SBW

NEW ZEALAND DEEPWATER FISHERIES MANAGEMENT PRACTICES

SOUTHERN BLUE WHITING

DEEPWATER GROUP LTD
PUBLICATION SERIES 2013/02

deepwater group

DEEPWATER GROUP LTD

A non-profit organisation delivering the vision of New Zealand's deepwater quota owners to be recognised as having the best managed deepwater fisheries in the world, working closely with scientists and in partnership with the Ministry for Primary Industries.

ACKNOWLEDGEMENTS

DWG would like to extend their appreciation to all those who supported and contributed to the preparation of this report. In particular, we'd like to thank the Ministry for Primary Industries.

CITATION

Clement, I.T, Gargiulo, S., Irving, A. & Tilney, R. (2013). New Zealand Deepwater Fisheries Management Practices: Southern Blue Whiting (Deepwater Group Ltd Publication Series 2013/02, dated November 2013). Wellington, New Zealand: Deepwater Group Ltd.

DESIGN & PRINT

Design: Nikki Kidd and Ros Wells. Printing: Copy Direct Ltd.

ISSN NO.

Print: 2350-3076 Online: 2350-3084

Introduction

OUR VISION: To be recognised as the best managed deepwater fisheries in the world.

New Zealand seafood products have a strong reputation for consistent high quality and for being harvested using environmentally sustainable practices. Consumers wanting a safe and sustainable food source need look no further than New Zealand's southern blue whiting.

New Zealand southern blue whiting are harvested almost entirely by mid-water and semi-pelagic trawl and are generally found in sub-Antarctic waters to the south of New Zealand. For most of the year, they are dispersed across the Campbell Plateau and Bounty Platform, but during August and September they come together in large aggregations to spawn near Campbell Island, on the Pukaki Rise, on the Bounty Platform, and near the Auckland Islands. The southern blue whiting fisheries are managed as separate biological stocks based on these spawning areas, referred to as Quota Management Areas (QMAs). Scientific assessments are carried out on each stock and Total Allowable Commercial Catch (TACC) limits are individually applied to each stock.

New Zealand's seafood industry, including quota owners in the southern blue whiting fisheries, is committed to ensuring sustainable utilisation. This is delivered through the business ethos that sound environmental practices make good business sense.

Our role is to supply consumers with safe, nutritious, appetising and affordable seafood. The combined pressures of human population growth, increasing energy costs and the need to ensure sustainable production mean we need to find ways to produce more seafood, with more certainty, while minimising any adverse environmental effects. By 2030 the world demand for food will double, which will need to be met while still maintaining the environmental integrity that supports this production sustainably.[i]

Our commitment to sustainable utilisation includes the use of independent third party assessments to verify that our management measures reflect international best practice. For southern blue whiting we are Certified, without Conditions, as meeting the very high standards required by the Marine Stewardship Council (MSC) programme.

Deepwater Group Ltd (DWG) is an alliance of quota owners in New Zealand's deepwater fisheries. DWG represents the interests of shareholders who collectively own 88% of the New Zealand southern blue whiting quota.

Profile

New Zealand southern blue whiting are harvested almost entirely by mid-water and semi-pelagic trawl and are generally found in sub-Antarctic waters to the south of New Zealand.

Common Name

Southern blue whiting

Scientific Name

Micromesistius australis

Ministry Code

SBW

Fishing Method

Mid-water and semi-pelagic trawl.

Distribution

Mostly harvested at depths of 250 m to 600 m, with the main fishing grounds in Southern New Zealand waters (Figure 1).

Quick Facts

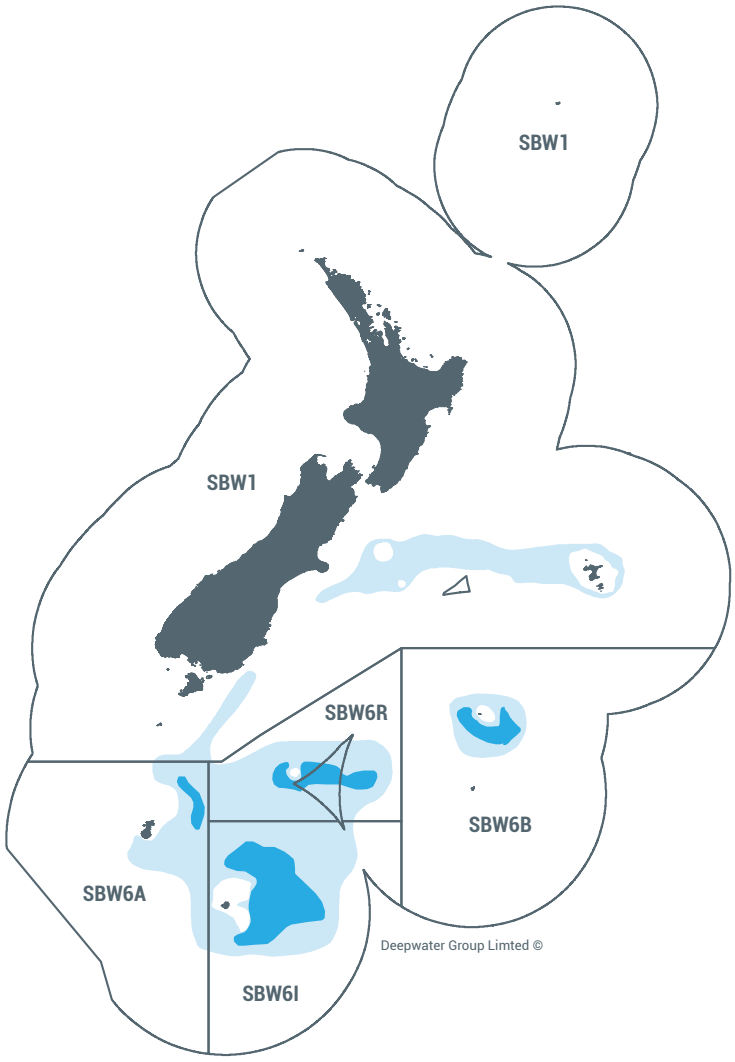
SBW have highly variable recruitment with infrequent but very large year classes often dominating the fishery.

As the New Zealand SBW fisheries all occur at approximately the same time of year it is not possible for vessels to fish all stocks in any one year.

Of the four New Zealand SBW fisheries, three are MSC Certified.

New Zealand SBW are the first blue whiting fisheries in the world to gain MSC certification, and are now without Conditions on this Certification.

FIGURE 1
SOUTHERN BLUE WHITING KNOWN DISTRIBUTION RANGE AND MAIN FISHING GROUNDS[1]



- Southern Blue Whiting Quota Management Area Boundaries
- Main Fishing Grounds
- Known Distribution Range

1. 'Known distribution range' provides an indication of where southern blue whiting are likely to be found based on all known records of southern blue whiting collected from research and commercial activities. They may be found elsewhere. 'Main fishing grounds' is based on the trawl footprint for the last ten years, only a fraction of this is trawled annually (see Habitats and Ecosystems).[xxii]

Stock Sustainability

Scientists work together to ensure the southern blue whiting fisheries are adequately monitored and that research surveys and stock assessments are regularly undertaken.

Stock Structure

Four biologically distinct southern blue whiting stocks are recognised within New Zealand waters. These are (Figure 1): Auckland Islands Shelf (SBW6A), Bounty Platform (SBW6B), Campbell Island Rise (SBW6I), and Pukaki Rise (SBW6R).

Each of these four southern blue whiting stocks is managed independently. Scientific research is carried out on each stock and separate catch limits (known as Total Allowable Commercial Catches, TACCs[2]) are set for each by the Minister for Primary Industries.

Stock Assessment

"The DWFAWG evaluates relevant research, determines the status of fisheries and fish stocks, and estimates likely future stock size under different catch level assumptions."

Deepwater Group Ltd (DWG), the Ministry for Primary Industries (MPI) and scientists work together to ensure the southern blue whiting fisheries are adequately monitored and that research surveys and stock assessments are regularly undertaken.

Research results are presented to MPI's open scientific forum, the Deep Water Fisheries Assessment Working Group (DWFAWG), which provides technical guidance and peer review. All research information must meet (or exceed) MPI's Research and Science Information Standard for New Zealand Fisheries prior to being accepted as being of sufficient quality to inform management decisions.[iii]

The DWFAWG evaluates relevant research, determines the status of fisheries and fish stocks, and estimates likely future stock size under different catch level assumptions. It does not make management recommendations or decisions, as these responsibilities lie with MPI fisheries managers and the Minister for Primary Industries.

The DWFAWG is attended by MPI scientists, research providers, independent scientists, fisheries managers, and representatives from Industry and environmental NGOs. Once accepted by the DWFAWG, stock assessments are further peer reviewed through a scientific plenary process and are reported in the annual Fisheries Assessment Plenary Report[iv] (publically available on MPI's website[v]).

Although assessment efforts for each of the stocks have varied, those with the most commercial focus are most closely monitored and assessed at regular intervals, given they will likely require more management attention (Table 1). High levels of observer coverage and the Vessel Monitoring System allow for easy monitoring of commercial activity and catch across the different fishing grounds. If current fishing patterns and rates alter significantly, management reviews will be undertaken as required.

