesting plans.

Examples in which true adaptive management techniques have been applied to new fishery development in practice appear relatively few and far between, however successful case studies do exist. A good example is the experimental program in the developing British Columbia sea cucumber fishery which applied varying levels of fishing pressure across a number of Experimental Fishery Areas and has provided sufficient information to provide recommendations on annual harvest rates as a proportion of virgin biomass as well as limit and target reference points[105]. Based on this information, the fishery is now being considered for transition to a developed fishery. In the New Zealand context, adaptive management approaches could be incorporated into research plans required for new purpose special permits.

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[104] Ibid, Hilborn and Sibert (1988); British Columbia giant sea cucumber fishery case study
[105] Ibid. Hand, et al (2008).

Rights of pioneers

A common incentive offered by virtually all major jurisdictions internationally for the development of new fisheries is to recognise the 'rights of pioneers' – i.e. those who have invested their own money to prove up new stocks. This is most often done by providing preferential entry into, or allocation under, a newly 'developed' fishery. However, no such incentive exists within the New Zealand framework. Under the current system where Crown quota is tendered in an open market, no incentive exists to develop new non-QMS stocks, except for Maori who are guaranteed 20% of the shares in any new QMS stock.

In order to address this lack of incentive, the argument was made by a few interviewees that a certain percentage of Crown quota be reserved for pioneers. Under such an approach, those who invested in the development of non-QMS stocks might be provided with 'first right of refusal' to a proportion of quota shares based on some equitable price – for example, the lowest successful price paid for shares in the open tender. However, while providing incentives for pioneers has superficial attraction, the practical implementation of such a scheme is likely to be difficult. Given the potentially limitless number of potential 'pioneers' under the non-QMS framework, thresholds and guidelines would need to be developed to distinguish genuine pioneers from others, and a considerable process of catch verification and other administrative tasks would likely be needed. Given the NZ government has recently moved away from catch history based allocation, we don't imagine it is an attractive proposition to move back so quickly (if at all).

The practical implication from the above then is to ensure that stocks showing development potential are introduced into the QMS at the earliest opportunity. Such an approach would help avoid the situation where an individual or entity invests significant private capital (and time) into the development of a new stock, only to miss out on quota shares in the Crown tender, resulting in a serious equity/political problem.

Incentives

If the policy of government is to promote the sustainable development of new stocks then incentives can be valuable in encouraging entrepreneurial investment amongst industry. The longer term incentive for industry is the quota asset value and ongoing profitability associated with a viable fishery. However, without the recognition of the rights of pioneers, the NZ framework lacks the key short-medium term incentive offered by virtually all other jurisdictions internationally. In the absence of such recognition, other short term incentives should be considered.

One option is to build incentives into the catch setting process under the new purpose special permits. Setting the 'additional' catch at a level that helps to minimise the upfront costs associated with biological and other research (while obviously remaining within the bounds of acceptable biological and ecological risk) would be an important incentive to overcome the cost impediments to new fishery development experienced by many other jurisdictions internationally. Any additional catch under new purpose special permits is also temporary in nature, reflecting the temporary 'hump' many new fisheries face before returning a profit, and subject to the standard review and cancellation provisions of special permits.

Other more direct means of assistance – for example, cash research grants or other government subsidies – may be considered, and may be valuable in a range of circumstances, however they are subject to the vagaries of government budgeting and have met with only patchy success in other jurisdictions. Incentives may also be considered in the form of larger than nominal TACCs upon entry into the QMS, however this would be inconsistent with the precautionary approach to new fisheries advocated in the New Zealand Harvest Strategy standard and not reflective of the lack of knowledge associated with most new stocks.