Bounty Platform Stock Assessment

The 2013 stock assessment used a model fitted to catch-at-age data from the fishery, by sex, and two time series

TABLE 1
SOUTHERN BLUE WHITING FISH STOCKS BY COMMERCIAL IMPORTANCE[vi]

STOCK	CODE	REASONING
Bounty Platform	SBW6B	Commercial effort has historically concentrated on SBW6B and SBW6I, given the larger biomasses available here.
Campbell Island Rise	SBW6I	Commercial effort has historically concentrated on SBW6B and SBW6I, given the larger biomasses available here.
Pukaki Rise	SBW6R	Although a smaller biomass is available in SBW6R, an increasing level of effort has occurred here in recent years, indicating increasing commercial importance.
Auckland Islands	SBW6A	The smaller size and uncertainty of the spawning aggregations in SBW6A means target SBW fishing rarely takes place.
Rest of EEZ	SBW1	No target SBW fishing occurs in SBW1.

2. The TACC is the amount of fish commercial fishermen are allowed to catch of a particular stock in a given year which has been set by the Minister.

of acoustic biomass estimates (wide area and local aggregation surveys).[iv] However, in exploratory model runs it was found that the very large 2002 year-class confounded model estimates of mean recruitment, unfished biomass (B_0[3]) and initial abundance ($C_{initial}$), and as a result the mean year-class strength constraint was modified to exclude the 2002 year-class. While removal of this year-class was necessary to introduce model stability, it resulted in the following consequences:

- Biomass reference points were lower than they would be if the 2002 year-class was included in the calculations.
- Biomass projections ignored the real possibility of very strong year-classes.

Preliminary model runs also failed to provide satisfactory fits to the highly variable local area aggregation acoustic biomass estimates and the DWFAWG did not accept any of these as a base case. Two model runs were, however, retained as a basis for management. Work is ongoing to develop a reliable model for this stock.

Campbell Island Stock Assessment

An updated stock assessment for the Campbell Island stock was completed in 2012, using acoustic survey data from

FIGURE 2
SPAWNING BIOMASS TRAJECTORIES (B_0) FOR CAMPBELL ISLAND (SBW6I) WITH 95% CONFIDENCE INTERVALS[iv]

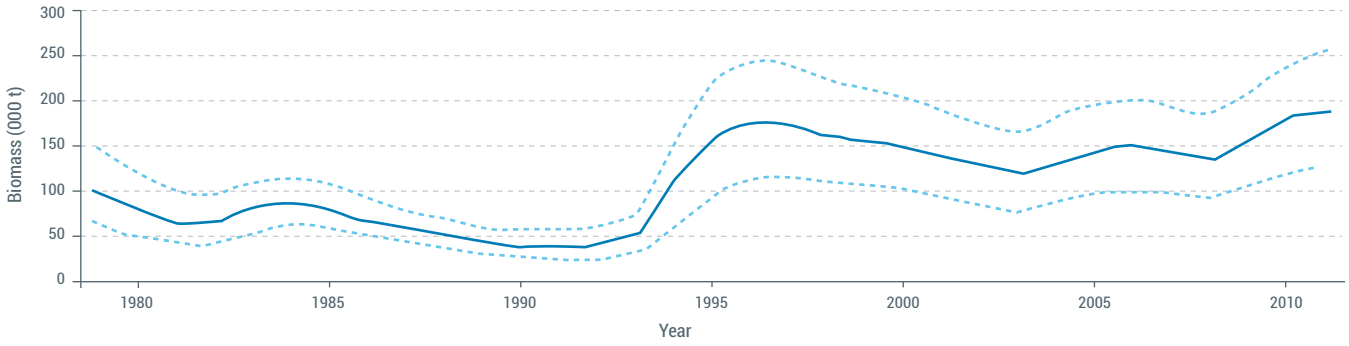
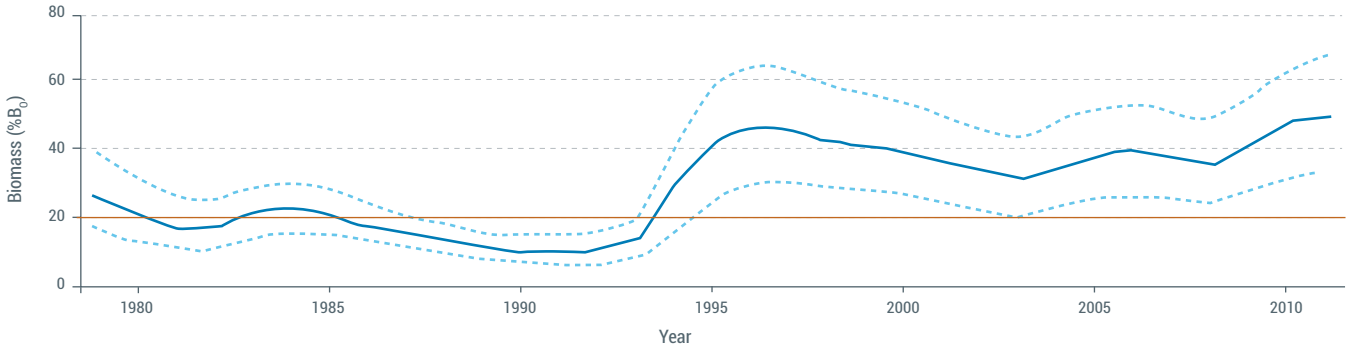


FIGURE 2+
CURRENT BIOMASS (%B_{2011}/B_0) FOR CAMPBELL ISLAND (SBW6I) WITH 95% CONFIDENCE INTERVALS[iv]



3. B_0 is the estimated biomass (B) that would exist in the absence of fishing.

1993 to 2011 and proportion-at-age data from the commercial fishery.[iv] Two main model runs were considered, one that assumed selectivity of the fishery was age-based and one that assumed this was size-based. As both models produced similar results, the Middle-depth Fisheries Assessment Working Group (MDFAWG) agreed that the age-based model would be reported as the base case. The MDFAWG cautioned that B_0 was probably not well determined given the high variability in recruitment levels and the few strong year classes that have been observed.

Pukaki Rise Stock Assessment

A stock assessment for the Pukaki Rise stock was completed in 2002.[iv] More frequent assessments have not been considered necessary since the stock is considered to be lightly harvested. An acoustic survey was undertaken in 2012 but was not accepted for use in a revised management assessment in 2013.

Auckland Islands Stock Assessment

No estimate of current biomass is available for the Auckland Islands stock.[iv] The only acoustic estimate of the adult biomass was in 1995 and was 7,800 t. However, given the very small size and extent of this stock, southern blue whiting is rarely harvested here, with, over the last decade to 2012-13, an average annual catch of 120 t and maximum annual catch of 278 t.

Stock Status

Bounty Platform Stock Status

As described above, the DWFAWG did not accept any of the model runs as a base case. Two model runs were, however, retained as a basis for management and provided estimates for pessimistic and optimistic scenarios.[iv]

These two model runs produced estimates of B_0 that were similar, ranging from about 57,000 t to 64,000 t. The B_{2012} estimate from model 2.2 was 19,994 t (35% B_0); while for model 2.3 it was 28,880 t (45% B_0).

The stock is About as Likely as Not (40-60%) to be at or above the target of 40% B_0 and Unlikely (<40%) to below the soft limit of 20% B_0. The biomass is expected to decrease over the next five years as the 2002 year-class is fished down. Catches from the fishery in 2012 indicate the strong 2002 year-class is declining as a proportion of catches (now 50% of the catch as it ages and 'moves through' the fishery) and the smaller 2007 year-class now makes up some 40% of catches.

Campbell Island Stock Status

The 2012 stock assessment for the Campbell Island stock estimates B_{2011} to be 50% B_0; Likely (i.e. >60% probability) to be at or above the target of 40% B_0, and Exceptionally Unlikely (<1%) to be below either the soft or the hard limits (Figure 2).[iv]

The Campbell Island stock size is expected to increase over the next 1-2 years as the 2006 and 2007 (and likely 2009) year classes grow and enter the fishery.

Modelling can be used to estimate future stock sizes under different catch assumptions. With an annual catch of 30,000 t, these analyses estimate the probability of the stock size declining to below the target biomass over the next 2-3 years to be less than 10%.

Pukaki Rise Stock Status

A stock assessment of the Pukaki Rise stock has not been updated since 2002.[iv] Based on the range of biomasses modelled in the 2002 stock assessment and the relatively low average (1,402 t) annual catches since the assessment, it is considered unlikely that catches are having an impact on the stock. Relatively large catches were taken in 2009 and 2010 but reduced again in 2011 (Figure 5).

> *"A more intensive fishery or more consistent catches from year to year would seem to be required to provide any contrast in the biomass indices."*

A biomass survey was undertaken on the spawning aggregations in 2012 but the DWFAWG did not believe that it provided an acceptably realistic biomass estimate for the stock and no assessment review was possible during 2013.

Auckland Islands Stock Status

No estimate of current biomass is available for the Auckland Islands stock.[iv] The only acoustic estimate of the adult biomass was undertaken in 1995 and was 7,800 t. However, as southern blue whiting is rarely harvested at this location, there is no concern for the sustainability of the stock (Figure 6).

Amaltal Atlantis, Talley's Group Ltd

Otakou, Sealord Group Ltd

Harvest Strategy

"When recruitment levels decline, stock sizes decline. The management response to this is to reduce the TACC."

The Fisheries Act 1996 requires stocks managed under the Quota Management System (QMS) to be

"maintained at or above the biomass that can produce the Maximum Sustainable Yield (MSY)"

(i.e. B_{MSY}[4]). MSY is the largest average long-term annual catch that can be taken from a stock under prevailing ecological and environmental conditions.

New Zealand has also adopted a Harvest Strategy Standard (HSS) that provides a technical elaboration of the MSY-related requirements of the Act.[vii] It also adds the concepts of two minimum biomass levels: a soft limit below which a formal time constrained rebuilding plan is required, and a hard limit, below which fisheries should be considered for closure.

Southern blue whiting stocks naturally vary in size, even without fishing. These large stock size fluctuations are driven by natural variations in the numbers of young fish maturing and entering the fisheries each year (i.e. recruitment). These recruitment fluctuations are thought to be driven mainly by environmental factors, such as sea temperature and the availability of plankton as food during the larval stage.

Because of these recruitment fluctuations, B_{MSY} is problematic as a management target for southern blue whiting stocks. Instead, where there is enough information to undertake a robust stock assessment, fisheries managers use the default target of 40% B_0, consistent with the HSS. In order to estimate the yields that will enable stock sizes to meet this target, scientists model future stock sizes under different recruitment and catch level assumptions.

Alternatively, where stock assessments are not available or less robust, managers apply an F-based harvest strategy, setting fishing mortality (F) at a level that reflects natural mortality (a proxy for B_{MSY}). For southern blue whiting, this equates to 20% of the estimated minimum spawning biomass measured during regular acoustic surveys. By using the survey estimates of spawning biomass and recognising that the surveys do not cover all of the recruited stock, setting catches at 20% of this level will increase the likelihood that stocks are maintained above B_{MSY}.

When recruitment levels decline, stock sizes decline. The management response to this is to reduce the TACC to ensure that fishing intensity is maintained near optimal levels. Conversely, the TACC and catch limits are increased when stock sizes increase due to higher recruitment levels. The use of conservative targets, combined with regular stock monitoring and reviews, enables fisheries managers time to respond to changes in stock size and to make timely TACC changes. This process provides greater certainty that southern blue whiting stocks will remain at or above MSY and within the optimum range for both long-term sustainability and economic harvest levels.

4. B_{MSY} is the estimated biomass that will support the Maximum Sustainable Yield (MSY).

Management Reference Points & Responses

"...conservative targets, combined with regular stock monitoring and reviews, enables fisheries managers time to respond to changes in stock size and to make timely TACC changes."

Management reference points have been established for the southern blue whiting fisheries according to the HSS (Table 2).[vi] Management use these to respond to different stock statuses and ensure stocks are maintained at optimum sustainable levels.

Since 2000, total annual harvests of southern blue whiting have ranged between 25,000 t and 40,000 t. The TACCs from the Campbell Island Rise and Bounty Platform stocks have been almost fully caught each year since 2005. However, catches from the other two stocks are only a small proportion of their respective TACCs. This reflects the relatively low economic value of southern blue whiting; the inherent difficulties in catching them on these small fishing grounds; the spawning events here are smaller, and are less predictable in their location and timing; and the fishing season for all four fisheries overlaps, precluding deployment of vessels in all four during each season.

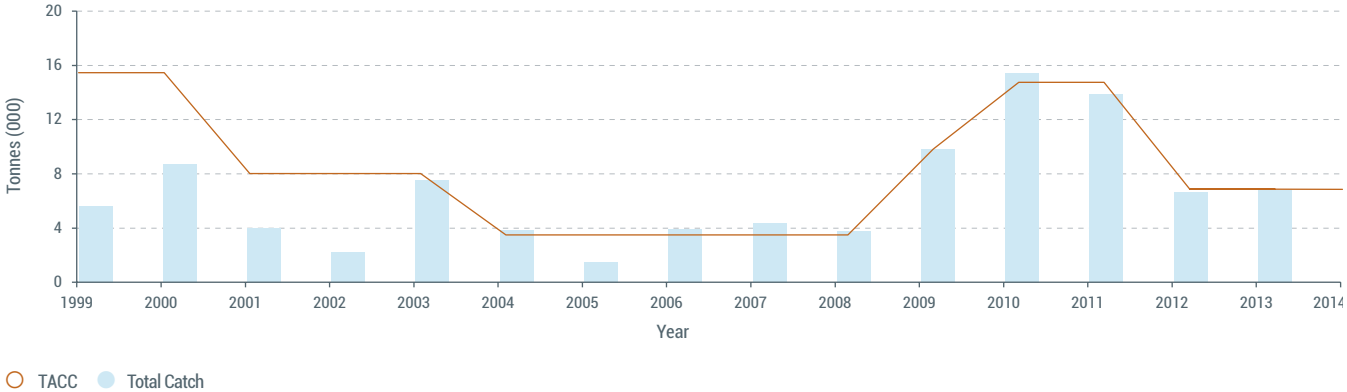
Bounty Platform Management

The Bounty Platform stock is the second largest of the four stocks, although catches have varied over the years, largely in response to significant changes

TABLE 2
SOUTHERN BLUE WHITING FISHERIES HARVEST STRATEGY

REFERENCE POINT	MANAGEMENT RESPONSE
Management Target of >B_{MSY}	Stock size should fluctuate around this target. As a default, B_{MSY} is assumed to be 40% B_0. Where robust stock assessments models are available, these are used to estimate catch levels. Where stock assessment models are less robust, catches are set at 20% of the estimated minimum spawning biomass (i.e. F=0.2, the estimated fishing mortality that will provide for a stock to fluctuate around B_{MSY}). TACC changes are used to maintain stocks above the target level.
Soft Limit of 20% B_0	If stock size is below this threshold, a formal time-constrained rebuilding plan will be implemented to increase the stock size back up to within the Management Target.
Hard Limit of 10% B_0	If stock size is below this limit, fisheries on this stock will be considered for closure.
Rebuild Strategy	To be determined and implemented when and if required.
Harvest Control Rules	Management actions are determined after consideration of the current stock assessment, along with the results of five-year forecasts of stock sizes under a range of catch assumptions, if available, and guided by the management reference points.

FIGURE 3
CATCHES AND TACCs FOR BOUNTY PLATFORM (SBW6B)[iv]



in recruitment between years. This stock has recently undergone one such fluctuation, driven by the strong 2002 year-class recruiting to the fishery from 2007. As the 2002 year-class has aged and been 'fished down' management have reduced the TACC in line with this.[viii] The TACC of 6,860 t was retained for the 2013-14 fishing year. However, in light of uncertainties, quota owners have agreed to conservatively shelve half of the TACC and continue close monitoring of the fishery and stock (Figure 3).

Campbell Island Management

The Campbell Island stock is the largest of the four stocks and has supported a catch limit in excess of 20,000 t for over 15 years. Similar to the Bounty Platform stock, catches have varied in response to changes in annual recruitment. For the 2011-12 fishing year, the TACC was increased from 23,000 t to 29,400 t with stock assessments estimating stock size to be above B_{MSY} and projected to increase with two strong year-classes recruiting into the fishery (Figure 4). The 2013 stock assessment continues to support this.

Pukaki Rise and Auckland Islands Management

Catches from the Pukaki Rise and Auckland Islands stocks are only a small proportion of their respective TACCs. This reflects the inherent difficulties in fishing these smaller fishing grounds. As such there has been less management effort required for these fisheries.

FIGURE 4
CATCHES AND TACCs FOR CAMPBELL ISLAND (SBW6I)[iv]

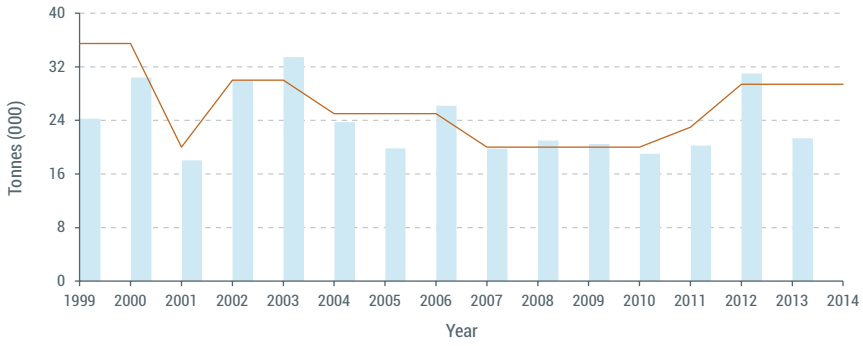


FIGURE 5
CATCHES AND TACCs FOR PUKAKI RISE (SBW6R)[iv]

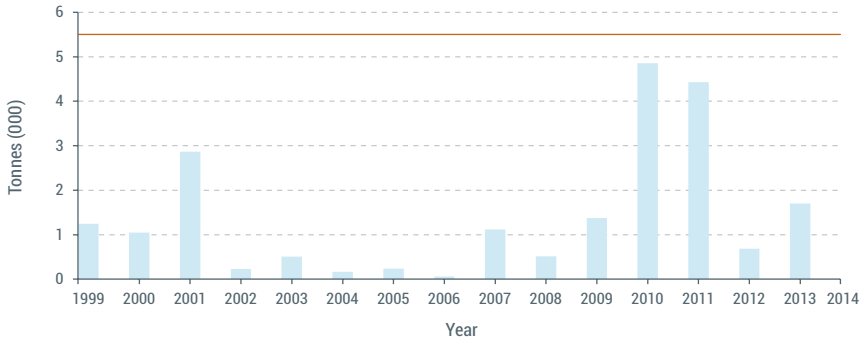
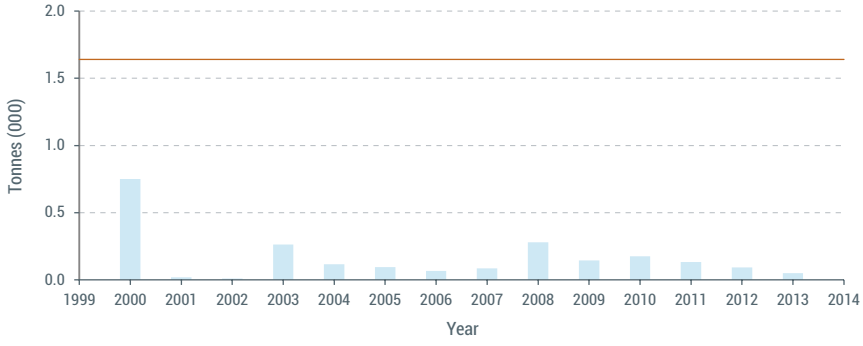


FIGURE 6
CATCHES AND TACCs FOR AUCKLAND ISLANDS (SBW6A)[iv]




THOMAS HARRISON. SEALORD GROUP LTD.