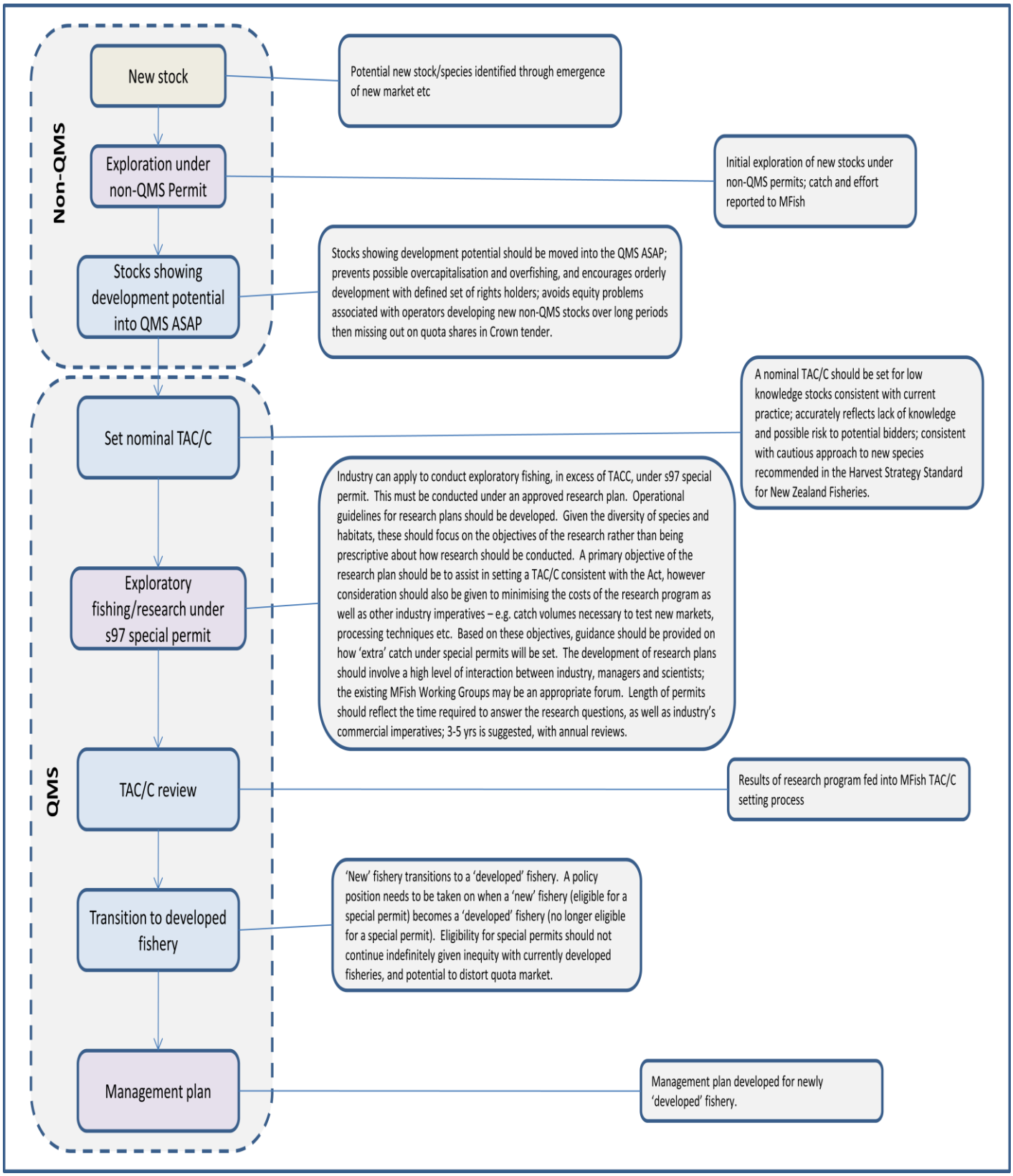

Figure 17 : Indicative process for the development of new stocks under New Zealand's existing management framework.

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Annex 1: Project survey

RESPONDENT DETAILS

Department/Agency:	
Name of Contact Officer:	
Position:	
Email address:	
Telephone Number:	

Please tick boxes and elaborate where necessary. Spaces provided for responses may be extended wherever necessary.