Managing Environmental Effects

All marine mammals and seabirds, four coral groups, and many shark species are protected by law in New Zealand waters.

Bycatch Species

"The bulk (99%) of catches in the southern blue whiting fisheries consists only of southern blue whiting."

New Zealand's southern blue whiting fisheries generally take very little bycatch of other finfish (about 1% based on MPI observed and industry reported catch).[iv] The bulk (99%) of catches in the southern blue whiting fisheries consists only of southern blue whiting.[ix]

Detailed reporting and catch balancing procedures are required by law for QMS species taken within New Zealand's Exclusive Economic Zone (EEZ). All catches of quota species, whether taken as bycatch or as target catch, must be landed and reported against the appropriate catch limit and against Annual Catch Entitlements (ACE).

Due to the generally low catch volumes, species outside of the QMS are considered to be at low risk of being overfished. However, if a sustainability problem is identified for any non-QMS species, these may be introduced to the QMS under the provisions of the New Zealand Fisheries Act 1996 which requires such stocks, or species, be added to the QMS if the existing management is not ensuring sustainability or is not providing for utilisation.

The Fisheries Act, defines 'ensuring sustainability' as

"maintaining the potential of fisheries resources to meet the reasonably foreseeable needs of future generations"

and

"avoiding, remedying, or mitigating any adverse effects of fishing on the aquatic environment"

while 'utilisation' is defined as

"conserving, using, enhancing and developing a fisheries resources to enable people to provide for their social, economic, and cultural wellbeing."

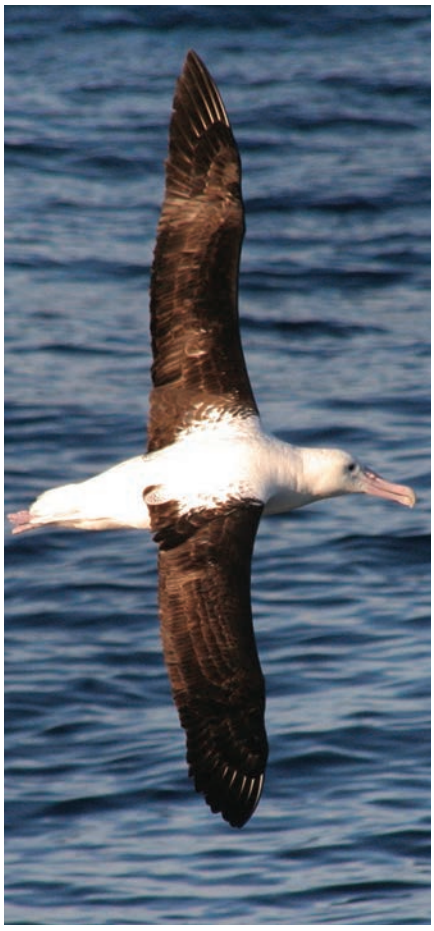
Endangered, Protected & Threatened Species

"MPI and DWG have active programmes in place to reduce incidental interactions, including developing and implementing mitigation methods."

Seabirds and marine mammals are at times attracted to fishing vessels as an opportunistic source of food. In doing so they may unwittingly put themselves at risk of harm. In seeking easy access to food, they have demonstrated that they can modify their behaviours to overcome obstacles. Patterns of 'at risk' behaviour are observed to vary both seasonally and between species, and to be dependent on their eagerness to feed in close proximity to vessels and nets. As such, incidental interactions with fishing vessels are inherent and will continue to occasionally occur. In the same way that other industrial workplaces have hazard management plans in place to reduce accidents, MPI and DWG have active programmes in place to reduce incidental interactions, including developing and implementing mitigation methods.

All of New Zealand's seabirds, four coral groups, and many shark species are protected under the Wildlife Act 1953 (Table 3). All marine mammals in New Zealand are protected under the Marine Mammal Protection Act 1978. It is an offence to harass, hunt, or kill any of these protected species without lawful authority. While the accidental or incidental capture of these species by commercial fishing activities is not unlawful, all incidents must be reported.

Observer coverage of New Zealand's southern blue whiting fisheries is delivered through the government's Scientific Observer Programme, which provides independent monitoring of any interactions that occur between protected species and vessels in the southern blue whiting fisheries (Figure 9). On average, around 40% of all tows targeting southern blue whiting have been observed in recent years.[x] In 2011-12 observer coverage increased to 70% of all tows targeting southern blue whiting.



Northern Royal Albatross

Seabirds

"Information on interactions with seabirds is reviewed annually and demonstrates that annual numbers of birds captured is very low."

MPI uses a risk-based approach to assess and to prioritise seabird species that might require management intervention. This approach is informed by the New Zealand Seabird Risk Assessment[xi], which has quantitatively estimated the potential levels of risk to seabird populations arising from incidental mortalities associated with New Zealand's commercial fisheries. Using this information, further research, education, and seabird mitigation measures can be determined and applied where these are most needed and where they will be most effective.

The southern blue whiting fisheries have been found to pose little risk to seabirds (i.e. seabird population growth is able to sustain the few fishing-related captures). With effective mitigation measures in place the risk scores for deepwater fisheries, including those for southern blue whiting, have reduced over time.[xii]

Trawlers targeting southern blue whiting all employ international best practices to mitigate the risk of interacting with seabirds. Management measures to mitigate interactions with seabirds and New Zealand's deepwater trawl fisheries currently include:

- Mandatory use of seabird mitigation devices during fishing;
- Mitigation research;
- Education, training and outreach;
- Vessel-specific offal management procedures; and
- Real-time incident reporting.

The current high level of observer coverage in New Zealand's southern blue whiting fisheries enables independent monitoring and reporting of seabird interactions and of vessel adherence with Government and industry mitigation requirements.

Information on interactions with seabirds is reviewed annually and demonstrates that annual numbers of birds captured is very low and is without any obvious trends over time.[iv] For the 2010-11 fishing year there were 16 observed bird captures at a rate of 3.7 birds per 100 observed tows. This is the highest annual capture in the last nine years; typically less than five observed captures are reported each year. Grey petrels are the most commonly caught species (23 of the 31 observed seabird captures since 2002-03). Grey petrels are estimated to have a low risk ratio by Richard *et al*. (2011).[xi]

Regulated use of seabird mitigation devices, together with Industry's Vessel-specific Management Plans (VMPs) have

TABLE 3
MARINE SPECIES FULLY PROTECTED UNDER THE WILDLIFE ACT 1953

PHYLUM	CLASS		
Cnidaria	Anthozoa *(corals and sea anemones)*	Black corals	All species in the order Antipartharia
	Hydrozoa *(hydra-like animals)*	Gorgonian corals	All species in the order Gorgonacea
		Stony corals	All species in the order Scleractinia
		Lamniformes *(mackerel sharks)*	All species in the order Stylasteridae
Chordata	Chondrichthyes *(cartilaginous fishes)*	Lamniformes *(mackerel sharks)*	Basking shark *(Cetorhinus maximus)*
			Deepwater nurse shark *(Odontapsis ferox)*
			White pointer shark *(Carcharodon carcharias)*
		Orectolobiformes *(carpet sharks)*	Whale shark *(Rhincodon typus)*
		Rajiformes *(skates and rays)*	Manta ray *(Manta birostris)*
			Spinetail devil ray *(Mobula japanica)*
	Osteichthyes *(bony fishes)*	Perciformes *(perch-like fishes)*	Giant grouper *(Epinephelus lanceolatus)*
			Spotted black grouper *(Epinephelus daemelii)*

proved effective at mitigating seabird interactions. One of the most important factors influencing contact between seabirds and trawl warp cables is the discharge of offal. Offal management methods, in particular controlled timing of release or the intermittent batching of offal (as opposed to continuously discharging), has proven effective in reducing the attraction of seabirds to the stern of vessels and ahead of where the warps enter the water. This is the 'danger area', where seabirds are at risk of collision with the trawl wires. This has been accepted as world's best practice by the Agreement on the Conservation of Albatrosses and Petrels, and underpins the VMPs.[xiii] Middleton and Abraham confirmed that discharge of offal was the main factor influencing warp strikes; almost no strikes were recorded when there was no discharge.[xiv]

Other best practice measures include mitigation methods such as streamer lines, bird bafflers, and warp deflectors, which have been mandatory since April 2006. Although warp captures have reduced significantly, achieving reductions in the net captures of small diving birds is proving to be more challenging. MPI and industry are continually seeking better ways to deter birds from attending the net.

New Zealand Sea Lions

Southern blue whiting trawlers occasionally catch marine mammals, including New Zealand sea lions (which are classified as 'Nationally Critical' under the New Zealand Threat Classification System).[xv]

In particular, New Zealand sea lions (NZSL) are known to interact with the Campbell Island fishery. Recent analyses have been undertaken by DWG and MPI to assess the level of risk this may pose.

FIGURE 7
ESTIMATED SEABIRD CAPTURES IN SOUTHERN BLUE WHITING TRAWL FISHERIES WITH 95% CONFIDENCE INTERVALS[x]

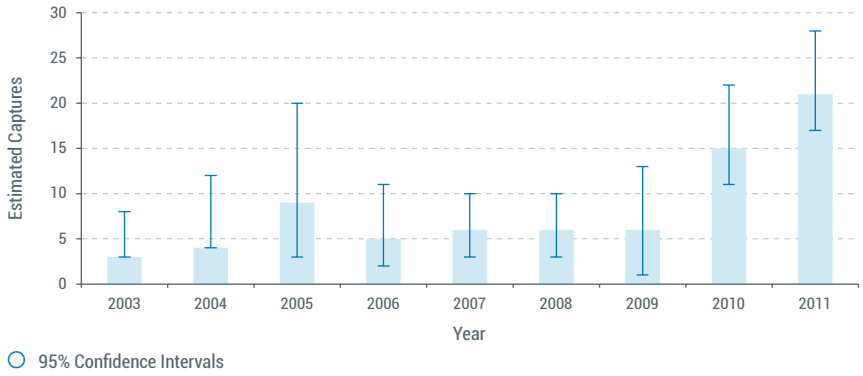


FIGURE 8
OBSERVED SEABIRD CAPTURES IN SOUTHERN BLUE WHITING TRAWL FISHERIES[x]

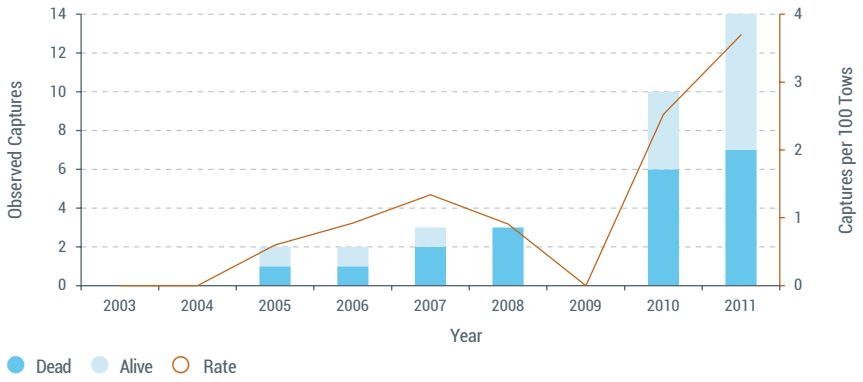
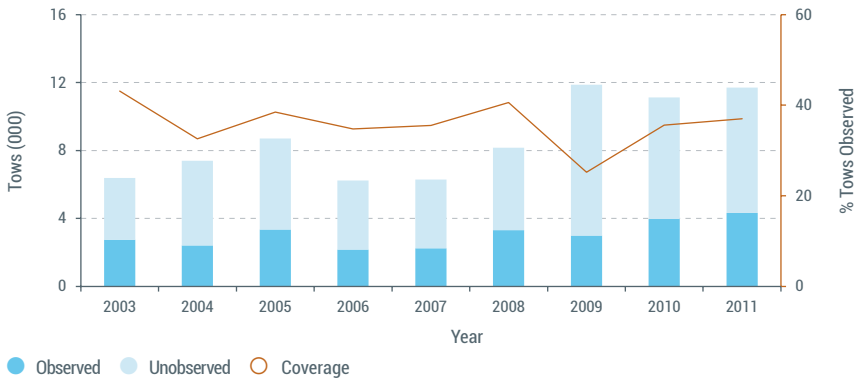


FIGURE 9
EFFORT AND OBSERVED EFFORT IN SOUTHERN BLUE WHITING TRAWL FISHERIES[x]



These analyses show that the level of current fishing-related mortality is below the level of mortality that the Campbell Island sea lion population is likely to be able to maintain, without compromising its growth or recovery. This work demonstrates that the level of sea lion interactions with the SBW6I fishery is likely to be within biologically based limits for this sea lion population, such that the fishery is not hindering recovery or rebuilding.[xvi]

Although observer coverage has been high (20-70% of fishing effort since 1996), no sea lion captures occurred until 2002. Low numbers of captures were observed until around 2005-06, at which point observed captures were reported to have increased.[xvii]

In response to these increased captures, the deepwater fleet implemented a number of management measures to reduce the risk of sea lion captures. These included increased education and awareness on how to reduce interactions with NZSL and, in particular, managing offal discharge and the loss of fish from nets and during factory processing. Observer coverage is also important in enabling a full and accurate assessment and the reporting of any captures.

There were no observed sea lion captures during 2012, despite reports from industry and MPI observers that confirm sea lions were abundant around the vessels during fishing operations.

However, an unprecedented number of captures was experienced in the Campbell Island fishery during the early part of the 2013 season, all of which were male. Real-time reporting and effective communication between the vessels, DWG and MPI aided a quick and adaptive response to the increased level of risk being observed, driven by a large

FIGURE 10

ESTIMATED CAPTURES OF NEW ZEALAND SEA LION IN SOUTHERN BLUE WHITING TRAWL FISHERIES WITH 95% CONFIDENCE INTERVALS[xvii]

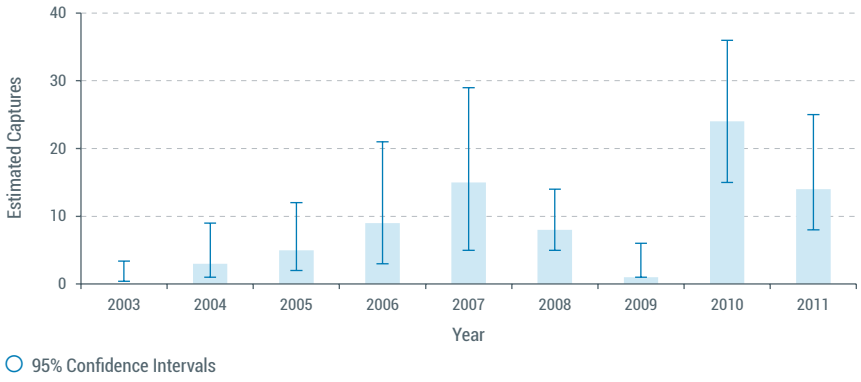
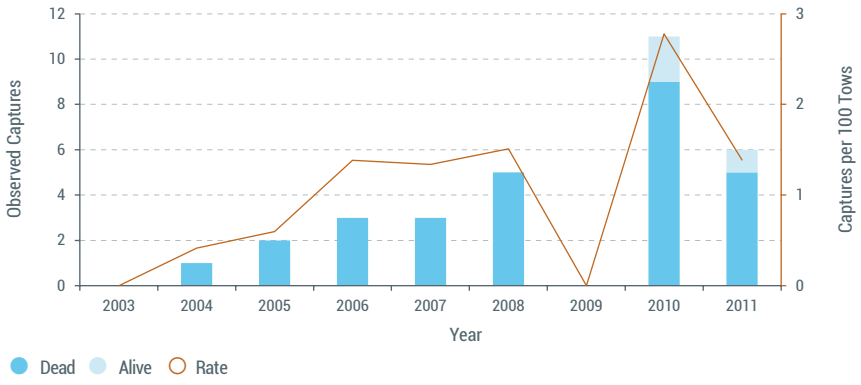


FIGURE11

OBSERVED NEW ZEALAND SEA LION CAPTURES IN SOUTHERN BLUE WHITING TRAWL FISHERIES[xvii]



Sea Lion[xxix]

New Zealand Fur Seal[xxix]

number of young males present in the fishery that year. In light of these events, DWG requested an expedited audit, as part of the fisheries' MSC Certification, to establish whether or not the fisheries' performance remained in conformance with MSC's standards and where improvements might be made.[xviii] The independent audit by Intertek Moody Marine concluded that there was a comprehensive management strategy in place and that it was proving effective. The quick adaptive response to the increased risk seen in 2013 is evidence of this.

New Zealand Fur Seal

The New Zealand fur seal was classified in 2008 as 'Least Concern' by the International Union for Conservation of Nature (IUCN) and in 2010 as 'Not Threatened' under the New Zealand Threat Classification System.[xv] Their numbers around New Zealand are widely considered to be increasing.

In 2010-11 there were 36 observed captures of New Zealand fur seal in southern blue whiting trawl fisheries.[xvii] The rate of observed captures during the year averaged 8.3 per 100 tows, this rate has fluctuated over the years without any obvious trend. These captures are mainly from the SBW6B area. Given the increasing fur seal population in these areas and the very low number of captures they are not considered to be at risk by the fisheries.

Protected Coral & Fish

MPI observers record the level of interactions between southern blue whiting fisheries and protected fish, of which none have been recorded, and with coral species, of which there are only very few interactions. Most southern blue whiting are harvested by mid-water trawl.

FIGURE 12
ESTIMATED NEW ZEALAND FUR SEAL CAPTURES IN SOUTHERN BLUE WHITING TRAWL FISHERIES WITH 95% CONFIDENCE INTERVALS[xvii]

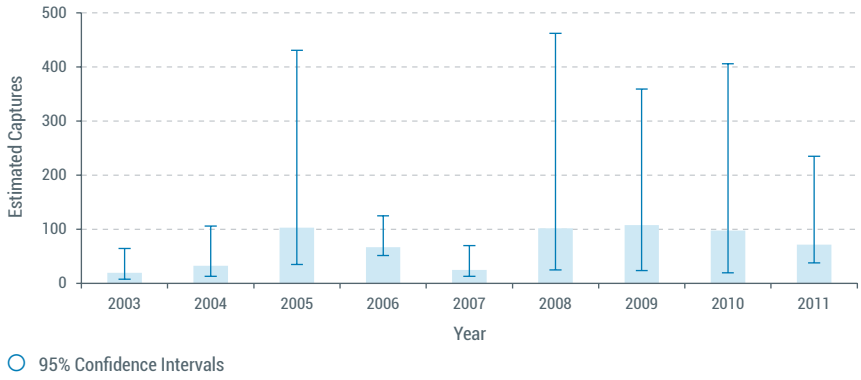


FIGURE 13
OBSERVED NEW ZEALAND FUR SEAL CAPTURES IN SOUTHERN BLUE WHITING TRAWL FISHERIES[xvii]

Observer records suggest that southern blue whiting target fishing operations are clean and take relatively little bycatch of other finfish (about 1% of total catch based on observed and reported catch).[ix]

Habitats & Ecosystems

"New Zealand's Benthic Protection Area network is over four times the area of New Zealand's landmass."

The southern blue whiting fisheries predominantly use mid-water and semi-pelagic trawl gear. Interactions with the seabed are therefore relatively low. Semi-pelagic trawl gear is typically lighter and more fragile than most bottom trawl gear and, therefore, generally has a very low impact on benthic communities.

In the sub-Antarctic regions, the majority of southern blue whiting trawling occurs over high-energy sediments, such as sandy silt and clay, although some lower-energy areas exist in these regions. Recovery from any impacts in these environments is expected to be quicker than in lower energy habitats.[xix] Furthermore, the duration of the fishing season is very short (August – September) with few tows being made. For example, in the last five years total tows that contacted the seabed (or were within 1 m of it) for southern blue whiting have averaged 477 per year.

The southern blue whiting fisheries have been developed during the past two decades and there is now relatively little exploratory fishing over new grounds. Because fishing takes place on spawning aggregations, catches are primarily focussed on relatively small, localised areas which support sustained catches year on year.

As part of the 10-Year Research Programme, the trawl grounds of the

FIGURE 14
BENTHIC PROTECTION AREAS AND 'SEAMOUNT' CLOSURES

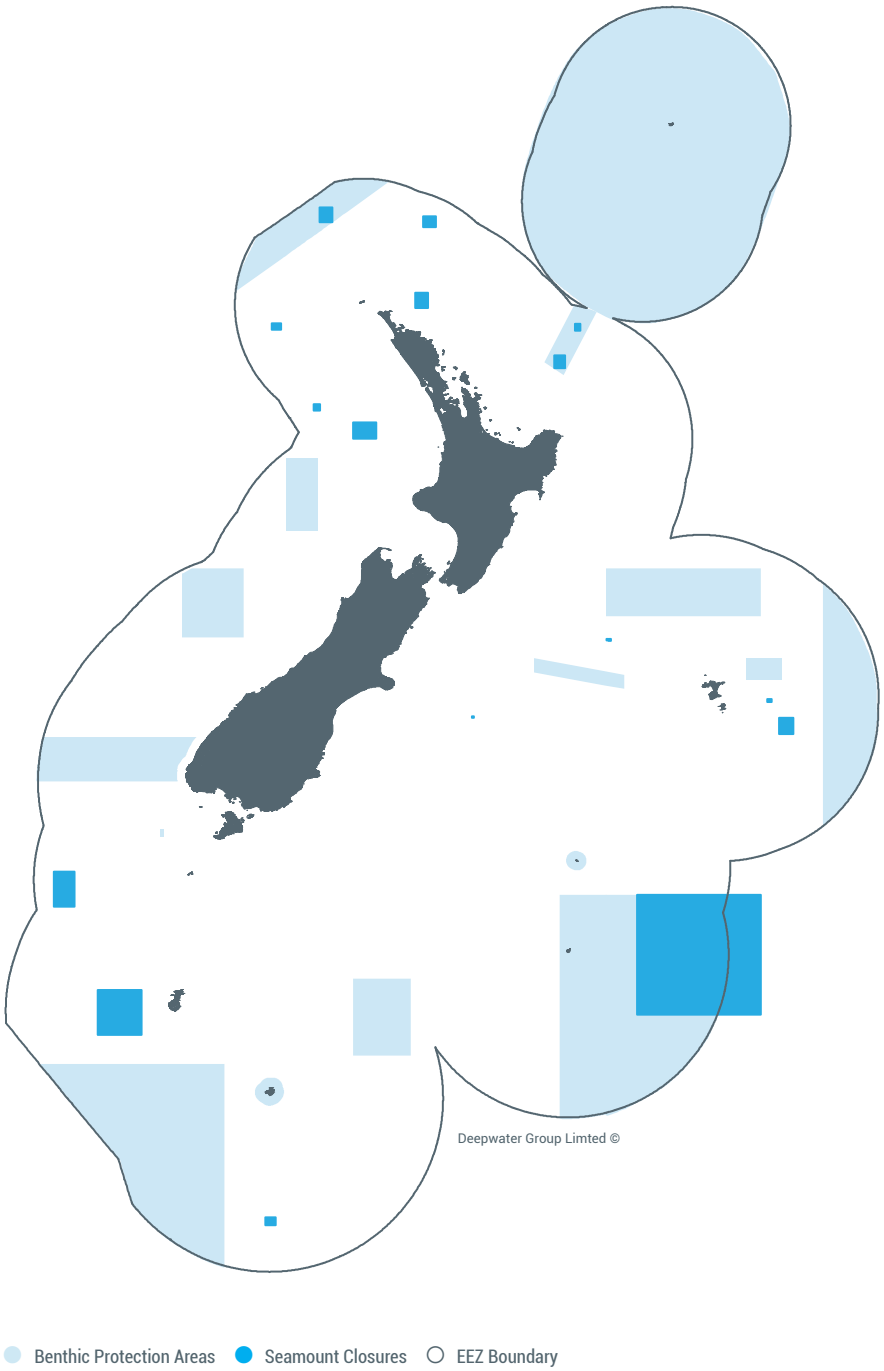


TABLE 4
MARINE SPATIAL MANAGEMENT IN NEW ZEALAND'S EEZ[xxiv]

MANAGEMENT TOOL	LEGISLATION	RESTRICTIONS	AREA (KM^2)
Benthic Protection Areas (BPAs)	Fisheries Act 1996 Fisheries (Benthic Protection Areas) Regulations 2007	Prohibition on use of dredge and restrictions on use of trawl net within 100 m of the seabed.	1,124,539
'Seamount' Closures	Fisheries Act 1996 Fisheries Regulations	Prohibition on trawling	78,466
Total Area Closed (km^2)[5]			1,200,741
Total Area as a Percentage of New Zealand's EEZ			30%

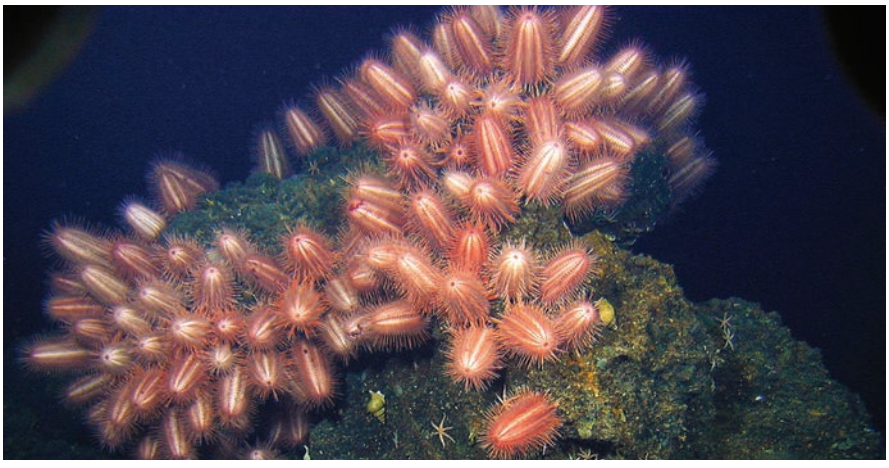
southern blue whiting fisheries are mapped and audited annually. This allows the extent of trawl interactions with the seabed to be monitored and provides a mechanism to identify if and where further management measures might be necessary.[xx]

MPI and DWG have also implemented a programme of spatial management (Figure 14 & Table 4), which includes:

- Closed areas – where fishing is excluded or subject to gear restrictions
- Benthic Protection Areas (BPAs) – where any trawling within 50 m of the seabed is prohibited[xxi]
- 'Seamount' Closures – where fishing is prohibited.

BPAs are large, broadly representative areas closed to set aside and protect the full range of benthic marine biodiversity. Their selection was based on the best available scientific knowledge, the Marine Environment Classification, to encompass pristine areas that for the most part have not been impacted by trawling, to provide large and untouched refuges for benthic communities.

In total, 30% of New Zealand's EEZ is closed by law to bottom trawling. This New Zealand marine spatial management programme continues to constitute one of the largest bottom trawl closures within any EEZ in the world and when introduced comprised 24% of the total area under Marine Protection Areas (MPAs) in the world. To give an indication of their size, New Zealand's BPA network is over four times the area of New Zealand's landmass.



Sea Urchins

5. In some areas, BPAs and 'seamount' closures overlap. Therefore, this is based on the footprint area.

NUGGET POINT. SOUTH ISLAND, NEW ZEALAND.[xxx]

Effective Fisheries Management

"New Zealand was ranked first for managing marine resources among the 53 major fishing nations that were assessed."

New Zealand by Satellite[xxxi]

Governance & Policy

Legal & Customary Framework

New Zealand's fisheries management regime is centred on the Quota Management System (QMS), a system introduced in 1986 based on Individual Transferrable Quotas (ITQ, quota) and Total Allowable Commercial Catches (TACCs). The QMS ensures sustainable utilisation of fisheries resources through the direct control of harvest levels based on best available scientific assessments.

Within the QMS, ITQ have been allocated in perpetuity providing each quota owner with a proportional share of the TACC. At the commencement of each year, ITQ give rise to Annual Catch Entitlements (ACE), the annual harvesting right expressed in tonnes. The QMS is administered by MPI through the Fisheries Act 1996.

Quota is an asset that provides owners with incentives to increase returns from their property rights by reducing harvest costs and increasing product values. Improved economic efficiencies have also resulted in alignment between fishing capacities and the sustainable catches from QMS fish stocks, thereby avoiding over-capitalised fisheries (i.e. too many vessels competing for available fish stocks).

Quota provides a property right to access commercial fisheries and has been allocated to Maori as part of the Treaty of Waitangi Settlements that acknowledge the Treaty guaranteed Maori

> *"full exclusive and undisturbed possession of their...fisheries".*

Maori interests are now significant participants in the New Zealand Seafood Industry.

New Zealand has implemented the most extensive quota-based fisheries management system in the world, with over a 100 species or species-complexes of fish, shellfish and seaweed now being managed within this framework. Almost all commercially targeted fish species within New Zealand's waters are now managed within the QMS. The status of the stocks of each species within the QMS is determined using the best available scientific information and each stock is managed independently.

MPI employs fisheries managers (to advise the Minister on the appropriate level at which to set catch allowances) and fisheries scientists (to oversee the collection and analysis of scientific information to inform management advice). Fisheries managers and scientists work closely to ensure the management advice provided to the Minister is consistent with the best available scientific information. TACCs are set by the Minister based on advice provided by fisheries managers, in consultation with quota owners and other external stakeholders.

At an operational level, the southern blue whiting fisheries are managed in accordance with the National Fisheries Plan for Deepwater and Middle-depth Fisheries.[vi]

New Zealand recently became one of only two fishing jurisdictions to achieve a top ranking in a review of fisheries management systems around the world.[xxiv] In a second study, New Zealand was ranked first for managing marine resources among the 53 major fishing nations that were assessed.[xxv]

Collaborative & Participatory Processes

"In 2006, DWG and MPI entered into a formal partnership..."

In 2006, DWG and MPI entered into a formal partnership to enable collaboration in the management of New Zealand's deepwater fisheries, including the southern blue whiting fisheries.[xxvi] This partnership has been updated in 2008 and 2010 and has directly facilitated improved management of the southern blue whiting fishery in almost all respects through:

- A close working relationship under a shared and agreed vision, objectives and collaborative work plan
- Real-time open communication between DWG and MPI on information relevant to management measures, particularly from the Ministry's Scientific Observer Programme and commercial catching operations
- Agreement on a strategic plan for the management of New Zealand's EEZ fisheries
- Development and implementation of clear and agreed management objectives for all New Zealand's deepwater fisheries, including southern blue whiting, through fisheries plans
- Increased dialogue with the Department of Conservation (DOC).

Compliance & Enforcement

"Commercial fishermen face prosecution and risk severe penalties, including automatic vessel or quota forfeiture, upon conviction of breaches to the fisheries regulations."

MPI maintains a comprehensive compliance programme, which includes both encouraging compliance through support and respect for the fisheries management regime, and creating effective deterrents.

This strategy is underpinned by the VADE compliance operating model, which focusses on all elements of the compliance spectrum and takes the following form:

1. Voluntary Compliance – outcomes are achieved through education, engagement and communicating expectations and obligations
2. Assisted Compliance – reinforces obligations and provides confidence that these are being achieved through monitoring, inspection, responsive actions and feedback loops
3. Directed Compliance – directs behavioural change and may include official sanctions and warnings
4. Enforced Compliance – uses the full extent of the law recognising that some individuals may deliberately choose to break the law and require formal investigation.

Since 1994 all vessels over 28 m have been required by law to be part of the Vessel Monitoring System (VMS) which, through satellite telemetry, enables MPI to monitor all deepwater vessel locations at all times. In combination with at-sea and air surveillance, supported by the New Zealand joint military forces, the activities of deepwater vessels are fully monitored and verified to ensure compliance with regulations and with industry-agreed operating procedures.

All commercial catches from QMS stocks must be reported and balanced against ACE at the end of each month. Catches may only be landed at designated ports and sold to Licensed Fish Receivers (LFRs). Reporting requirements for deepwater trawl vessels include logging the location, depth and main species caught for each tow and the total landed catch for each trip undertaken.

MPI audits catch-effort and landing reports from deepwater vessels, reconciles these against multiple sources including VMS records, data collected by onboard MPI observers, and catch landing records from LFRs to ensure that all catches are reported and documented correctly. A significant portion of fishing effort targeting southern blue whiting has been observed – observer coverage has been above 30% most years, with 70% observed in 2011-12, and MPI has plans in place to increase this coverage further (Figure 9). Quayside inspections are also undertaken to verify reported landings.

Commercial fishermen face prosecution and risk severe penalties, including automatic vessel or quota forfeiture, upon conviction of breaches to the fisheries regulations. Financial penalties are also imposed, in the form of deemed values, to discourage commercial fishermen from over-catching their ACE holdings. For every kilogram of catch above the available ACE held, MPI invoices the permit holders a deemed value charge.

Deemed values are set at a level to remove the commercial value from sale of any catch above the level of ACE held. This provides the incentive for permit holders to acquire or maintain sufficient ACE to cover all their catch. It is illegal to discard or to not report catches of QMS species. For some stocks, such as southern blue whiting, differential deemed values apply such that the rate charged increases depending on the proportion by which catches exceed ACE holdings.

The TACCs for southern blue whiting have on occasion been exceeded but catch limits have been adhered in recent years and the level of illegal and unreported catch is low.[iv]

The deepwater fishing industry in New Zealand works closely with the government to ensure compliance with all agreed management measures. A co-management approach to New Zealand's deepwater and middle-depth fisheries has been in place since 2006, encouraging open collaboration between quota holders and MPI.[xxvii] This collaborative approach to management has enabled the development of shared reporting and monitoring processes that allow both parties to utilise their own operational expertise to ensure ongoing adherence to the agreed non-statutory management measures.

Fishery Management Plans

Fisheries Plan

MPI and DWG, in consultation with other interested parties, have developed a National Fisheries Plan for Deepwater and Middle-depth fisheries, including those for southern blue whiting. This Fisheries Plan (the Plan) is a statutory document, approved by the Minister of Fisheries in 2010.[vi] The Plan provides an enabling framework, outlining agreed management objectives, timelines, performance criteria and review processes, and has a life of five years between reviews.

The Plan specifies that the southern blue whiting fisheries will be assessed against agreed reference points for the management of southern blue whiting harvest. It specifies a range of objectives and measures for bycatch management and for the mitigation of incidental interactions with protected species (e.g. seabirds, marine mammals, and certain sharks).

The actual management measures and delivery outcomes in the Plan are specified in MPI's Annual Operational Plan (AOP), which will be reviewed and updated annually. In addition, an Annual Review Report (ARR) assesses performance against the AOP, and the Plan in general, and is available to all stakeholders and interested parties.

Non-Regulatory Management

"...regulations are complemented by additional industry-agreed non-regulatory measures."

Extensive regulations govern the southern blue whiting fisheries including regulations detailing the minimum allowable net mesh size, bottom trawl area closures and a ban on the use of cables for net sounders to reduce incidental interactions with seabirds. These regulations are complemented by additional industry-agreed non-regulatory measures, known as the New Zealand Deepwater Fisheries Operational Procedures. The Minister relies on the effectiveness of both regulatory and non-regulatory measures to ensure the sustainable management of these fisheries.

The Operational Procedures were introduced by DWG on 1 October 2009 and outline the agreed management measures between DWG, quota owners, and MPI. They are implemented and administered by DWG and are audited by MPI.

The Operational Procedures that are particularly important to the southern blue whiting fisheries aim to mitigate marine mammal and seabird interactions with vessels operating in the fisheries. These are the:

- Marine Mammal Operational Procedures (MMOPs); and
- Vessel Management Plans (VMPs) for the mitigation of seabird interactions.

Research Plan

"...programme to improve both the information to underpin management decisions and the efficiencies in science service provision."

In 2009 DWG proposed that the industry's science and research programme should be integrated with that being undertaken by MPI to form a single and integrated 10-Year Research Programme that would be:

- Management Lead – to ensure we obtain adequate science-based information to underpin sustainable management decisions
- Comprehensive – increase the annual investment by MPI in deepwater science and information by 50% including more research surveys, more stock assessments, more stock characterisations, and greater observer coverage
- Environmentally Sound – including enhanced monitoring of interactions between the deepwater fleet and protected species, regular Ecological Risk Assessments to scientifically determine where fishing activities are causing risk of harm to the marine environment, and assessments of trophic interactions
- Cost Efficient – reduce service delivery costs through public tender and multi-year contracts.

In 2010 MPI implemented this 10-Year Research Programme to improve both the information to underpin management decisions and the efficiencies in science service provision.

COROMANDEL, NORTH ISLAND, NEW ZEALAND

Certified Sustainable

"DWG should be commended for undertaking, and meeting, such a rigorous and transparent assessment for their fishing practices."

MSC Commercial Manager, Patrick Caleo[xxviii]

In April 2012, New Zealand southern blue whiting became the third New Zealand fishery to be certified as meeting the Marine Stewardship Council's (MSC) standards.[xix]

The MSC's fishery certification programme sets the highest independent standards for sustainable fishing practices. MSC is a global organisation working with fisheries, seafood companies, scientists, conservation groups and the public to promote the best environmental choices in seafood.

The MSC standards are based on three principles:

1. Are the fish stocks healthy?
2. Is the fishery damaging the marine ecosystem?
3. Is there ongoing effective management of that fishery?

Fisheries are assessed by third-party accredited auditors and their findings are peer-reviewed.

MSC Commercial Manager, Patrick Caleo, commented:

> *"Deepwater Group should be commended for undertaking, and meeting, such a rigorous and transparent assessment for their fishing practices. This is the first southern blue whiting fishery in the world to gain MSC certification, and we expect demand for these products to be high in key export markets."*[xxviii]

The southern blue whiting fisheries were certified without objection and subject to a single condition on SBW6I that requires DWG and MPI to:

> *"...identify the level of ETP species interactions that would lead to adverse effects on population levels for sea lions"*

and in the event

> *"a problem is identified"*

by the second and third surveillance audit

> *"develop and implement appropriate management approaches to achieve those national requirements and objectives. Provide evidence that the strategy is being implemented successfully."*[xix]

DWG and MPI established an Action Plan to address this and during the 2013 Surveillance Audit this Condition was closed.

However, an unprecedented number of captures was experienced in the Campbell Island fishery the following season. In response, DWG requested an expedited audit to establish whether or not the fisheries' performance remained in conformance with MSC's standards, which included consultation with DWG, MPI, science providers, and eNGOs.[xxviii] The independent audit by Intertek Moody Marine concluded that there was a comprehensive strategy in place for managing the fisheries' impacts and evidence this was being implemented successfully. No conditions have been raised as a result.

This endorsement by MSC confirms for our customers what we already know – that a co-operative approach to fisheries management, backed up by excellent science and New Zealand's world leading quota management system, gets results.

To track a fishery's certification progress go to: *www.msc.org/track-a-fishery/fisheries-in-the-program*

References

Deepwater Group Limited
Email: info@deepwatergroup.org

i. United Nations Secretary-General's high-level panel on Global sustainability. (2012). Resilient People, Resilient Planet: A future worth choosing. New York: United Nations.

ii. Hanchet, S.M. (1999). Stock structure of southern blue whiting (Micromesistius australis) in New Zealand waters. New Zealand Journal of Marine and Freshwater Research 33(4): 599-610.

iii. Ministry for Fisheries. (2011). Research and Science Information Standard for New Zealand, April 2011. Wellington, New Zealand: Author.

iv. Ministry for Primary Industries. (2013). Fisheries Assessment Plenary, May 2013: Stock Assessments and Yield Estimates. Wellington, New Zealand: Author.

v. Ministry for Primary Industries. (2012). Document Library Homepage. Retrieved from http://fs.fish.govt.nz/Page.aspx?pk=61&tk=297

vi. Ministry of Fisheries. (2010) National Fisheries Plan for Deepwater and Middle-depth Fisheries: Fishery-specific Chapter: Southern Blue Whiting.

vii. Ministry of Fisheries. (2008). Harvest Strategy Standard for New Zealand Fisheries. Wellington, New Zealand: Author.

viii. Ministry for Fisheries. (2011). Ministers Decision letter on SBW6B and SBW6I for the 2011-12 fishing year. March 2011. Retrieved from http://www.fish.govt.nz/en-nz/Consultations/Archive/2011/SBW+01+April+2011/default.htm

ix. Anderson, O. (2008). Progress Reports for MFish Project ENV2008-01: Fish and invertebrate bycatch and discards in southern blue whiting fisheries, 2002–2007.

x. Abraham, E. & Thompson, F. (2013). Captures of birds in New Zealand southern blue whiting fisheries, in the New Zealand Exclusive Economic Zone 2002-03 to 2010-11. Retrieved from http://data.dragonfly.co.nz/psc/v20121101/birds/southern-blue-whiting-trawl/all-vessels/eez/2011/, Apr 15, 2013.

xi. Richard, Y., Abraham, E. & Filippi, D. (2011). Assessment of the risk to seabird populations from New Zealand commercial fisheries. Final Research Report for Ministry of Fisheries projects IPA2009/19 and IPA2009/20 (Unpublished report held by the Ministry of Fisheries, Wellington).

xii. Ministry for Primary Industries. (2012). Aquatic Environment and Biodiversity Annual Review 2012. Compiled by the Fisheries Management Science Team. Wellington, New Zealand: Author.

xiii. Pierre, J., et al. (2010) Reducing interactions between seabirds and trawl fisheries: Responses to foraging patches provided by fish waste batches. Biological Conservation 143 (11): 2779-2788.

xiv. Middleton, D. & Abraham, E. (2007). The efficacy of warp strike mitigation devices: trials in the 2006 squid fishery. Final Research Report for Ministry of Fisheries research project IPA2006/02.

xv. Baker, C.S., Chilvers, B.L, Constantine, R., DuFresne, S., Mattlin, R.H., van Helden, A. & Hitchmough, R. (2010). Conservation status of New Zealand marine mammals (suborders Cetacea and Pinnipedia), 2009. New Zealand Journal of Marine and Freshwater Research 44: 101-115.

xvi. Baker, B. & Hamilton, S. (2012). Assessment of the impact of incidental fisheries mortality on the Campbell Island New Zealand sea lion Phocarctos hookeri population using the Potential Biological Removal technique. Australia: Latitude 42 Environmental Consultants Pty Ltd.

xvii. Thompson, F., Berkenbusch, K. & Abraham, E. (2013). Marine mammal bycatch in New Zealand trawl fisheries, 1995-96 to 2010-11. New Zealand Aquatic Environment and Biodiversity Report No. 105. 77p.

xviii. Akroyd, J. & Pilling, G. (2013). Surveillance Report: Southern Blue Whiting Fishery – Expedited Audit Report. September/October 2013. Derby, United Kingdom: Intertek Moody Marine.

xix. Akroyd, J., Medley, P., Pilling, G., Hough, A. & Davies, S. (2012). MSC Assessment Report for New Zealand Southern Blue Whiting Trawl Fisheries: Public Certification Report Version 5. Derby, United Kingdom: Intertek Moody Marine.

xx. Ministry of Fisheries. (2011). Research Specifications for the 10-year Research Programme for Deepwater Fisheries. DFR2010-02 Appendix One: July 2011.

xxi. Helson, J., Leslie, S., Clement, G., Wells, R., Wood, R. (2010). Private rights, public benefits: industry-driven seabed protection. Marine Policy 2011 34: 557-566.

xxii. Black, J. & Wood, R. (2010). Analysis of New Zealand's Trawl Grounds for the Tier 1 Species, GNS Science Consultancy Report 2010/167. 31p.

xxiii. Ministry for Primary Industries (2013). National Aquatic Biodiversity Information System Homepage. Retrieved from http://www.nabis.govt.nz/

xxiv. Worm, B., Hilborn, R. et al. (2009). Rebuilding Global Fisheries. Science 325 (5940): 578-585.

xxv. Alder, J., Cullis-Suzuki, S., et al. (2010). Aggregate performance in managing marine ecosystems of 53 maritime countries. Marine Policy 34 (3): 468-476.

xxvi. Ministry of Fisheries and Deepwater Group Ltd. (2010). Memorandum of Understanding for the Deepwater Fisheries Management Partnership. 8p.

xxvii. Ministry of Fisheries and Deepwater Group Ltd. (2009). Compliance Charter. In: Memorandum of Understanding for the Deepwater Fisheries Partnership. Annex 2: Compliance. 1p.

xxviii. Marine Stewardship Council. (May 02, 2012). New Zealand southern blue whiting trawl fishery gains MSC certification. Retrieved from http://www.msc.org/newsroom/news/nz-southern-blue-whiting-gains-marine-stewardship-council-certification

xxix. Retrieved from http://www.kiwiwise.co.nz/stock-photos

xxx. Retrieved from http://en.wikipedia.org/wiki/Nugget_Point

xxxi. Retrieved from http://earthobservatory.nasa.gov/IOTD/view.php?id=3101&eocn=image&eoci=related_image