POLICY FRAMEWORK

1. **Do you have a specific policy (or policy framework) for new and developing fisheries?**

   YES ☐ NO ☐

2. **If yes, could you please provide a copy, or website address?**

   Document attached ☐ Website Address: _____

3. **How many fisheries have been processed/assessed under your policy in the past 10 years?**

   Number ☐

4. **How many fisheries have transitioned to "developed" fisheries under your policy in the past 10 years?**

   Number: _____

Are you able to provide us with information on each fishery listed in the table below?

Name of Fishery	Target Species	Gear Type	Number of permits

5. **Has your policy undergone changes in the past 10 years?**

YES ☐ NO ☐

If yes, please describe the major changes and, if possible, briefly explain why the changes were made.

_____

_____

_____

_____

6. **Does your policy contain explicit guidance on the level of acceptable risk to target stocks in the development of new fisheries?**

YES ☐ NO ☐

If yes, please briefly describe the guidance provided.

_____

_____

_____

7. **Does your policy contain explicit guidance on the level of acceptable risk to the environment in the development of new fisheries?**

YES ☐ NO ☐

If yes, please briefly describe the guidance provided.

_____

_____

_____

_____

MANAGEMENT APPROACHES

8. Do you, or the applicant, conduct an assessment of the possible impacts of the new/developing fishery on the proposed target stock/s prior to the commencement of the fishery?

YES – Management agency conducts assessment ☐

YES – Applicant conducts assessment ☐

NO – Neither conduct assessment ☐

If yes, what process/method do you use (e.g. formal risk assessment)?

_____

_____

_____

_____

9. Do you, or the applicant, conduct an assessment of the possible ecosystem impacts of the new fishery prior to commencing the fishery (e.g. impacts on bycatch, habitats, trophic levels, etc)?

YES – Management agency conducts assessment ☐

YES – Applicant conducts assessment ☐

NO – Neither conduct assessment ☐

If yes what process/method (e.g. formal risk assessment) do you use?

_____

_____

_____

_____

10. Do you set aside reserve areas in your management arrangements for new/developing fisheries (i.e. defined areas encompassing some of the target stock in which no fishing is allowed)?

YES ☐ NO ☐

11. Do you take a staged approach to the development of new/developing fisheries (e.g. progressively exposing more of the stock to commercial exploitation)?

YES ☐ NO ☐

If yes, please briefly describe the stages in the development of new fisheries?

_____

_____

_____

_____

12. Do you actively incorporate experimental fishing approaches into management arrangements for developing fisheries (e.g. varying catch levels in different areas to test the impact of fishing on stock)?

YES ☐ NO ☐

If yes, please briefly describe some examples below.

_____

_____

_____

_____

13. How often do you review your management arrangements for new fisheries?

More than once per year ☐ once a year ☐

Every one to three years ☐ less frequently ☐

14. Do you devolve any aspects of the management of new fisheries to fishers/ the fishing industry?

YES ☐ NO ☐

If yes, briefly describe the particular aspects and how they are to be dealt with by the fishing industry.

_____

_____

_____

RESEARCH / INFORMATION COLLECTION

15. Do you prepare a structured research plan to guide information collection in the development of new fisheries?

YES ☐ NO ☐

If yes, please briefly outline how the plan is developed and information needs are prioritised.

_____

_____

_____

If no, please briefly describe how information needs for new fisheries are identified and prioritised.

_____

_____

_____

16. Do you use fishery-dependent data and information (e.g. logbook catch and effort data) to obtain information on new fisheries?

YES ☐ NO ☐

If yes, what types of information are fishers in new fisheries required to report (and are there any differences from the information required from developed fisheries)?

_____

_____

_____

17. Do you use fishery-independent data (i.e. scientific surveys) to obtain information on new fisheries?

YES ☐ NO ☐

If yes, how are fishery-independent data needs determined? For example, collectively by managers, scientists and industry or by management alone?

_____

_____

_____

18. If you use fishery-independent data, who pays for the data collection? If 100% management please state so. If 100% industry likewise. If a combined effort, please apportion.

Management ☐ % Industry ☐ %

19. Is there a baseline level of information about new fisheries that you require before allowing the commencement of commercial fishing?

YES ☐ NO ☐

If yes, please describe the baseline.

_____

_____

_____

_____

20. Do you provide incentives to fishers to provide data and information in the development of new fisheries (e.g. increases in commercial total allowable catch – providing it is taken in accordance with an agreed research plan)?

YES ☐ NO ☐

If yes, please briefly describe the types of incentives offered.

_____

_____

_____

ACCESS TO DEVELOPING FISHERIES

21. How does the process of developing a new fishery commence?

a) Industry applies for a permit ☐

b) A dedicated government policy and assessment process to identify new fisheries ☐

c) Other (please describe) ☐

_____

_____

_____

22. Do you have an agreed framework/process for the allocation of rights/access to new fisheries?

YES ☐ NO ☐

If so, are you able to provide us with a copy?

Document attached ☐ Website Address: _____

23. Do you require permit holders to actively develop the fishery to maintain access to the fishery (e.g. by maintaining a minimum level of catch or by maintaining a minimum level of ongoing investment)?

YES ☐ NO ☐

If yes, could you please describe your requirements?

_____

_____

_____

24. For what period of time are permits to new fishers issued?

One year ☐ Two years ☐ Three years ☐

Four years ☐ Five years or more ☐ Variable ☐

What matters are taken into account in setting the period?

_____

_____

_____

25. Do your developing fishery permits include provision to cancel or suspend access for non-compliance or other matters?

YES ☐ NO ☐

If yes, please briefly describe the types of circumstances that might lead to suspension or cancellation of access.

_____

_____

_____

TRANSITION TO "DEVELOPED" FISHERY

26. On what criteria does a new/developing fishery become recognised as a "developed" (mature) fishery?

_____

_____

_____

27. Do you have a formal policy which determines how access/rights are allocated in newly developed fisheries?

YES ☐ NO ☐

If so, are you able to provide us with a copy?

Document attached ☐ Website Address: _____

28. Do you recognise the rights of "pioneers" (i.e. those who have invested in the development of a fishery) in allocating access to newly developed fisheries?

YES ☐ NO ☐

If no, what is the rationale?

_____

_____

_____

_____

INCENTIVES / SUBSIDIES

29. Does your government offer incentives or subsidies (financial or otherwise) to develop new fisheries (e.g. tax concessions, R&D grants, market development grants)?

YES ☐ NO ☐

Please detail the incentives/grants, and in monetary terms if possible.

_____

_____

_____

30. Are there incentives for the development of fisheries built into your policy framework?

YES ☐ NO ☐

If yes, please briefly describe the types of incentives.

_____

_____

_____

COST RECOVERY

31. Do you have a dedicated cost-recovery framework that applies to new fisheries?

YES ☐ NO ☐

If yes, could you please provide a copy?

Copy Included ☐ Website Address: _____

OVER-CAPITALISATION

32. What, if any, steps are taken to prevent overcapitalisation in the development of new fisheries?

_____

_____

_____

_____

OTHER USERS

33. Does your policy take into account the rights/interests of other users of shared resources when developing new fisheries (e.g. other fishing sectors taking the same species [recreational; commercial; customary]; other activities in the same area)?

YES ☐ NO ☐

If so, please describe how these rights/interests are taken into account.

_____

_____

_____

34. Do you undertake public consultation on the development of new fisheries?

YES ☐ NO ☐

35. At what stage of the process do you undertake public consultation?

From the very beginning ☐ After a preliminary assessment ☐

After a final assessment ☐ Other ☐

36. Do you have formal processes to provide for interaction between stakeholders (e.g. industry, management, scientists, NGOs, etc) in the development of new fisheries (e.g. Management Advisory Committee, etc.)?

YES ☐ NO ☐

If so, please briefly describe your processes.

_____

_____

_____

COMPLIANCE

37. Do you consider the compliance and enforcement needs and their costs with the development of a new fishery?

YES ☐ NO ☐

38. 3. Do you develop a specific compliance plan for each new fishery?

YES ☐ NO ☐

39. 4. Who pays the cost of the compliance plan?

Industry ☐ Management ☐ Other ☐

INDUSTRY STRUCTURES

40. In your experience, have there been some industry structures/arrangements that have proven more successful in the development of new fisheries than others (e.g. all permit holders operating as part of a single company/entity; all permit holders operating independently)?

Yes ☐ No ☐

If yes, please briefly describe the attributes of the more successful examples.

_____

_____

_____

KEY LESSONS

41. Based on your experience, what have been the key lessons learned in the development of new fisheries in your jurisdiction (e.g. important pre-requisites for success, key obstacles to development, important parts of the development process)?

_____

_____

_____

_____

_____

OTHER

42. Are there any other comments you would like to make about the management of developing fisheries in your jurisdiction?

_____

_____

_____

_____

Annex 2: People consulted

Person Consulted/Title	Department/Agency
New Zealand	
Dr Jeremy Helson	MFish
Dr Ralph Townsend	MFish
Dr Eugene Rees	MFish
Tim Persen	MFish
Dr Pamela Mace	MFish
Dr Martin Cryer	MFish
Dr Mark Soboil	Aotearoa Fisheries Limited
Tony Craig	Surfco/Crabco
Alan Riwaka	NZGC
Bruce Chapman	SeaFIC
Tony Clark	SeaFIC
Australia	
Selina Stoute A/g Senior Manager – Fisheries Policy	Australian Fisheries Management Authority (AFMA)
Ian Curnow, A/g Executive Director & Rachael Davies, A/g Aquatic Resource Management Officer	Department of Regional Development, Primary Industry, Fisheries and Resources Northern Territory
Daryl Sullings, Senior Fisheries Manager	Fisheries Resource Management Industry and Investment NSW
Dr Stephen Mayfield, Subprogram Leader: Molluscan Fisheries	SARDI Aquatic Sciences
Grant Pullen, Manager Wild Fisheries Management	Tasmanian Department of Primary Industries, Parks, Water & Environment
Ross Gould Principal Management Officer, Northern Bioregion	Western Australia (W.A.) Department of Fisheries
Dr Paul Gribben Chancellor's Post-Doctoral Fellow	Department of Environmental Sciences, University of Technology, Sydney
CANADA	
Stefan Leslie, Director, Resource Management Maritimes Region	Fisheries and Oceans Canada
Guy.Parker, Resource Manager, Pacific Region	Fisheries and Oceans Canada 250-756-7163
Dr R. Ian Perry	Fisheries and Oceans Canada

Pacific Biological Station	
United States of America	
Fentress H. Munden	North Carolina Division of Marine Fisheries
Harry Blanchet Marine Fisheries Division	Louisiana Department of Wildlife and Fisheries
Gway Kirchner Marine Program Office	Oregon Department Of Fish and Wildlife
Melanie Brown Fishery Program Specialist Sustainable Fisheries Division,	National Marine Fisheries Service, Alaska Regional Office National Ocean and Atmospheric Administration (NOAA)
Europe	
Dr Poul Degnbol Scientific Advisor	European Commission
Anders Munk Jensen Director of Fisheries	The Danish Directorate of Fisheries Denmark
Magnus Bergstrom Senior Advisor, Resource Management Division	Swedish Board of Fisheries Sweden
Vegard Haukeland Higher Executive Officer Fisheries Management Section	Department of Marine Resources and Coastal Management, Ministry of Fisheries and Coastal Affairs, Norway
Brynhildur Benediktsdottir Advisor, Dep. of International Affairs	Ministry of Fisheries and Agriculture, Iceland
Africa	
Dr Kim Prochazka, Director, Resources Research	Department of Environmental Affairs and Tourism Marine and Coastal Management. South Africa
Dr Ané Oosthuizen National Marine Co-ordinator Park Planning & Development	South African National Parks South Africa
Dave Japp Fisheries & Oceanographic Support Services	CapFish South Africa
Other	
John Barton Director of Fisheries	Fisheries Department, The Falkland Islands
Ignacio Paya Senior Stock Assessment Scientist	Fisheries Department, Falkland Islands Government The Falkland Islands
Dr Denzil Miller Executive Secretary	Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR)