HOKI, HAKE & LING TRAWL SITUATION REPORT

PREPARED FOR THE 4TH MSC SURVEILLANCE AUDIT 2023

Seafood New Zealand
DEEPWATER COUNCIL

TABLE OF CONTENTS

S:\PROJECTS\2022-23 Projects\2590 to 93 MSC HOK HAK LIN SBW\HOK-HAK-LIN\Situation Report\Situation Report HHL Trawl 2023_030823.docx

SITUATION REPORT FOR THE 4TH MSC SURVEILLANCE AUDIT NEW ZEALAND HOKI, HAKE & LING TRAWL FISHERIES

PURPOSE OF THIS REPORT

This report is one of three prepared for the New Zealand combined MSC reassessments for hake, hoki, ling and southern blue whiting.

1. **Situation Report for New Zealand Hoki, Hake & Ling Trawl Fisheries**
2. Situation Report for New Zealand Ling Longline Fishery
3. Situation Report for New Zealand Southern Blue Whiting Trawl Fisheries

This report provides an update on ten Units of Certification (UoC), for hoki (HOK 1 East & West), hake (HAK 1 & 4), and ling (LIN 3, 4, 5, 6 & 7) trawl fisheries, and builds on the information previously provided for the 2022 surveillance audit.

It is Seafood New Zealand Ltd - Deepwater Council's (DWC) submission that these nine fisheries, continue to conform to the MSC Fisheries Standard (FCR V3.0) as evidenced in the following updated information and references.

OVERVIEW OF FISHERY MSC CERTIFICATION

Hoki trawl certification details

Certification date	Initial Certification: March 2001 First Recertification: October 2007 Second Recertification: September 2012 Third Recertification: September 2018
Stock areas	UoC 1: HOK 1 (East) UoC 2: HOK 1 (West)
Species	*Macruronus novaezealandiae*
Method/gear	Trawl

Hake trawl certification details

Certification date	Initial Certification: September 2014 Recertification: September 2018 (synchronised with Hoki)
Stock areas	UoC 3: HAK 1 (Sub-Antarctic) UoC 4: HAK 4 (Chatham Rise)
Species	*Merluccius australis*
Method/gear	Trawl

Ling trawl certification details

Certification date	Initial Certification: September 2014 Recertification: September 2018 (synchronised with Hoki)
Stock areas	UoC 6: LIN 3 UoC 7: LIN 4 UoC 8: LIN 5 UoC 9: LIN 6 UoC 10: LIN 7
Species	*Genypterus blacodes*
Method/gear	Trawl

P1 OVERVIEW OF STOCK STATUS INFORMATION

Stock status summary for the combined UoC (hoki mixed-species trawl fishery – HOK, HAK and LIN)

Table 1: Summary of the stock status of the UoC based on the base model runs

Stock	Most recent assessment	Depletion [Year]	P < Target	P < Soft Limit	P < Hard Limit
HOK 1 East	2023	54 (41-70) [2023]	> 90%	< 10%	< 1%
HOK 1 West	2023	37 (31-45) [2023]	< 40%	< 40%	< 10%
HAK 1	2021	62 (50-75) [2021]	> 90%	< 1%	< 1%
HAK 4	2020	55.1 (45.7-65.8) [2020]	> 90%	< 1%	< 1%
LIN 3 & 4*	2022	55.8 (46.9-66.3) [2022]	> 90%	< 1%	< 1%
LIN 5 & 6	2021	70.8 (63.1-79.3) [2021]	> 99%	< 1%	< 1%
LIN 7WC	2023	51.1 (38.2-63.5) [2023]	> 90%	< 10%	< 1%

Stock status, TACC & catches by component UoCs

UoC 1 & UoC 2 – HOK 1 East & HOK 1 West

- UoA share of TACC 100%
- UoC share of TACC 93%

Update on stock status (FNZ, 2023)

HOK 1 East:

- B_{2023} was estimated to be 54% B0; Very Likely (> 90%) to be at or above the target
- B_{2023} is Very Unlikely (< 10%) to be below the Soft Limit and Exceptionally Unlikely (< 1%) to be below the Hard Limit.

- The stock projection is that the biomass will remain within the target range over the next five years.

HOK 1 West:

- B_{2023} was estimated to be 37% $B_{0,}$ Unlikely (< 40%) to be at or above the target.
- B_{2023} is Unlikely (< 40%) to be below the Soft Limit and Very Unlikely (< 10%) to be below the Hard Limit.
- The stock projection is that the biomass of the western hoki stock is expected to slowly increase over the next five years at assumed future catch levels, based on future recruitment remaining comparable to recent recruitment (FNZ, 2023).

TACC & catch trends (FNZ, 2022)

Table 2, Figure 1 and Figure 2 show the TACC and catch trends for HOK 1 (eastern and western sides). Notably:

- During the 2022-23 fishing year quota owners have agreed to an overall catch of 100,000 t with catch limits of 60,000 t for East and 40,000 t for West – delivered through shelving of ACE.
- During the 2021-22 fishing year quota owners have agreed to an overall catch of 100,000 t with catch limits of 55,000 t for East and 45,000 t for West – delivered through shelving of ACE.
- During the 2020-21 fishing year quota owners agreed to an overall catch of 95,000 t with catch limits of 50,000 t for East and 45,000 t for West – delivered through shelving of ACE.
- During the 2018-19 fishing year, quota owners agreed to an overall catch of 130,000 t with catch limits of 60,000 t for East and 70,000 t for West – delivered through shelving of 30,144 t of ACE (i.e., including under-catch from 2017-18).

Table 2 Catch limits, ACE, catch and associated balances for the HOK 1E and 1W fisheries from 2018-19 to 2022-23.

Stock	TACC	2018-19	2019-20	2020-21	2021-22	2022-23	5-year average
HOK 1E	Catch limit	60,000	60,000	60,000	65,000	65,000	
	ACE	64,217	60,000	64,584	65,000	71,461	
	Catch	63,610	55,070	54,786	48,946	36,545	51,792
	Balance	607	4,930	9,797	16,054	34,916	13,261
HOK 1W	Catch limit	90,000	55,000	55,000	45,000	45,000	
	ACE	99,157	55,000	57,141	45,000	47.270	
	Catch	56,953	53,030	46,338	42,773	14,111	42,641
	Balance	42,204	1,970	10,802	2,227	33,159	18,073

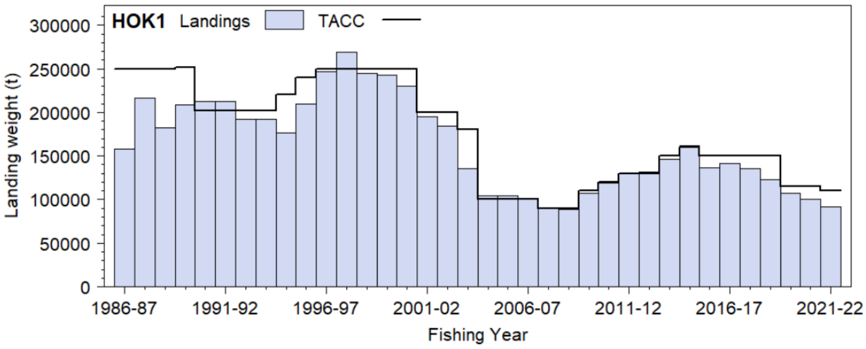


Figure 1: Total Allowable Commercial Catches and reported catches for HOK 1 (East & West combined) (FINZ, 2023).

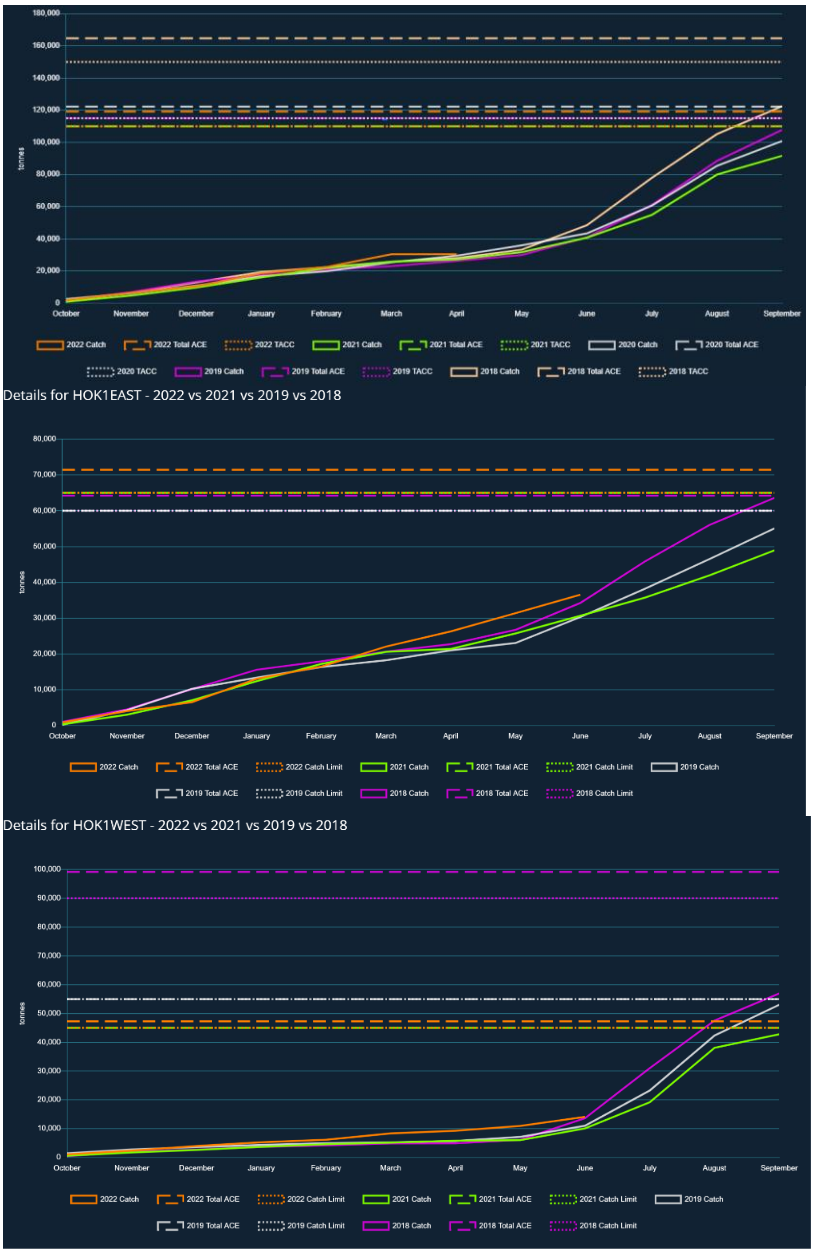


Figure 2: Catch trends and associated total allowable commercial catch for HOK 1 (Top - East & West combined, Centre – HOK1 East and Bottom – HOK1 West). (Source: FishServe KUPE system)

Catch management

The harvest strategy for hoki is to manage the stock within the target range of 35-50% B_0. The management response is to reduce or increase catches to maintain stock size within the target range.

Over the past five or so years, many in the hoki fishery have expressed concerns with aspects of fishery performance, with no agreement on the causes and a general preference to rely upon the science and the stock assessment results. During 2018, HOK 1 quota owners reached agreement that there was a problem, particularly with the lack of abundance of hoki in the West Coast South Island fishery outside the 25 nm line, and that management intervention was required.

- **2018-19 fishing year** – quota owners agreed to reduce the HOK 1 W catch limit by 20,000 t from 90,000 t to 70,000 t and to leave the HOK 1 E catch limit at 60,000 t, providing a HOK 1 catch limit of 130,000 t. This was given effect to by collectively setting aside 30,144 t ACE from HOK 1 W during 2018-19 (noting that, unless there is a TACC reduction, there will be ACE carried forward from under-catch in the previous year. To account for some of the 14,730 ACE carried forward from 2017-18, an additional 10,144 t ACE was set aside – see table below). In addition, some companies elected to change their fishing strategies during 2018-19 to further reduce their HOK 1 catch.
- **2019-20 fishing year** – FNZ advised their options of a TACC reduction of either 20,000 t or 30,000 t. Industry did not support either of these options. Instead, we asked for a 35,000 t catch reduction, to be implemented by shelving 35,000 t ACE (plus any carry forward) from HOK 1 W – thereby reducing the western catch limit from 70,000 t to 55,000 t and with the catch limit for HOK 1 E being retained at 60,000 t and the total catch limit set at 115,000 t. In the event, the Minister did not agree with either FNZ or with quota owners' proposals and reduced the TACC by 35,000 t to 115,000 t. Again, some companies elected to change their fishing strategies to further reduce their HOK 1 catch. Hoki is a low-value species and fishing companies operate to maximise their returns, not their catches and will deploy their vessels where the returns are highest. During 2020, many vessels that would have otherwise fished for hoki elected to stay on in the squid fishery, given the favourable catch rates and market prices for squid. In addition, during the hoki spawning season three fillet boats were deployed into the Australian blue grenadier fishery. Sealord's CEO publicly announced at the time that they had a deliberate strategy to further reduce the pressure on New Zealand hoki resources. Overall, during 2019-20, the deepwater trawl fishery undertook 21,500 tows, compared with ~25,000 tows in previous years, and there will be an increased number of squid tows and a reduced number of hoki tows in that lower figure.
- **2020-21 fishing year** – Given continued concerns over the performance of the hoki fishery, quota owners agreed to reduce the HOK 1 catch limit to 95,000 t, lower than the TACC of 115,000 t, achieved by setting aside ~20,000 t. The agreed catch limit for HOK 1 E was reduced by 10,000 t (from 60,000 t to 50,000 t) and for HOK 1 W by 10,000 t (from 55,000 t to 45,000 t). These catch management measures were reviewed based on the 2021 hoki stock assessment and quota owners' views on the state of the fisheries.
- **2021-22 fishing year** – The HOK 1 TACC was reduced by 5,000 t to 110,000 t (FNZ, 2021, 2021a). Quota owners agreed to set a catch limit of 100,000 t, achieved by setting aside 10,000 t of HOK 1 E ACE (DWG, 2021).
- **2022-23 fishing year –** The HOK 1 TACC remained at 110,000 t. Quota owners agreed to set a catch limit of 100,000 t, achieved by setting aside 10,000 t of HOK 1 E ACE (DWG, 2021).

Stock assessment development and structure

Hoki is assessed as two intermixing biological stocks, based on the presence of two main areas where simultaneous spawning takes place (Cook Strait and the WCSI), and observed and inferred migration patterns of adults and juveniles:

- Adults of the western stock occur off the west coast of the North and South islands and the area south of New Zealand including Puysegur, Stewart-Snares shelf, and the Sub-Antarctic;
- Adults of the eastern stock occur off the east coast of the South Island, Cook Strait, and the ECNI up to North Cape;

- Juveniles of both biological stocks occur on the Chatham Rise including Mernoo Bank (FNZ, 2023).

In response to concerns from quota owners regarding the conflict between the high stock status estimated by the stock assessment model and the low catch rates observed by the commercial fleet in recent years, a review of the 2019 stock assessment model was undertaken during 2020 (Langley, 2020), and no stock assessment was undertaken during 2020.

The 2021 assessment differed substantially from 2019 in having different assumptions for natural mortality, maturation, and migrations, and spatially restructured fisheries dependent data with revised selectivity assumptions (FNZ, 2023). A suite of exploratory models was developed and tested during 2020 incorporating:

- Changes in fishery configuration
- Relaxed model constraints associated with trawl survey selectivity functions
- Constant rates of M for male and female hoki
- Alternative parameterisations for the distribution and migration of fish between the Chatham Rise and the Sub-Antarctic regions.

The exploratory models provided improved fits to the individual data sets, yielded estimates of stock status that were more consistent between the eastern and western stock components and identified some persistent discrepancies that required further investigation. Further development of the model during 2020 and 2021 resulted in a number of changes and improvements to model fits.

Subsequently the 2022 stock assessment made the following changes from the 2021 model:

- Selectivity caps free for spawning males
- Sub-Antarctic summer survey minimum age extended to 3 years from 4 years
- Selectivity shifts as applied to Sub-Antarctic selectivity estimated in the Stock Synthesis model were not applied
- West coast north fishery not split at 2000 (FNZ, 2023)

The most recent stock assessment was completed in 2023. The 2023 assessment updated the 2022 assessment which followed a review of input data and model assumptions completed between 2018 and 2020 (Dunn & Langley 2018, Langley 2020). Figure 3 and Figure 4 shows results from the most recent stock assessment showing that HOK 1E is within the management target range when using long term recruitment and associated projections show the stock will remain within the management target range. For HOK 1W is within the management target range when using recent recruitment and associated projections show the stock will remain within the management target. The assessed trajectories of fishing intensity and spawning biomass from 1972 to 2023 are illustrated below for the East stock (top) and West stock (bottom) (Figure 5) (FNZ, 2023).

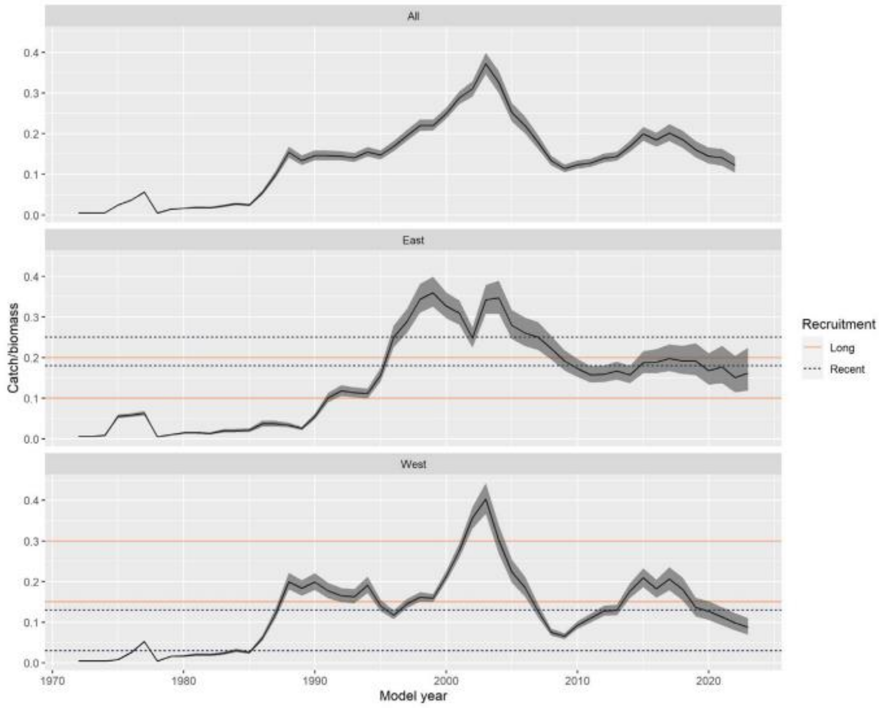


Figure 3: Fishing intensities, U (from MCMCs) for model 2023A, plotted by stock. Shown are medians (solid black line) with 95% confidence intervals (shaded area). Also shown with horizontal lines is the management range where the upper bound is the reference level U35%Bo and the lower bound U50%Bo which are the fishing intensities that would cause the spawning biomass to tend to 35% B0 and 50% B0, respectively, under recent recruitment (dashed) or long-term recruitment (solid). Reference U values were estimated in the 2022 assessment (FNZ, 2023).

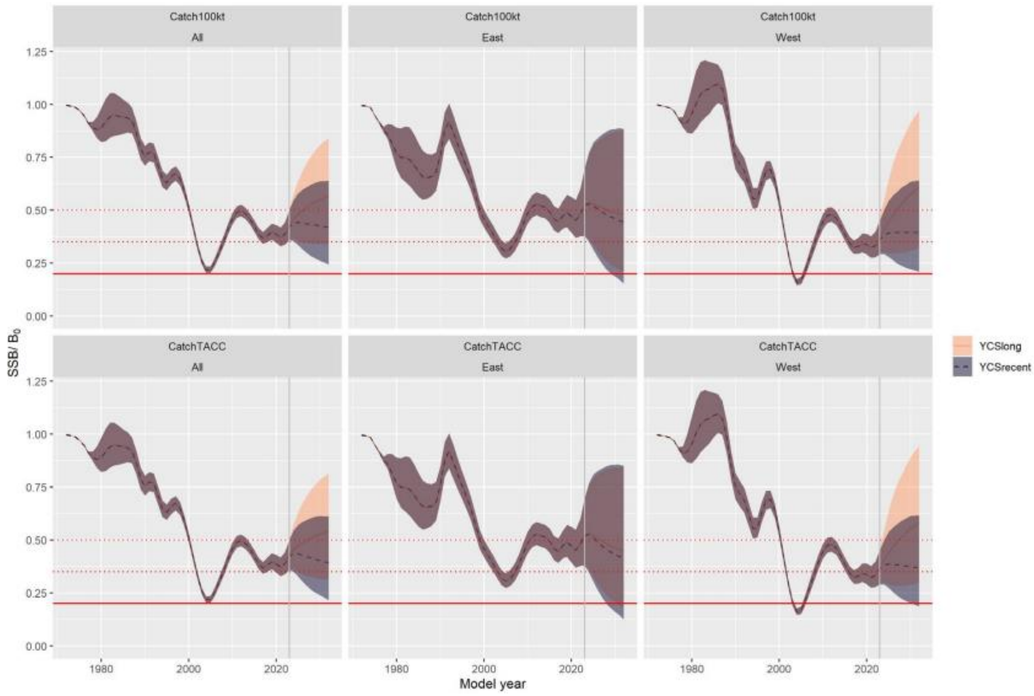
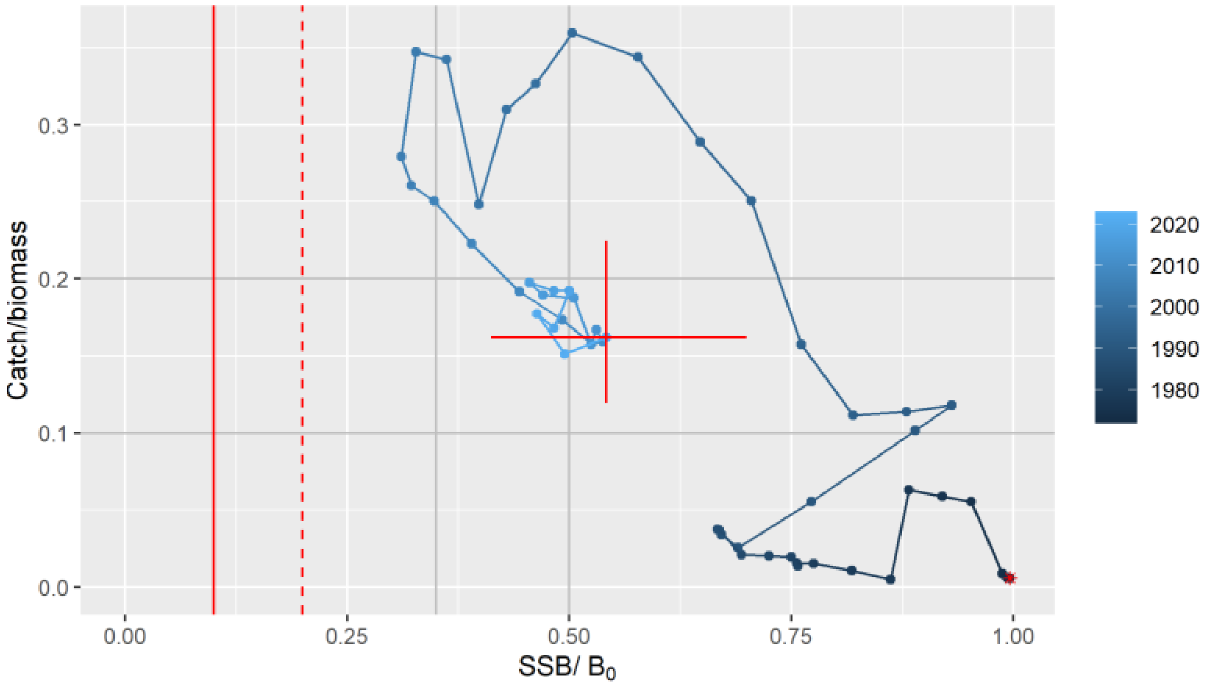


Figure 4: Projected spawning biomass (as % B0) from the base model (2023A) under two recruitment scenarios: recent (2010–2019) (grey); long-term (1975–2019) (peach), for eastern stock (middle), western stock (right), and summarised over both stocks ('All', left) for two catch scenarios: 100 000 tonnes (top) and TACC (110 000 tonnes) (bottom). The horizontal dotted red lines represent the target management range of 35–50% B0. The horizontal solid red line shows 20% B0. Shaded areas give 95% CIs, and central line gives median SSB/B0 (FNZ, 2023).



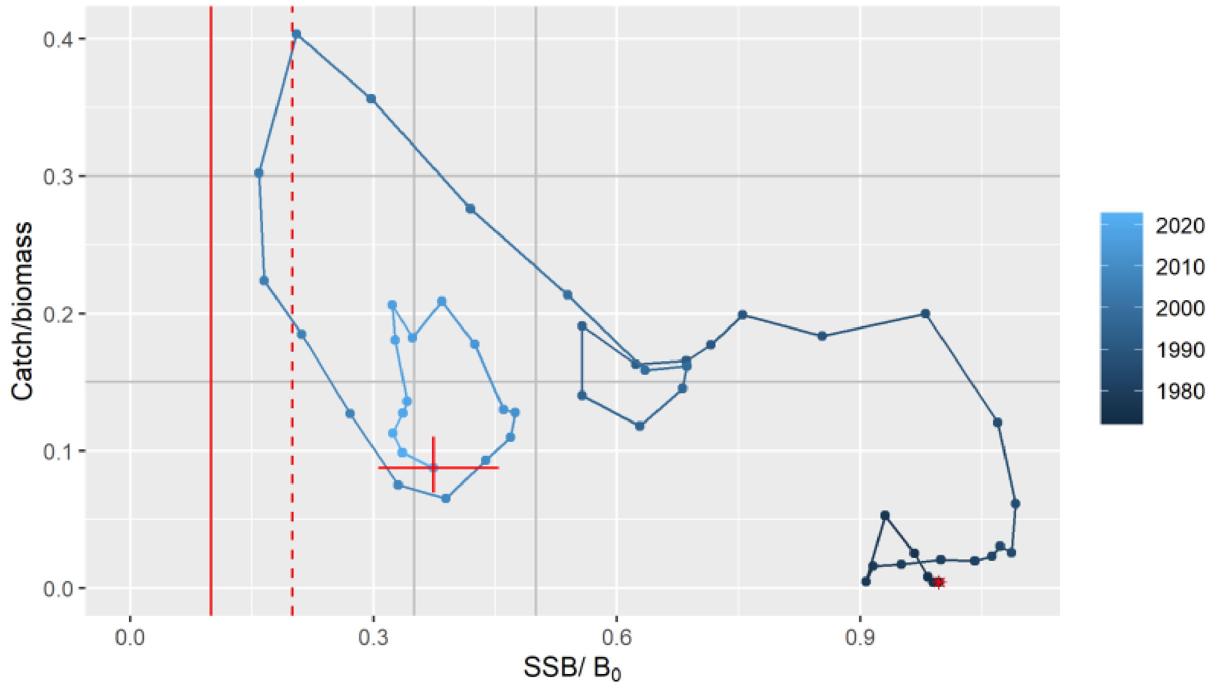


Figure 5: Trajectories over time of fishing intensity (U) and relative spawning biomass (SSB/SSB0), for the eastern hoki stock (top) and western hoki stock (bottom) from the start of the assessment period in 1972 (represented by a red asterisk) to 2023 (centre of red cross). The red solid vertical line at 10% B0 represents the hard limit, the red dashed line at 20% B0 is the soft limit, and the grey lines represent the management target ranges in biomass and fishing intensity, with fishing intensity estimated in the 2023 assessment using long-term recruitment. Biomass and fishing intensity estimates are medians from MCMC results. Red cross represents 95% CIs for 2023 (FNZ, 2023).

Fishery independent surveys

- **Cook Strait** – the acoustic abundance index in 2021 was 75% higher than the equivalent index from the 2019 survey (O'Driscoll & Escobar-Flores, 2020), reversing the decreasing trend observed in the time series since 2015 (FNZ, 2022).
- **West Coast South Island** – the trawl and acoustic abundance index in 2018 was the lowest in the time series, down 47% on 2013 (O'Driscoll & Ballara, 2019).
- **Chatham Rise** - the trawl abundance index in January 2022 was 9% higher than that in 2020, relative biomass of recruited hoki (ages 3+ years and older) increased (by 8%) from that in 2020 and there was also an above average estimate for 2+ hoki (2019 year class) (Figure 6) (FNZ, 2023).
- **Sub-Antarctic** - the trawl abundance index in December 2018 was down 18% from 2016 but similar to that in 2014 (c). The most recent trawl survey estimate in November-December 2020 was higher than that in 2018 and similar to that in 2016 (FNZ, 2022).

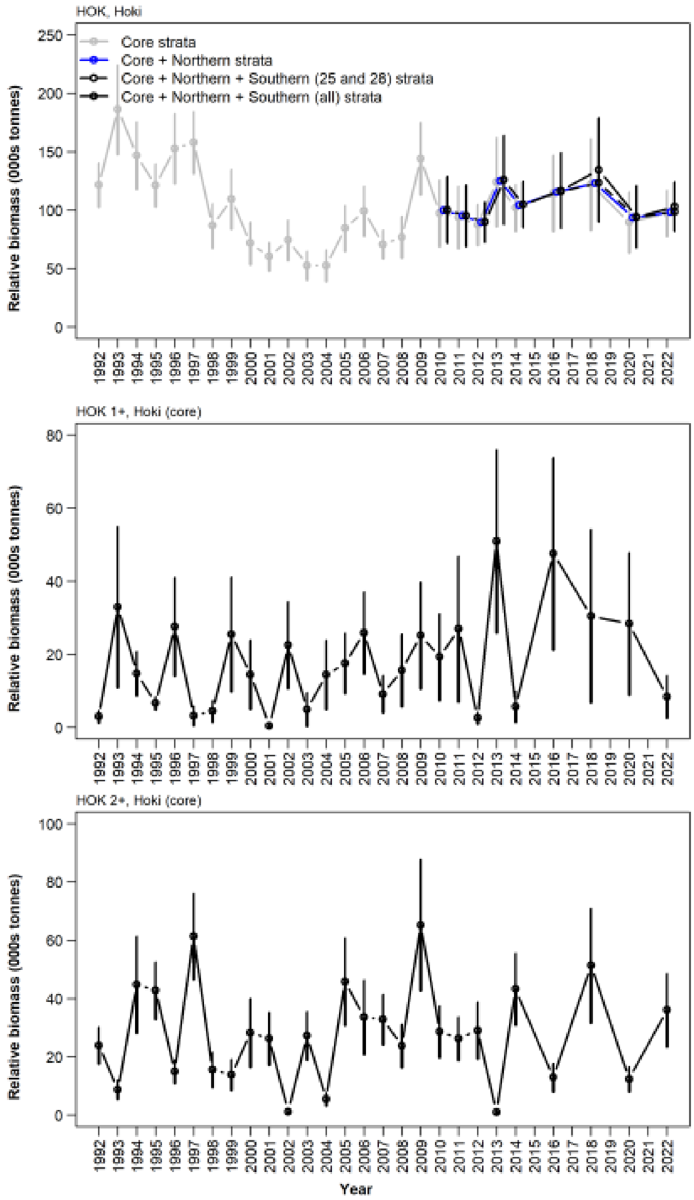


Figure 6: Relative biomass estimates (thousands of tonnes) of hoki, hake, ling, and 8 other selected commercial species sampled by annual trawl surveys of the Chatham Rise, January 1992–2014, 2016, 2018, 2020, and 2022 (core and all strata). Error bars show ± 2 standard errors (Stevens et al., 2023).

UoC 3 and 4 – HAK 1 and HAK 4

	HAK 1	HAK 4
UoA share of TACC	100 %	100 %
UoC share of TACC	94 %	94 %

Update on stock status (FNZ, 2023)

HAK 1:

- HAK 1 (Sub-Antarctic): B2021 was estimated at 62% B0; Very Likely (> 90%) to be at or above the target of 40% B_0.
- B2021 is Exceptionally Unlikely (< 1%) to be below the Soft Limit of 20% B0.

HAK 4:

- For the Chatham Rise stock (HAK 4 plus HAK 1 north of the Otago Peninsula), B_{2020} was estimated to be about 55% B0;
- Very Likely (> 90%) to be at or above the target of 40% B0 and Exceptionally Unlikely (< 1%) to be below the Soft Limit of 20% B0.
- The HAK 4 catch is taken largely as bycatch in the eastern hoki trawl fishery and catch trends are therefore subject to forces other than hake abundance.

TACC & catch trends (FNZ, 2023)

Table 3, Figure 7, Figure 8, Figure 9 and Figure 10 show the TACC and catch trends for HAK 1 and 4.

Table 3: TACC, catch limits, catch and associated balances for the HAK 1, 4 and 7 fisheries from 2018-19 to 2022-23.

Stock	TACC	2018-19	2019-20	2020-21	2021-22	2022-23	5-year average
HAK 1	TACC	3,071	3,071	3,071	3,071	3,071	
	ACE	4,109	4,110	4,109	4,111	4,110	
	Catch	896	1062	1503	1,692	947	1,220
	Balance	3,212	3,047	2,606	2,419	3,163	2,889
HAK 4	TACC	1,800	1,800	1,800	1,800	1,800	
	ACE	2,000	1,999	1,998	1,998	1,998	
	Catch	183	137	207	137	116	156
	Balance	1,817	1,862	1,792	1,861	1,882	1,843

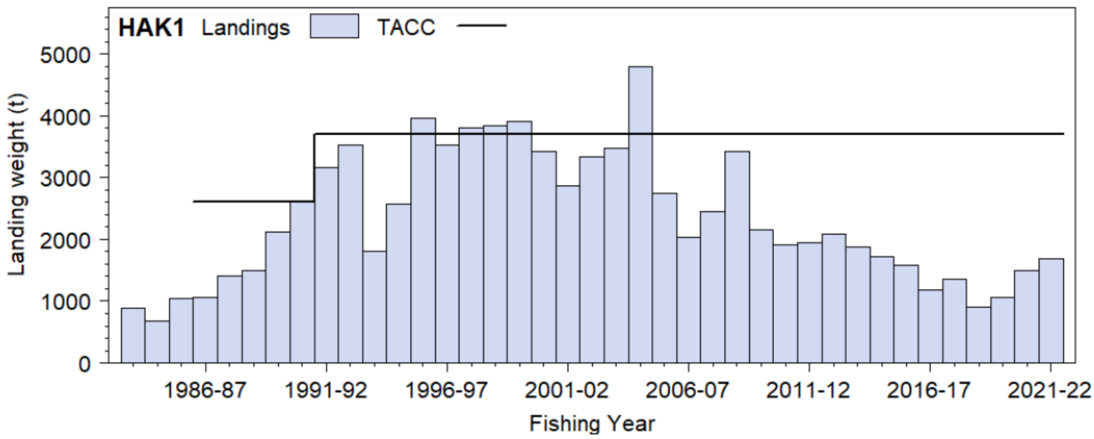


Figure 7: Total Allowable Commercial Catches and reported catches for HAK 1 (FINZ, 2023).

Note: The HAK 1 catch is taken largely as bycatch in the western hoki trawl fishery and catch trends are therefore subject to forces other than hake abundance.

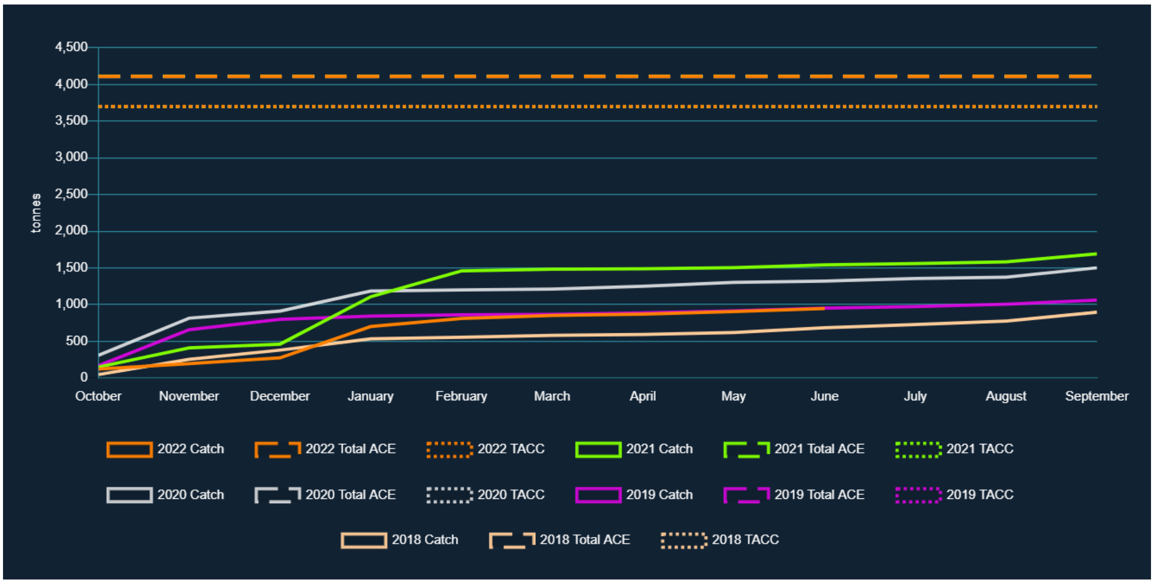


Figure 8: Reported commercial landings, total ACE and TACC for HAK 1 for fishing years 2018 – 2022. (Source: FishServe KUPE system)

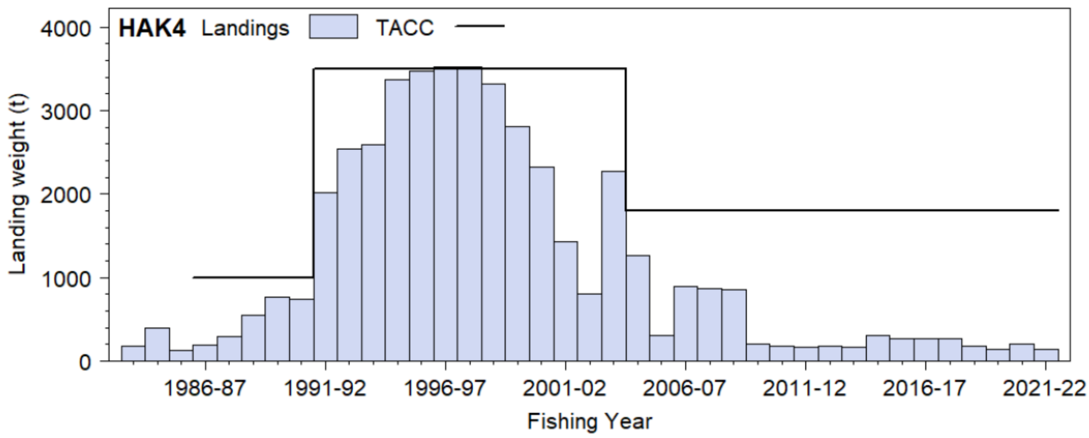


Figure 9: Total Allowable Commercial Catches and reported catches for HAK 4 (FNZ, 2023).

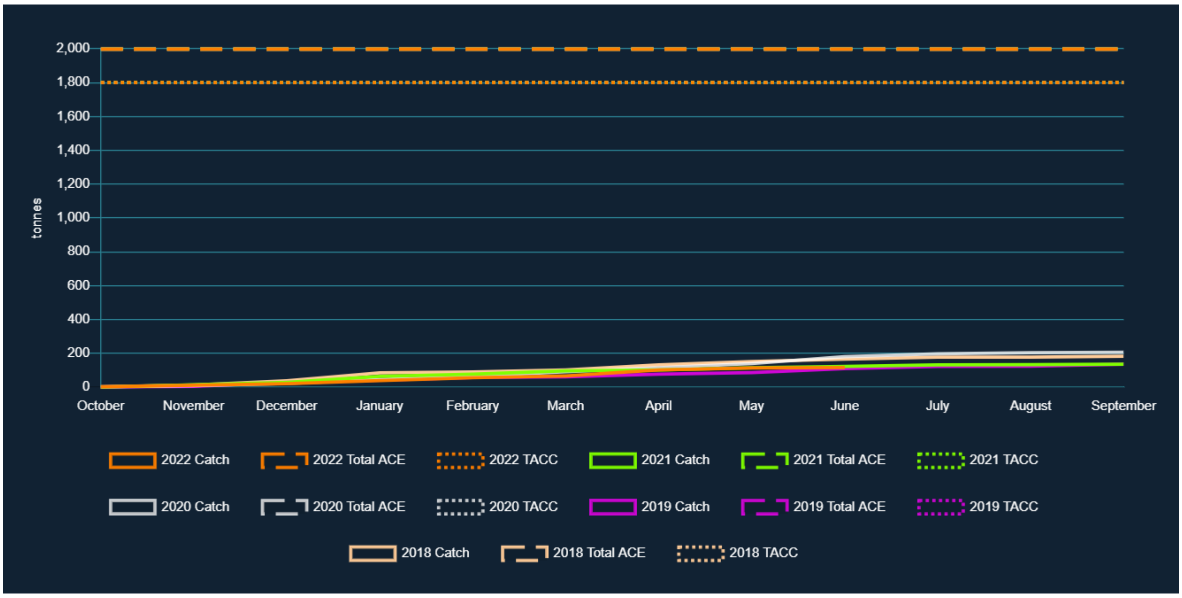


Figure 10: Reported commercial landings, total ACE and TACC for HAK 4 for fishing years 2018 – 2022. (Source: FishServe KUPE system)

Stock assessment development and structure

HAK 1

Sub-Antarctic stock

The 2021 stock assessment (Dunn et al., 2021b) was carried out with data up to the end of the 2020 calendar year, implemented as a Bayesian model using the general-purpose stock assessment program CASAL v2.30 (Bull et al., 2012). The assessment used research time series of abundance indices (trawl surveys of the Sub-Antarctic from 1991 to 2020), catch-at-age from the trawl surveys and the commercial fishery since 1990–91, and estimates of biological parameters. A trawl fishery CPUE series was used in a sensitivity run.

The model had a single area and was an age-structured two-sex model partitioned into age groups 1–30 with the last age group considered a plus group. Maturity-at-age was assumed using estimates made outside the model.

The model was initialised assuming an equilibrium age structure at an unfished equilibrium biomass (B0), i.e., with constant recruitment set equal to the mean of the recruitments over the period 1974–2016. Selectivity and natural mortality were assumed to be constant across the time period whilst growth was also assumed to be constant and was fixed to a von Bertalanffy growth model. Year class strengths for the period 1974–2016 were estimated, and otherwise assumed to be 1.0.

Year class strength estimates suggested that the Sub-Antarctic stock was characterised by a group of above average year class strengths in the late 1970s, a very strong year class in 1980, followed by a period of average to less than average recruitment through to 2016 (Figure 5). The absolute catchability of the Sub-Antarctic trawl surveys was estimated to be extremely low (Figure 6).

The 2021 assessment model structure was different to the previous (2018) model in (a) correcting the time series of survey biomass estimates used and (b) modifying the annual cycle to more accurately align the observations with their timing in the model. The biomass estimates from the reference model and the 2018 model were similar, albeit the current estimates were more optimistic due to the correction in the time series of biomass estimates use

Deepwater Working Group noted there may be additional uncertainty in the strength of the early age classes, and the resulting trajectory of the assessment. Sensitivity models carried out suggested that the model conclusions were robust to choices of the early strength of year classes. The inclusion of estimates of incidental mortality and pre-QMS unreported catch resulted in a very similar status, and similar estimates of current biomass.

Biomass estimates for the stock appeared well above the target (40% B0), with estimated current biomass from the base model at about 62% B0 (95% CIs 50–75% B0) (Figure 11, Table 4 and Table 5). Annual exploitation rates (catch over vulnerable biomass) were low in all years because of the high estimated stock size relative to the level of catches. At the current catch (1066 t), SSB is predicted to remain stable over the next five years (Figure 12). At a catch of the TACC (3701 t), SSB is predicted to decrease. At the current catch, the estimated probability of SSB falling below the soft or hard limits is zero. At the TACC, the probability of the SSB dropping below the soft limit is about 1% or less using both all YCS and just more recent YCS.

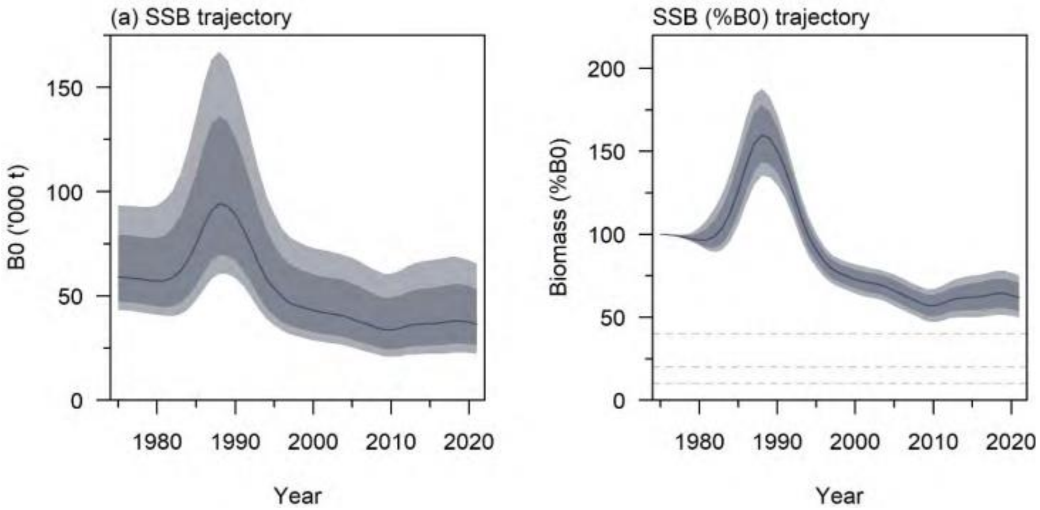


Figure 11 Reference model MCMC trajectories for absolute spawning stock biomass and spawning stock biomass as a percentage of B0. Dark shaded areas represent the 80% CIs, and light shaded areas the 95% CIs. The management target (40% B0, upper dotted horizontal line), soft limit (20% B0, middle dotted horizontal line), and hard limit (10% B0, lower dotted horizontal line) are shown on the right-hand panel. (Source: FNZ, 2023)

Table 4 MCMC median (95% credible intervals) of B0, B2021, B2021 as a percent of B0, and the probability of B2021 being above the target (40% B0), for the reference model and sensitivity runs. (Source: FNZ, 2023)

Model run	B_0	B_{2021}	B_{2021} (% B_0)	P($B_{2021} > 0.4\,B_0$)
Reference model	59 000 (43 220–93 600)	36 490 (22 250–65 510)	62 (50–75)	1.00
Fixed M=0.15 y^{-1}	40 440 (36 050–46 170)	20 990 (14 970–28 760)	52 (41–64)	0.98
Fixed M=0.23 y^{-1}	75 130 (55 310–110 190)	51 700 (33 480–85 480)	68 (55–84)	1.00

Table 5 HAK 1 Bayesian median (t) and 95% credible intervals (t, in parentheses) of projected B2026, B2026 as a percentage of B0, and B2026/B2021 (%) for the reference model. (Source: FNZ, 2023)

Model run	Catch (t)	B_{2026}	B_{2026} (% B_0)	B_{2026}/B_{2021} (%)	p($B_{2026} > 0.4\,B_0$)	p($B_{2026} < 0.2\,B_0$)	p($B_{2026} < 0.1\,B_0$)
Reference model	1 066	34 410 (19 950–64 740)	58 (42–78)	94 (76–117)	0.99	0.00	0.00
with recent YCS	3 701	26 240 (11 620–56 700)	44 (25–66)	72 (47–96)	0.66	0.01	0.00
Reference model	1 066	38 070 (21 960–78 930)	63 (46–111)	102 (80–176)	1.00	0.00	0.00
with all YCS	3 701	29 950 (13 590–71 460)	49 (30–97)	80 (54–155)	0.82	0.00	0.00

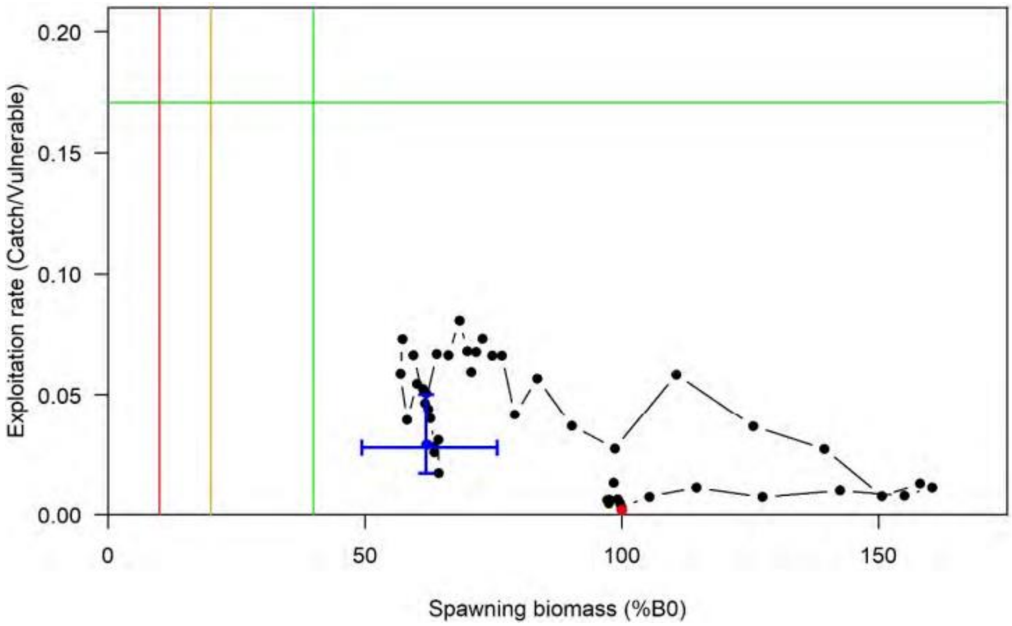


Figure 12 Trajectory over time of exploitation rate (U) and spawning biomass (%B0), for the Sub-Antarctic stock reference model from the start of the assessment period in 1974 (represented by a red point), to 2021 (blue cross). The red vertical line at 10% B0 represents the hard limit, the orange line at 20% B0 is the soft limit, and green lines are the %B0 target (40% B0) and the corresponding exploitation rate (U40= 0.17 calculated using CASAL CAY calculation). Biomass and exploitation rate estimates are medians from MCMC result. (Source: FNZ, 2023)

HAK 4 (Chatham Rise stock (HAK 4 and HAK 1 north of Otago peninsula)

The 2020 stock assessment was carried out up to the end of 2020 using data up to the end of the 2018– 19 fishing year and an assumed catch of 436 t for the 2019–20 year (Holmes 2021). To align with the seasons of the fishery more closely, the model year was set as September to August, rather than the fishing year (October to September).

The base case model partitioned the Chatham Rise stock population into unsexed age groups 1–30 with the last age group considered a plus group. No CPUE was included, and a constant M was used. The models were initialised assuming an equilibrium age structure at an unfished equilibrium biomass (B0), i.e., with constant recruitment set equal to the mean of the recruitments over the period 1975–2017 (Figure 13). Commercial fishing was split into two fisheries, east and west (split at latitude 178.1° E).

Selectivities were assumed constant across all years in both fisheries and the survey, and hence there was no allowance for possible annual changes in selectivity. The age at full selectivity for the trawl survey series was strongly encouraged to be in the range 8± 2 years. This range was determined by visual examination of the at-age plots and was implemented because unconstrained selectivity resulted in age at full selectivity being older than most of the fish caught in the survey series.

Base case model projections assuming a future annual catch of 1800 t suggest that biomass will decline between 2021 and 2025. The rate of decline depends on whether recruitments are some combination of those from all estimated years or whether they remain at the level of the last decade. In either recruitment scenario there is little risk (i.e., < 1%) that the stock will fall below 20% B0 in the next five years under this catch scenario. Note that 1800 t is higher than recent annual landings from the stock (they have averaged about 362 t in the last six years), but lower than what could be taken (if all the HAK 4 TACC plus some HAK 1 catch from the western Chatham Rise was taken). Under the assumption there has been no long-term decline in recruitment, future catches of 362 t per year will allow further stock rebuilding. If it is assumed recruitment will remain at the level of the last decade, future catches of 362 t per year are predicted to see SSB essentially unchanged over the next 5 years (Figure 14).

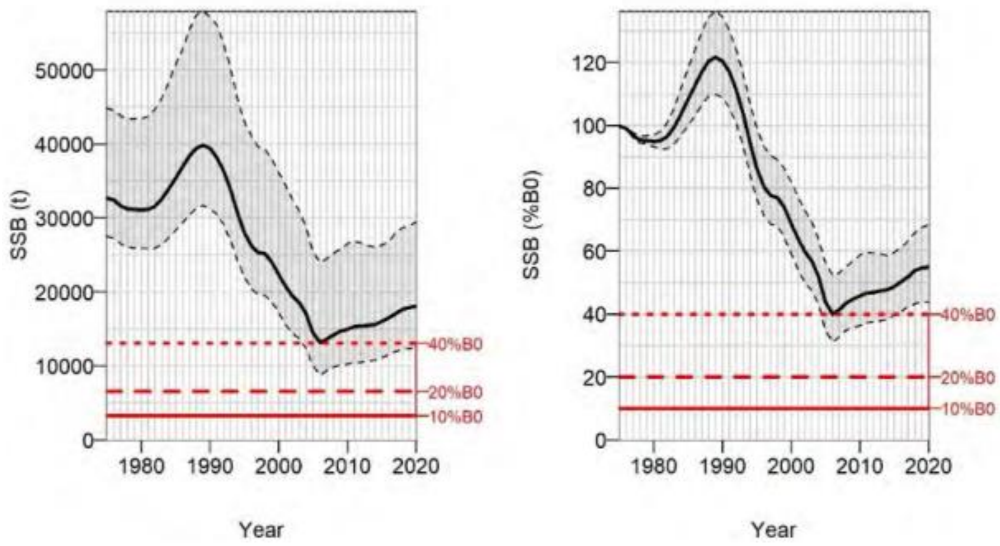


Figure 13 Estimated median trajectories (with 95% credible intervals shown as dashed lines) for the Chatham Rise base case model for absolute biomass and stock status (biomass as a percentage of B0) (Source: FNZ, 2023)

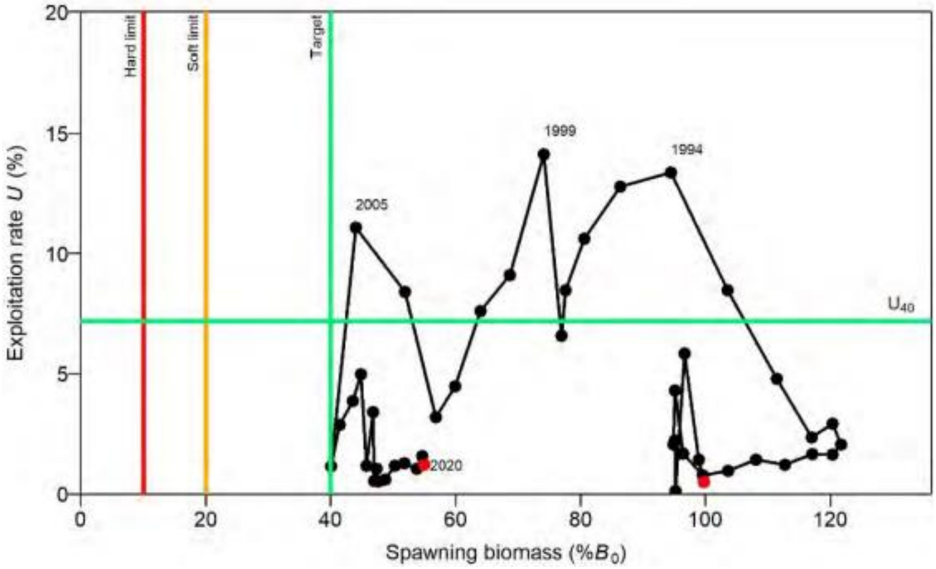


Figure 14 Trajectory over time of exploitation rate (U) and spawning biomass (% B0), for the HAK 4 stock base model from the start of the assessment period in 1975 (represented by a red point), to 2020 (red and labelled). The red vertical line at 10% B0 represents the hard limit, the orange line at 20% B0 is the soft limit, and green lines are the %B0 target (40% B0) and the corresponding exploitation rate (U40). Biomass and exploitation rate estimates are medians from MCMC results. (Source: FNZ, 2023)

UoC 6 - 10 – LIN 3, LIN 4, LIN 5, LIN 6 and LIN 7

	LIN 3	LIN 4	LIN 5	LIN 6	LIN 7
UoA share of TACC	100 %[1]	100%[3]	100 %[5]	100 %[7]	100 %[9]
UoC share of TACC	93 %[2]	[4]	95 %[6]	61 %[8]	73 %[10]

[1] 44% of total LIN catch (based on average estimated trawl catch over the last two years)

[2] 40% of total LIN catch (based on average estimated trawl catch over the last two years

[3] 32% of total LIN catch (based on average estimated trawl catch over the last two years)

[4] 30% of total LIN catch (based on average estimated trawl catch over the last two years)

[5] 90% of total LIN catch (based on average estimated trawl catch over the last two years)

[6] 85% of total LIN catch (based on average estimated trawl catch over the last two years

[7] 61% of total LIN catch (based on average estimated trawl catch over the last two years)

[8] 57% of total LIN catch (based on average estimated trawl catch over the last two years)

[9] 50% of total LIN catch (based on average estimated trawl catch over the last two years)

[10] 46% of total LIN catch (based on average estimated trawl catch over the last two years)

Update on stock status (FNZ, 2023)

LIN 3 & 4:

- For Chatham Rise (LIN 3 & 4), B_{2022} was estimated to be about 56% B_0
- Very Likely (> 90%) to be above the management target of 40% B_0 (base case run)

LIN 5 & 6:

- LIN 5&6 (Sub-Antarctic excl. Bounty Plateau): B_{2021} was estimated to be between 71% B_0;
- Virtually Certain (>99%) to be at or above the target (40% B_0).
- For the Bounty Plateau stock, fished only by longline (LIN 6B part of LIN 6), B_{2006} was estimated to be 61% B_0; Very Likely (> 90%) to be at or above the management target of 40% B_0.

LIN 7:

- Three alternative model runs were presented, with B_{2020} estimated to be about 47% B_0, Likely (>60%) to be at or above the management target

TACC & catch trends (FNZ, 2023)

Table 6 TACC, catch limits, catch and associated balances for the HAK1 fishery from 2018-19 to 2022-23

Stock	TACC	2018-19	2019-20	2020-21	2021-22	2022-23	5-year average
LIN 3	TACC	2,060	2,060	2,060	2,060	2,060	
	ACE	2,104	2,141	2,252	2,252	2,264	
	Catch	2,016	1,685	1,489	1,175	868	1,447
	Balance	88	456	764	1078	1397	757
LIN 4	TACC	4,200	4,200	4,200	4,200	4,200	
	ACE	4,601	4,591	4,652	4,626	4,619	

	Catch	2,044	1,778	2,129	2,604	845	2,044
	Balance	2,558	2,812	2,523	2,023	3,774	2,558
LIN 5	TACC	4,735	4,735	4,735	5,208	5,208	
	ACE	4,806	4,944	4,998	5,257	5,416	
	Catch	4,596	4,678	4,950	5,049	3,790	4,613
	Balance	210	266	49	208	1,625	472
LIN 6	TACC	8,505	8,505	8,505	8,505	8,505	
	ACE	9,420	9,418	9,399	9,370	9,389	
	Catch	3,706	3,972	3,916	3,881	3,811	3,857
	Balance	5,714	5,447	5,482	5,490	5,577	5,542
LIN 7	TACC	3,080	3,387	3,387	3,387	3,387	
	ACE	3,118	3,446	3,616	3,695	3,740	
	Catch	3,059	3,216	3,308	3,325	1,130	2,808
	Balance	59	230	308	370	2,609	715

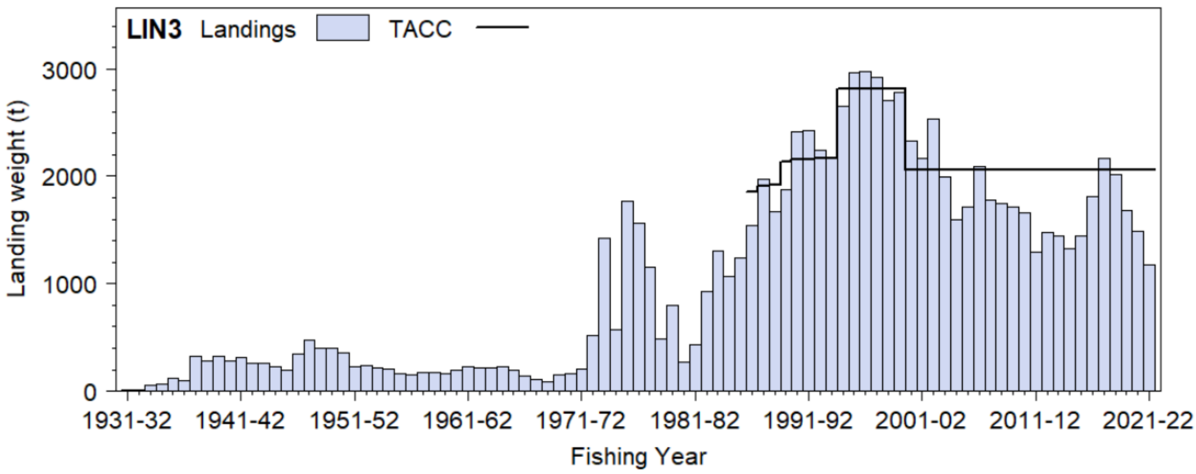


Figure 15: TACCs and reported catches for LIN 3 (all gear types) (FINZ, 2023).

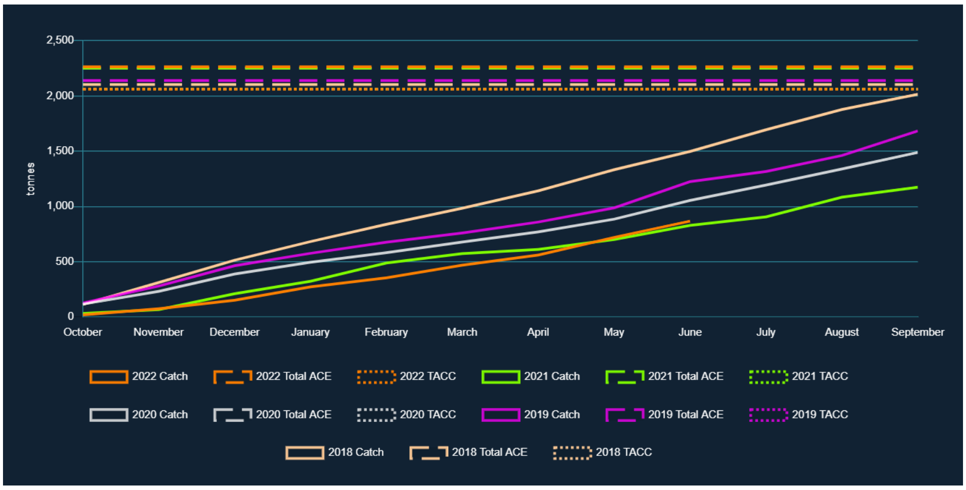


Figure 16: Reported commercial landings, total ACE and TACC for LIN 3 for fishing years 2018 – 2022. (Source: FishServe KUPE system)

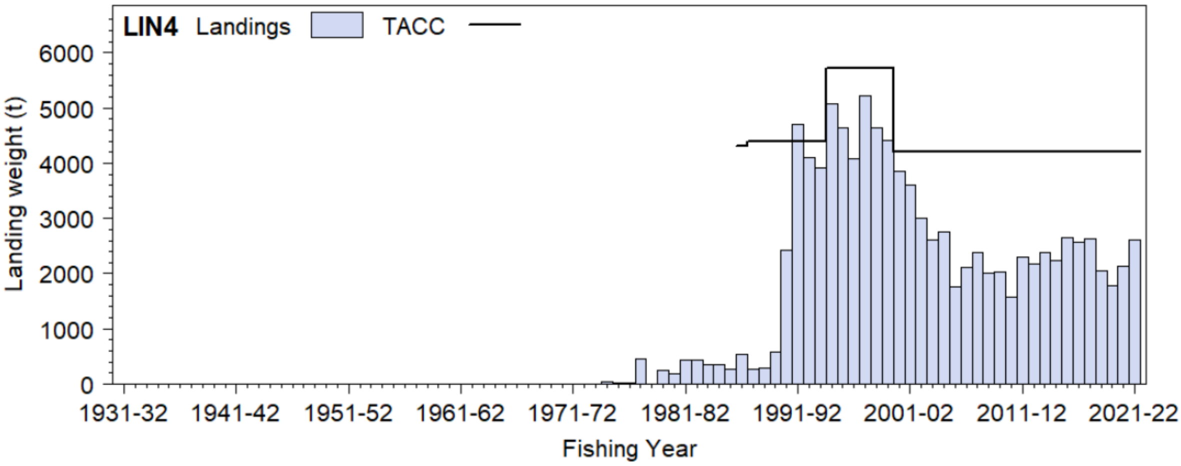


Figure 17: Total Allowable Commercial Catches and reported catches for LIN 4 (all gear types). Note: The LIN 4 trawl catch is largely a bycatch in the much larger eastern hoki trawl fishery and catch trends are therefore subject to forces other than ling abundance (FINZ, 2023).

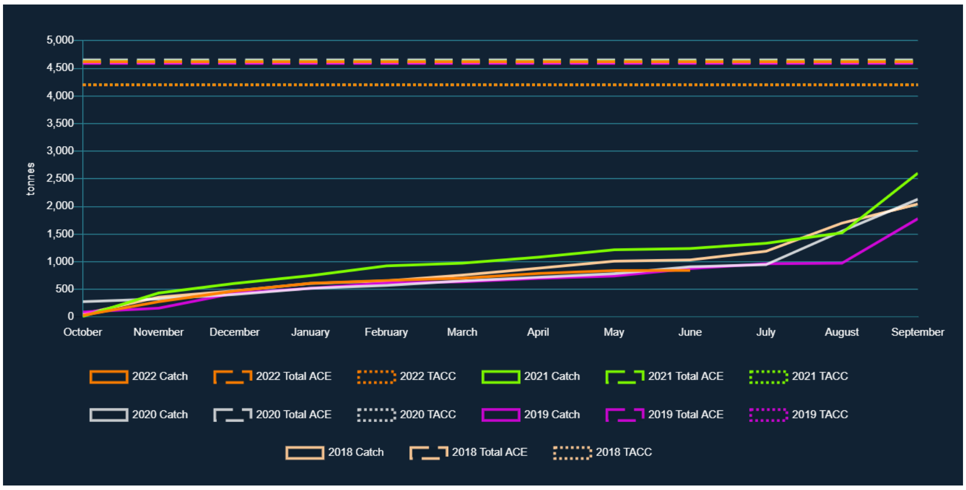


Figure 18: Reported commercial landings, total ACE and TACC for LIN 4 for fishing years 2018 – 2022. (Source: FishServe KUPE system)

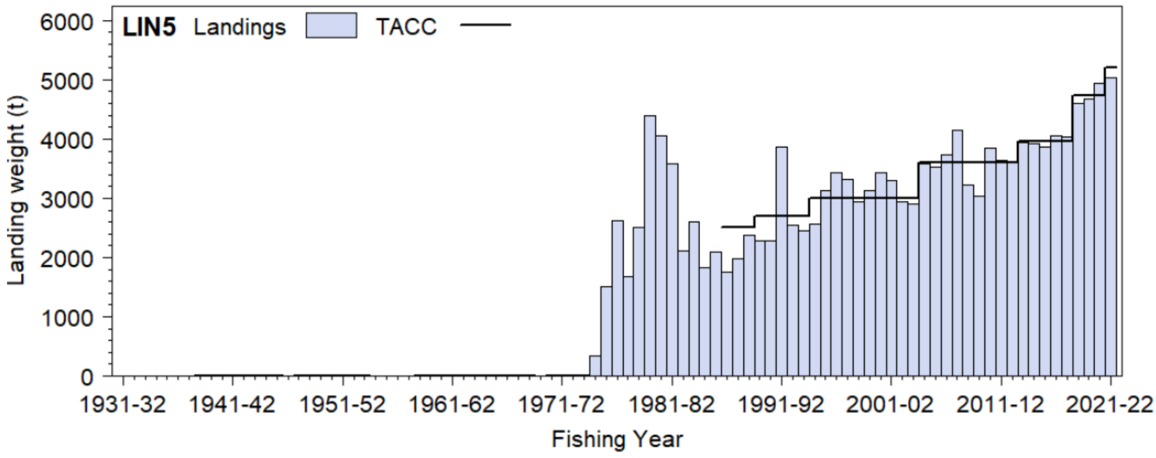


Figure 19: Total Allowable Commercial Catches and reported catches for LIN 5 (all gear types) (FINZ, 2023).

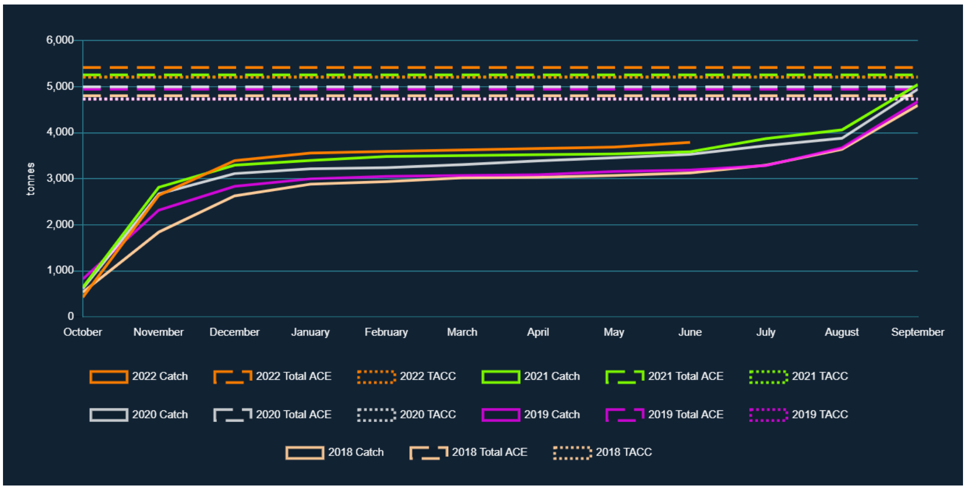


Figure 20: Reported commercial landings, total ACE and TACC for LIN 5 for fishing years 2018 – 2022. (Source: FishServe KUPE system)

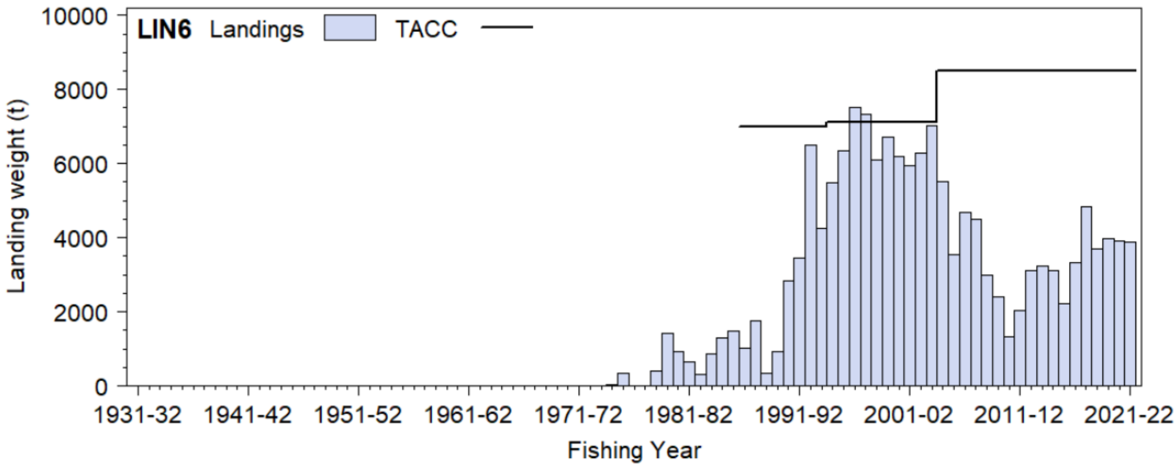


Figure 21: Total Allowable Commercial Catches and reported catches for LIN 6 (all gear types). Note: The LIN 6 trawl catch is largely a bycatch in the much larger western (sub-Antarctic) hoki trawl fishery and catch trends are therefore subject to forces other than ling abundance (FINZ, 2023).

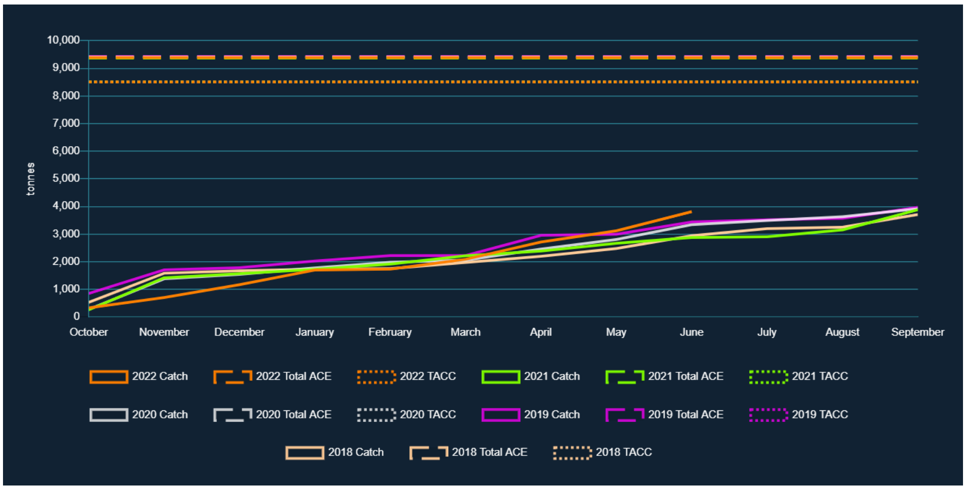


Figure 22: Reported commercial landings, total ACE and TACC for LIN 6 for fishing years 2018 – 2022. (Source: FishServe KUPE system)

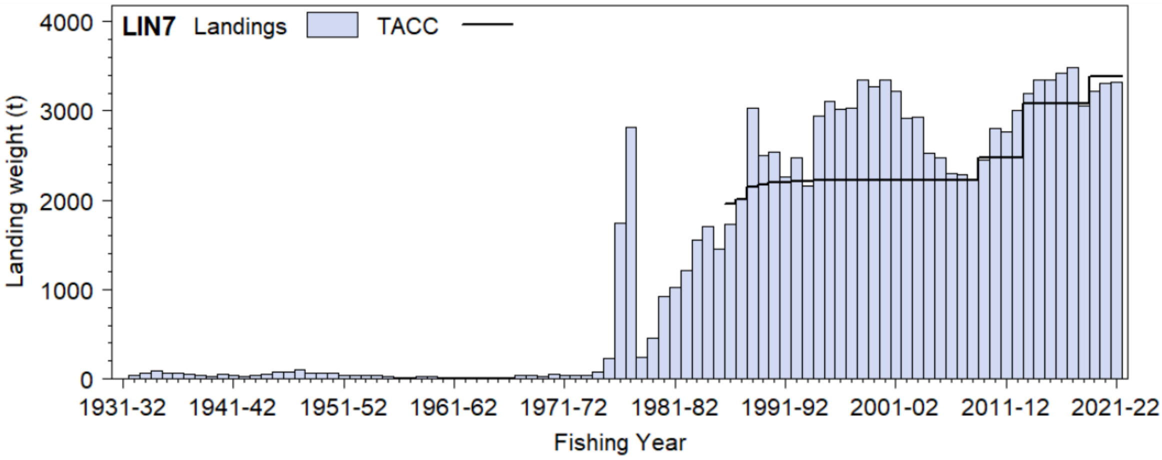


Figure 23: Total Allowable Commercial Catches and reported catches for LIN 7 (all gear types) (FINZ, 2023).

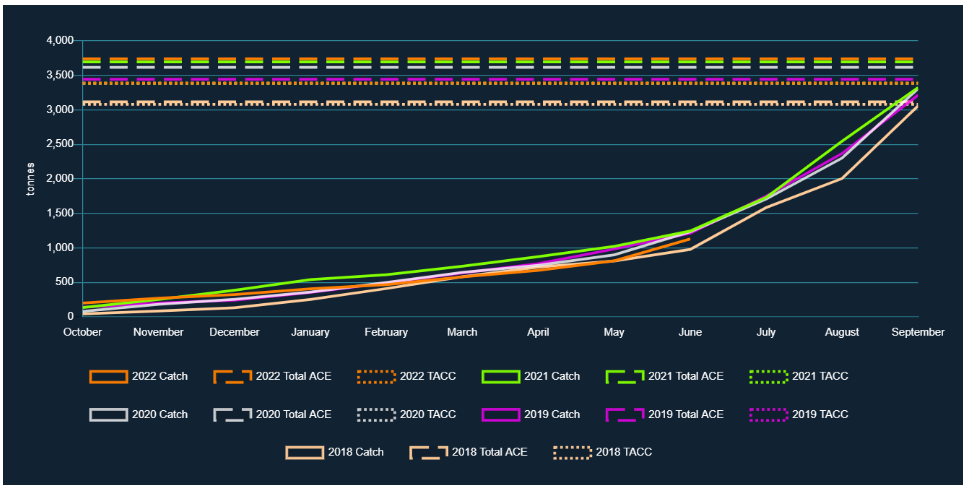


Figure 24: Reported commercial landings, total ACE and TACC for LIN 7 for fishing years 2018 – 2022. (Source: FishServe KUPE system)

Stock assessment development and structure

LIN 3 & 4

The stock assessment for LIN 3&4 (Chatham Rise) was updated in 2022. For final runs, the full posterior distribution was sampled using Markov chain Monte Carlo (MCMC) methods, based on the Metropolis-Hastings algorithm. Bounded estimates of spawning stock virgin (B0) and current (B2021) biomass were obtained.

The model indicated a relatively flat biomass trajectory from about 2009 (Figure 25). Annual landings from the LIN 3&4 stock have been less than 4600 t since 2004, markedly lower than the 6000–8000 t taken annually between 1992 and 2003. Base case estimates indicated that it was unlikely that B0 was lower than 100 000 t for this stock, or that biomass in 2022 was less than 46% of B0 (Table 12, Figure 4). Annual exploitation rates (catch over vulnerable biomass) were estimated to be lower than 0.15 (often much lower) since 1979 (Figure 5). The sensitivity model based on the longline CPUE estimated a lower initial biomass (88 450–96 520 t), with biomass in 2022 estimated between 27 and 41% B0.

For LIN 3&4, using the base case model, stock size is likely to remain about the same or increase by about 5%, assuming future catches equal recent catch levels and year class strengths are consistent with recent (2003–2013) or all year class strengths, respectively, or decrease to around 83–89% of the 2022 biomass by 2027 if catches reach the TACC with the same year class strength assumptions

The probability of biomass in 2027 being above 40% B0 is 0.85–1.0 and the probability of being below 20% B0 is zero for all projection scenarios.

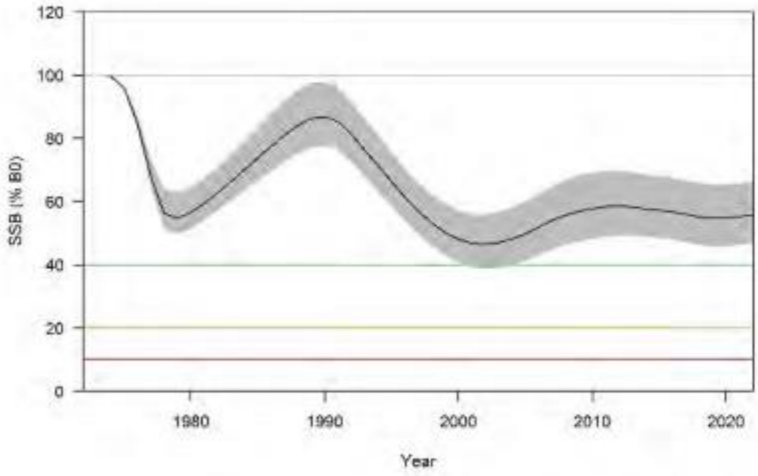


Figure 25: LIN 3 & 4 base model. Estimated median trajectories (with 95% credible intervals shown as grey band) for absolute biomass and biomass as a percentage of B_0. The red horizontal line at 10% B_0 represents the hard limit, the orange line at 20% B_0 is the soft limit, and the green line is the %B_0 target (40% B_0) (FINZ, 2023).

Sub-Antarctic, LIN 5 & LIN 6 (excluding Bounty Plateau)

An age-based total catch history stock assessment model assuming a Beverton-Holt stock-recruit relationship for LIN 5&6 (Sub-Antarctic) was updated in 2021 (Mormede et al 2021b). For final runs, the full posterior distribution was sampled using Markov chain Monte Carlo (MCMC) methods, based on the Metropolis-Hastings algorithm. Bounded estimates of spawning stock virgin (B_0) and current (B_{2021}) biomass were obtained.

The new 2021 base case model differs from the 2018 model in that it has two fisheries (and associated updated annual cycle), a fixed natural mortality of 0.18 y-1, nuisance survey q parameters, fixed the right-hand limb trawl selectivity parameters, and included the longline standardised CPUE index. The 2018 model use three fisheries, estimated natural mortality, a revised annual cycle for the spawning and non-spawning longline fisheries, free survey q parameters, and excluded the longline CPUE index.

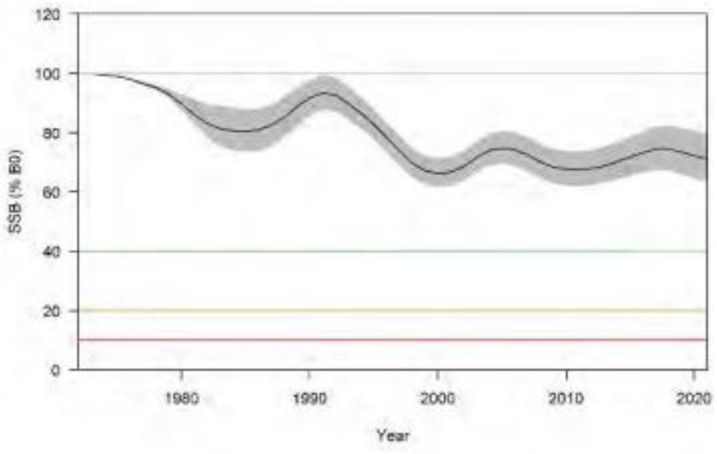


Figure 26: LIN 5 & 6 base model. Estimated median trajectories (with 95% credible intervals shown as grey band) for absolute biomass and biomass as a percentage of B_0. The red horizontal line at 10% B_0 represents the hard limit, the orange line at 20% B0 is the soft limit, and the green line is the % B0 target (40% B0) (FINZ, 2023).

Bounty Plateau, LIN 6B (Bounty Plateau only)

The stock assessment for the Bounty Plateau stock (part of LIN 6) was updated in 2007. Only a base case model run was completed. Final runs for the base case model used a full posterior distribution was sampled using Markov chain Monte Carlo (MCMC) methods, based on the Metropolis-Hastings algorithm. Bounded estimates of spawning stock virgin (B0) and current (B2021) biomass were obtained.

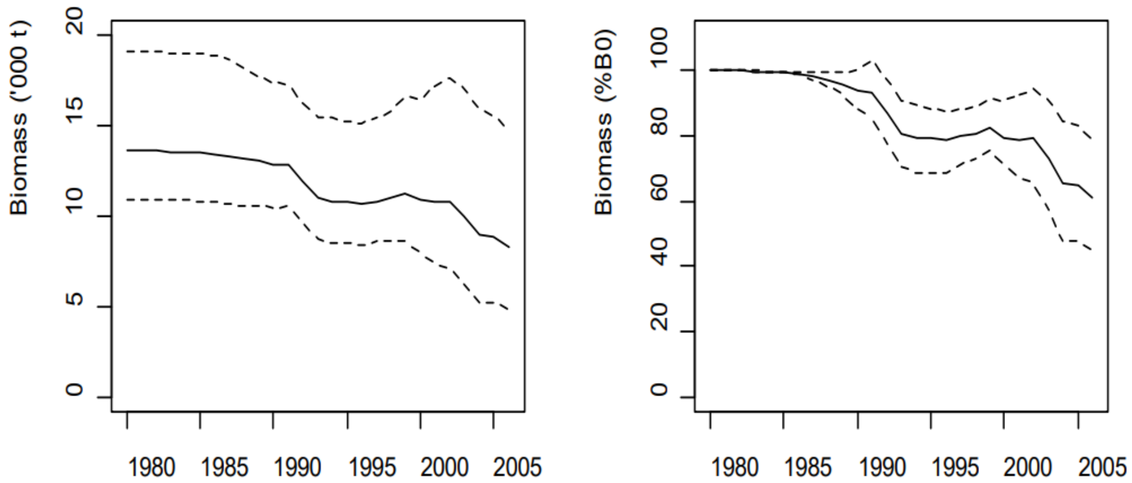


Figure 27: Trajectory over time of spawning biomass (absolute, and % B0, with 95% credible intervals shown as broken lines) for the Bounty Plateau ling stock from the start of the assessment period in 1980 to the most recent assessment in 2006. Years on the x-axis are fishing year with "1995" representing the 1994–95 fishing year. Biomass estimates are based on MCMC results (FINZ, 2023).

LIN 7

West coast South Island, LIN 7WC

An age-based total catch history stock assessment was updated in 2020. SSB has declined to approximately 50% of its virgin biomass by 2020 with all the sensitives showing that the model is not sensitive to alternative indices of abundances. Stock projections from the model shows that based on average catches biomass was expected to remain stable – noting that these projections were out to 2022 (Table 7and Figure 28).

Table 7 LIN 7WC Bayesian median and 95% credible intervals (in parentheses) of B0 and B2020 (in tonnes) and B2020 as a percentage of B0 for all model runs (FINZ, 2023).

Model run	B_0		B_{2020}		B_{2020} (% B_0)	
Base case	54 546	(50 463–59 833)	25 556	(17 877–35 527)	47	(35–60)
Adding CPUE index of abundance (model 2)	56 159	(51 964–61 580)	28 393	(21 034–38 047)	50	(40–62)

Model run	$P(B_{2020} > 0.4B_0)$	$P(B_{2020} < 0.2B_0)$	$P(B_{2020} < 0.1B_0)$
Base case	87	0	0
Adding CPUE index of abundance (model 2)	97	0	0

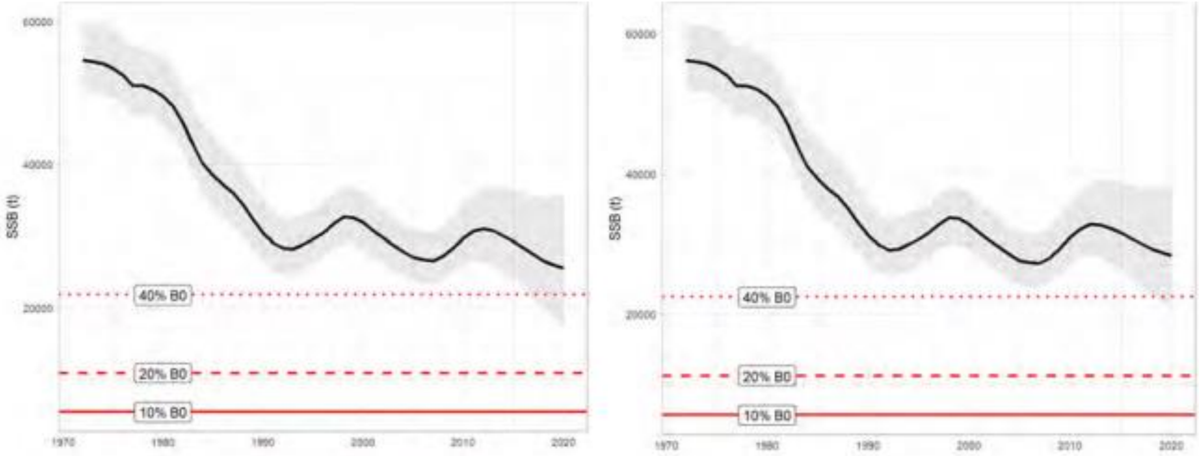


Figure 28: LIN 7WC. Estimated posterior distribution of the spawning stock biomass (SSB in tonnes) trajectory and estimated virgin spawning stock biomass reference points (40%, 20%, and 10% B0) for the base case model (left panel) and the model 2 (right panel). The solid black line represents the median values and the shaded areas the 95% confidence intervals (FINZ, 2023).

Cook Strait, LIN 7CK

The last stock assessment was completed in 2013 but was not accepted because the model was considered to not accurately represent declines in resource abundance that appear evident from CPUE values. The 2010 model, the last accepted stock assessment, showed that stock status was 54% B0 but the estimate had large confidence intervals. The assessment is driven by the trawl fishery catch-at-age data and tuned by the trawl CPUE. Projections to 2015 were that biomass would increase based on future catch levels remaining equal to previous catch levels.

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P2 - OVERVIEW OF ENVIRONMENTAL INFORMATION

Observer Coverage

Fisheries New Zealand (FNZ) observers are deployed on commercial fishing vessels to carry out biological sampling, monitor environmental interactions, and observe and record compliance with a range of regulatory and non-regulatory management measures. An important function is to collect data on incidental catches and mortalities of endangered, threatened and protected (ETP) species. The monitoring of ETP captures is administered and funded by the Department of Conservation (DOC) through levies recovered from quota owners. Observer data are used for the following purposes:

- As an input to monitor key fisheries against harvest strategies
- As an input to monitor bycatch species
- To enable reliable estimations and nature of ETP species interactions and captures
- To enable timely responses to sustainability and environmental impact issues
- To provide a high level of confidence in fishers at sea compliance with regulatory and non-regulatory measures.

Observer coverage of deepwater fisheries is planned by financial year and is based on biological information requirements, international requirements, percentage-level coverage targets and observer programme capacity.

The level of observer coverage for the different fisheries/sectors is tailored to suit the data and information requirements, including for stock assessment, compliance monitoring and ETP species captures. FNZ considers that 30% coverage is sufficient for most fisheries/sectors but implements high (80-100%) coverage for fisheries where there may be what are deemed by management to be high-risk ETP species (e.g., squid and southern blue whiting trawl fisheries where operations overlap with sea lions[1]).

The total observed catches from the top 33 species as per the Centralised Observer Database (COD) shows that from 2000/01 to 2019//20 HOK is the most observed in terms of catch with HAK and LIN also representing a large proportion of the total catch observed (Figure 29).

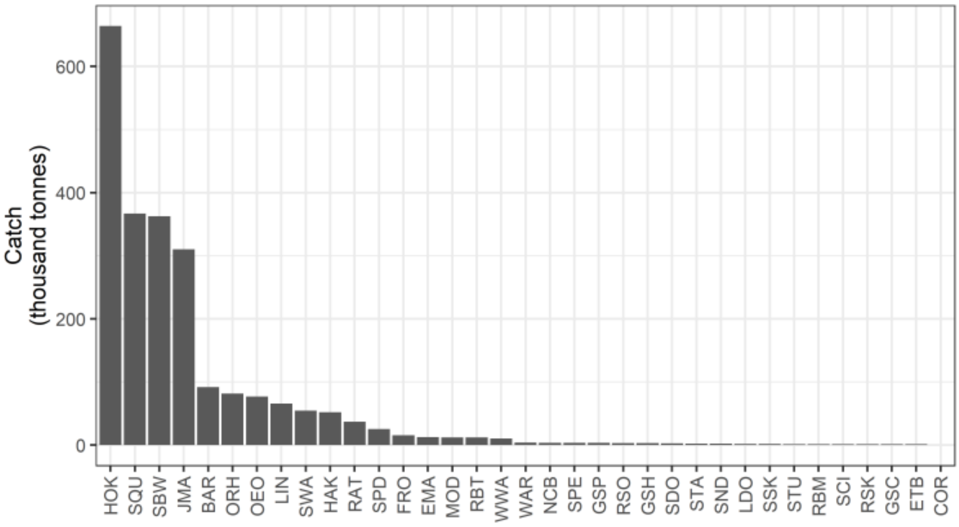

Figure 29: Total observed catch for the top 33 species recorded in the Centralised Observer Database 2000/01 to 2019/20 (Edwards & Mormede, 2023).

1 Note: The levels of interactions with NZ sea lions are very low. However, as sea lions are considered 'high risk' from a political perspective, high observer coverage is essential to ensure good capture-rate estimations are available.

The trend in FNZ observer coverage for the relevant stocks of HAK, HOK, LIN, SBW, SWA and WWA target fisheries from 2018/19 is shown in Table 8. The planned observer coverage for 2022/23 has been included based on FNZ's observer coverage plans for middle-depth, mixed species fisheries in 2022-23 are provided in the Annual Operational Plan, with a total of 2,135 observer days for middle-depth trawl (excluding Squid) planned and observer coverage rate. This level of coverage is considered by MPI sufficient given the low level of ETP species captures and high level of overall compliance.

The latest Annual Review Report for Deepwater Fisheries covers the 2020/21 fishing year, meaning the publicly available information on 2021/22 and 2022/23 fishing years is based on the Annual Operating Plans for Deepwater Fisheries.

Table 8: Observer coverage obtained within deepwater fisheries from 2018/19 to 2022/23.

Fishery	QMA	2018-19	2019-20	2020-21	2021-22 (planned)	2022-23 (planned)
Hake	HAK 1	93%	100%	48%*	30-40%*	30%
	HAK 4	100%	-	48%*	20-30**	30%
	HAK 7	32%	74%	42%+	50%***	30%
Hoki	HOK 1	29%	44%	42%+ 22%++ 10%+++ 46%++++ 64%+++++	30-40%* 20-30** 50%***	30%
Ling	LIN 3	8%	9%	48%++++	30-40%*	30%
	LIN 4	0%	0%			30%
	LIN 5	28%	17%	54%**	20-30**	30%
	LIN 6	34%	52%			30%
	LIN 7	5%	10%	42%+	50%***	30%

+ This is the combined % observer coverage for West Coast South Island (FMA 7)
++ This is the combined % observer coverage for WCSI HOK 'inside the line'
+++ This is the combined % observer coverage for Cook Strait HOK
++++ This is the combined % observer coverage for Chatham Rise Middle depths (FMA 3 & 4) HOK 1 target
+++++ This is the combined % observer coverage for Sub-Antarctic middle-depth excl. SQU/SBW (FMA 5/FMA 6) HOK 1 target
* This is the % observer coverage target for the Chatham Rise Middle depths (FMA 3 & 4) (HOK 1, HAK 1 & 4, LIN 3 & 4, SWA 3 & 4, JMA 3, BAR 1 & 4).
** This is the % observer coverage target for Sub-Antarctic Middle depths (ex. SQU/SBW) (FMA 5 & 6) (HOK 1, HAK 1, LIN 5 & 6, SWA 4, WWA 5B, JMA 3, BAR 5).

Retained & bycatch species (In-scope species)

Estimates of the level of individual fish and invertebrate species non-target catch in each fishing year from 1990–91 to 2016–17 by Finucci et al. (2019) concluded:

- The most caught bycatch species were javelinfish (*Lepidorhynchus denticulatus*, JAV), unspecified rattails (Macrouridae, RAT), and silver warehou (*Seriolella punctata*, SWA).
- Of the 493 non-target catch species examined, 35 had a significant decrease in catch over time and 83 a significant increase in catch.
- The species showing the greatest decline were unspecified skates (SKA), lanternshark (Etmopterus spp., ETM), and moonfish (*Lampris guttatus*, MOO). Notably SKA and ETM are generic codes that have been replaced by more specific codes, which probably explains these declines.

- The species showing the greatest increase were umbrella octopus (Opisthoteuthis spp., OPI) Tam O'Shanter sea urchins (Echinothuriidae & Phormosomatidae, TAM), and floppy tubular sponge (Hyalascus sp., HYA).

The most recent available information on catch composition of non-target catches and discards is from Anderson et al. (2019) who have expanded the definition of the target fishery to include hoki, hake, and ling target fisheries combined, and most recently included silver warehou and white warehou. This work represents the first time that the calculation of non-target catches, and discards has been done from observer data based on a statistical model (Figure 30) (Anderson et al., 2019).

Hoki accounted for about 73% of the total estimated catch from the observed tows in the target fishery for the five species since 2002–03. The remainder of the observed catch comprised hake (6.7%), ling (5.2%), silver warehou (3.9%), javelinfish (1.9%), other (unspecified) rattails (1.6%), spiny dogfish (1.4%), and white warehou (1.3%), plus a range of other (mainly non-QMS) species. Arrow squid was the ninth most common bycatch species by weight (0.5% of the catch) and the only invertebrate in the top 30 bycatch taxa.

Eight of the top ten bycatch species by weight are managed within the QMS and therefore catches are well monitored, and direct controls exist to limit their overall catch.

Javelinfish (37%), unspecified rattails (43%), and spiny dogfish (69%) were the fish species with the largest rate of observed discarding in this fishery. Other species frequently caught and often discarded included shovelnose dogfish, Baxters dogfish (*Etmopterus granulosus*), redbait (*Emmelichthys nitidus*), silverside (*Argentina elongata*), leafscale gulper shark (*Centrophorus squamosus*), and silver dory (*Cyttus novaezealandiae*).

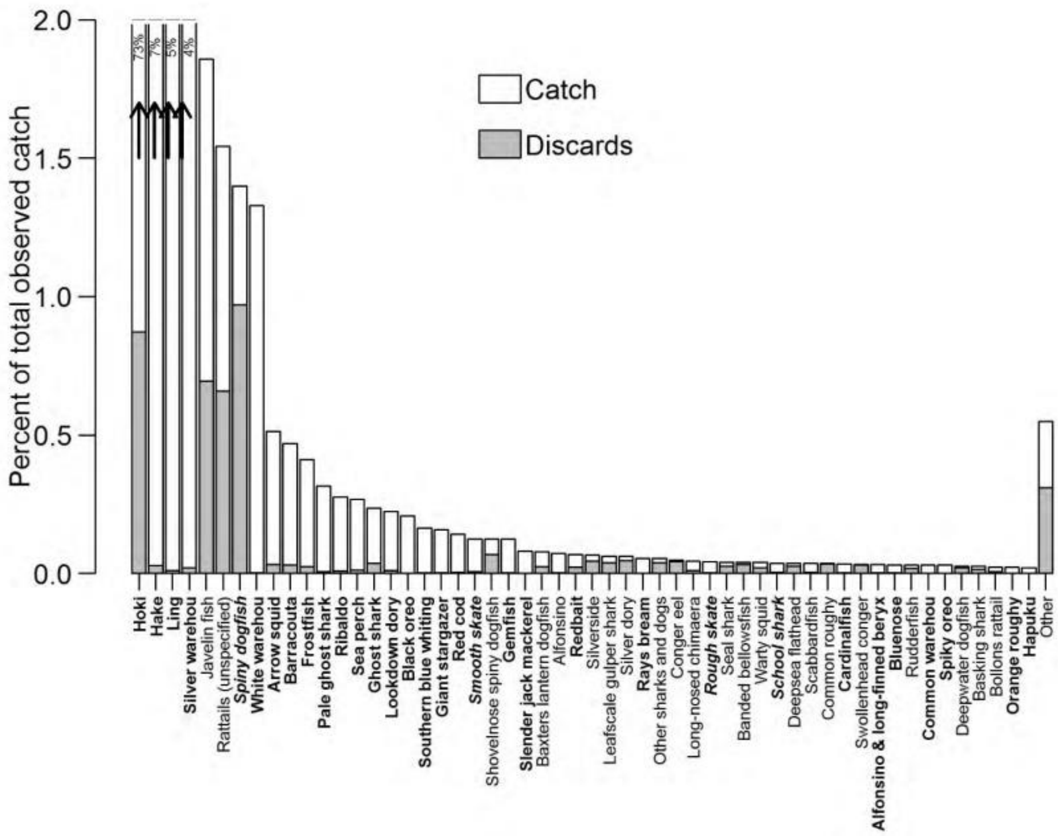

Figure 30: Percentage of the total catch contributed by the main bycatch species (those representing 0.02% or more of the total catch) in the observed portion of the HOK, HAK, LIN, SWA and WWA target trawl fishery for fishing years 2002–03 to 2016–17, and the percentage discarded. The Other category is the sum of all bycatch species representing less than 0.02% of the total catch. Names in bold are QMS species, names in italics are QMS species which can be legally discarded under Schedule 6 of the Fisheries Act (1996) (Anderson, et al., 2019)

Discard estimates were calculated only for the 2002–03 to 2016–17 period for the primary target species (hoki, hake, ling) and were low but highly variable, 76–2300 t. Discards of QMS species and non-QMS fish species followed a similar pattern to bycatch (for the years in common), with increased QMS discards (240– 3500 t) and a significant decline in non-QMS fish discards (2000–19 000 t). Discards of non-QMS invertebrates declined over time despite increased bycatch over the same period, most likely due to the increased use of meal plants for catch species previously discarded. Total discards were 5000–25 000 t per year and decreased significantly between 2002–03 and 2016–17 (Figure 31).

Bycatch and discards were highest during the summer months and lowest during the winter hoki spawning period.

Discard rates were greatest when targeting silver warehou and lowest when targeting hoki. Overall, there were lower discard levels associated with midwater trawls than bottom trawls, and lower discarding where meal processing was occurring. The discard fraction (kg of total discards/kg of target species catch) varied from 0.03 in 2015–16 to 0.17 in 2008–09 with an overall value for the 27-year period of 0.06 and showed little trend over time. This is similar to previous estimates for this fishery, and relatively low compared with most other fisheries that are monitored, which ranged between 0.005 (southern blue whiting trawl fishery) and 3.6 (scampi trawl fishery).

Since 2005–06 there has been a trend of increasing discards over time. Differences among vessel categories were pronounced, with the highest discard rates associated with foreign owned or chartered vessels and the lowest with BATM vessels (which are all installed with meal plants). Median discard rates were low for the small amount of fishing effort in area EAST, and lower also in COOK, AUCK, and for midwater trawls in WCSI than in other areas; discard rates were highest for bottom trawling in WCSI.

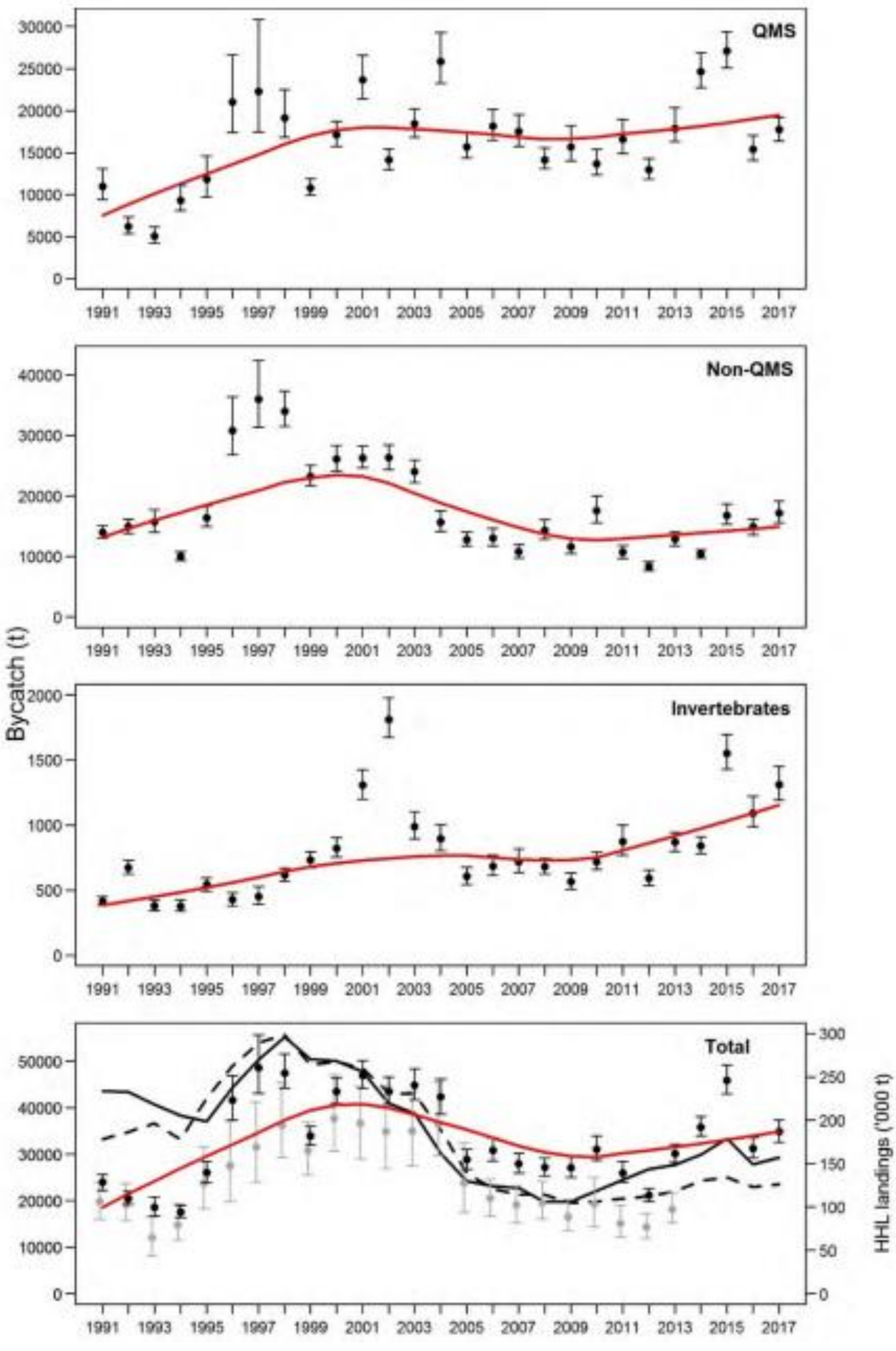

Figure 31: Annual estimates of bycatch in the target hoki, hake, ling, silver warehou or white warehou trawl fishery, by species category, for 1990–91 to 2016–17 (black dots). Error bars indicate 95% confidence intervals. The red lines show the fit of a locally-weighted polynomial regression to annual bycatch. Bottom panel shows estimates (grey dots) of total bycatch calculated for 1990–91 to 2012–13 from Ballara & O'Driscoll (2015), the total annual catch of the target species (solid black line), and annual effort (number of tows) (dashed line), scaled to have the mean equal to that of total bycatch (Anderson et al., 2019).

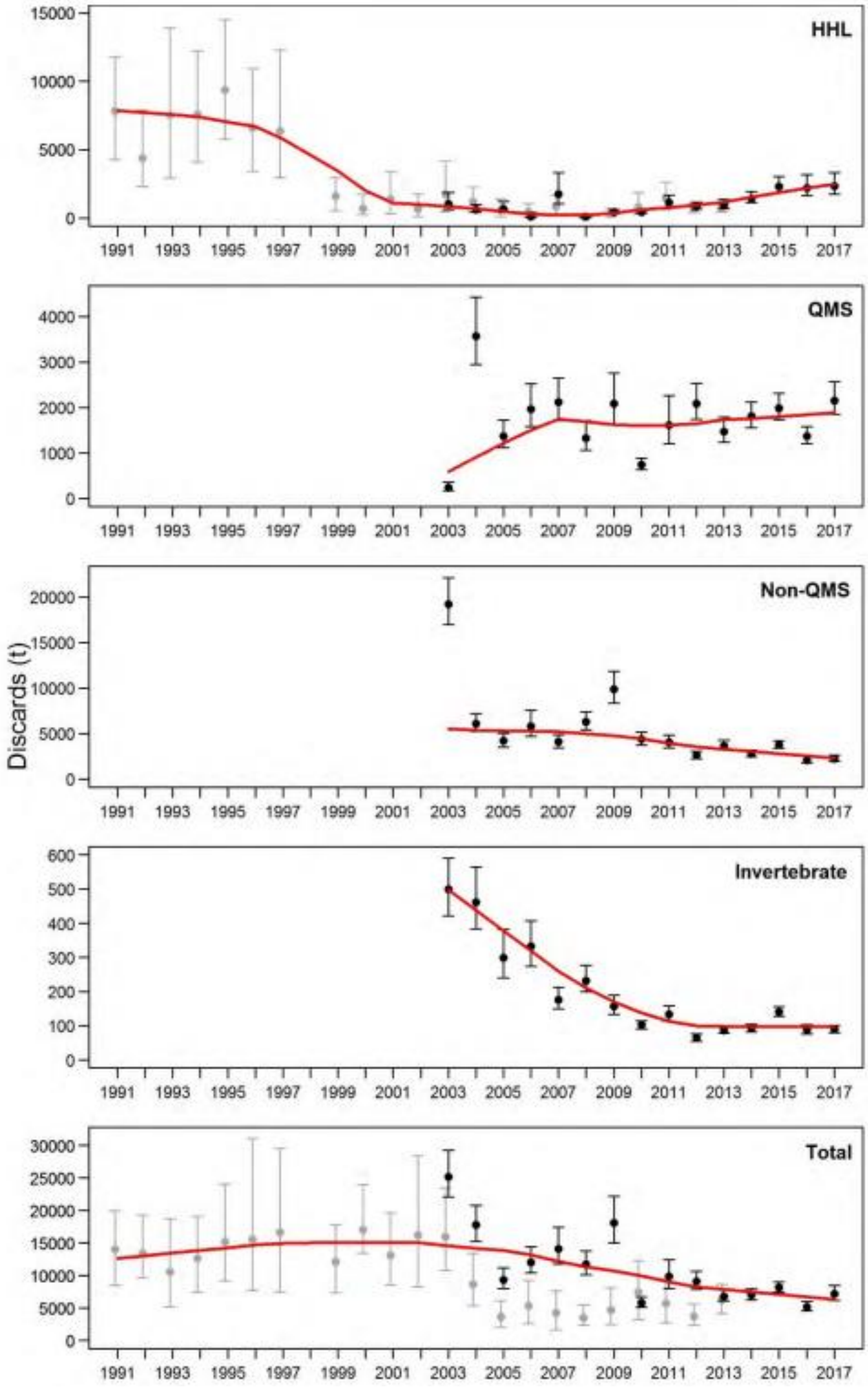

Figure 32: Annual estimates of discards in the target hoki, hake, ling, silver warehou or white warehou trawl fishery, by species category, for 2002–03 to 2016–17 (black dots). Error bars indicate 95% confidence intervals. The red lines show the fit of a locally-weighted polynomial regression to annual discards. Also shown (grey dots, bottom panel) are earlier estimates of target species and total discards calculated for 1991–92 to 2016–17 by Ballara & O'Driscoll (2015) (Anderson et al., 2019).

ETP species

Information on incidental captures of ETP species reported by the MPI Observer Programme is summarised in a series of annual reports (e.g. Abraham & Thompson, 2015, published on the Dragonfly website (www.dragonfly.co.nz/data/) and, MPI, 2016)), which enable the incidental captures of seabirds, marine mammals and turtles by the commercial fisheries to be monitored on an ongoing basis

Seabirds

The following information is available for use in assessing the nature and extent of ETP seabird interactions with these fisheries:

- Seabird interactions recorded by MPI Observers (as reported by MPI/Dragonfly)
- Assessments of the risk posed to ETP bird species using the estimation of Annual Potential Fatalities (APFs) and Potential Biological Removals (PBRs) (Richard & Abraham, 2015; Baker & Hamilton, 2016; Edwards et al., 2023)
- Population studies
- Annual Environmental Liaison Officer reports
- Trigger reports (i.e., real time responses to actual incidents)
- Review of ETP species monitoring

Between 2014-15 and 2018-19, approximately 88% of observed seabird captures on deepwater trawl vessels were classed as ‘net captures’, of which 37% were released alive. Smaller seabirds (e.g., petrels or shearwaters) may get trapped inside the net when they dive into its mouth, while other species (e.g., albatrosses) tend to get tangled in the net mesh from the outside when they try to seize fish (FNZ, 2021b).

The National Plan of Action Seabird reports 2018/19, 2019-20 and 2020/21 provide breakdowns of the observed seabird captures by hoki, hake and ling trawlers illustrating that small albatross species (i.e., mollymawks) and petrels & shearwaters are the most abundant groups caught, (FNZ, 2020a; FNZ, 2021b; FNZ, 2022a). Figure 33 shows the historical capture rate trend showing that the capture rate is reasonable stable with a slight downward trend, noting that it has remained close to the baseline level. The capture rates of 2.36 per 100 tows during 2020/21 by these fisheries trawl fisheries is close to the ‘capture rate reduction target’ of 2.3 per 100 tows as specified in the Supporting Document of the NPOA Seabirds (FNZ, 2020b).

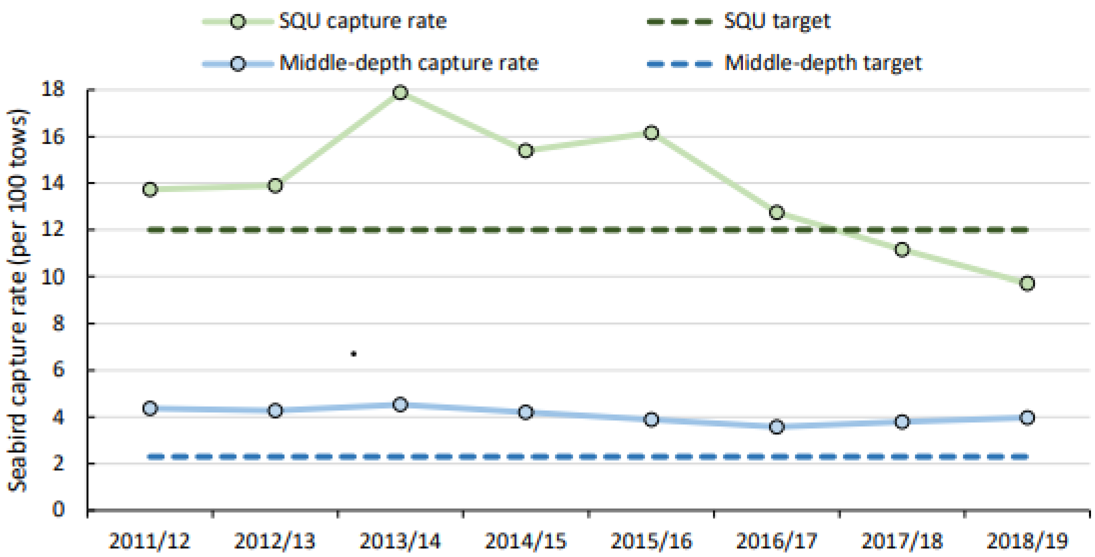

Figure 33:: Estimated seabird capture rates (captures per 100 tows) relative to agreed reduction targets, for the >28 m squid and middle-depth trawl fisheries between the 2011/12 and 2018/19 fishing years. As seabird capture rates are expressed as three-year rolling averages, data for 2018/19 represents the average for the 2017/18, 2018/19, and 2019/20 years. Data taken from the Protected Species Capture webpage.

The latest Spatially Explicit Fisheries Risk Assessment (SEFRA) framework for seabirds in the New Zealand Exclusive Economic Zone was released on 5 July 2023 and attempts to quantify the impact of New Zealand commercial fisheries on New Zealand populations of seventy-one seabird species. The new SEFRA has made significant structural changes in order to improve seasonal resolution and improve the transparency diagnosis of the capture predictions. The results of the update are noticeably different and are reported to be a result of the updated structural changes.

The results show that only the southern Buller's albatross was estimated to have a risk metric of greater than one, indicating that current captures are higher than what can be sustained by the population over the long term. The results of the annual deaths from the HOK, HAK and LIN trawl fisheries are shown in Table 9.

The associated catchability and vulnerability for the HOK, HAK and LIN trawl fisheries are shown in Figure 39, Figure 40 and Figure 41.

Reviewing the latest risk assessment results and the previous comparison between the 2017 and 2020 risk assessments indicates a continued reduction in risk indicating that ongoing operational mitigation is resulting in beneficial outcomes.

Table 9: HOK, HAK and LIN trawl fisheries' annual deaths for the top thirty at-risk species, ranked in order of highest to lowest median risk (Source: Edwards et al., 2023).

	Deepwater		Large Freezer		Large Fresher	
Code	Mean	95% CI	Mean	95% CI	Mean	95% CI
XBM	0	[0–2]	215	[150–315]	0	[0–4]
XSA	21	[8–41]	553	[390–780]	37	[14–80]
XWM	7	[0–19]	292	[204–429]	33	[13–69]
XBP	0	[0–3]	0	[0–2]	1	[0–5]
XWP	0	[0–2]	13	[6–27]	0	[0–3]
XCI	17	[6–36]	4	[0–13]	3	[0–15]
XFS	0	[0–1]	2	[0–8]	0	[0–1]
XNB	2	[0–8]	30	[14–55]	3	[0–19]
XAU	0	[0–5]	0	[0–2]	0	[0–2]
XAN	0	[0–2]	0	[0–2]	0	[0–1]
XWC	2	[0–6]	206	[130–372]	1	[0–6]
XRA	3	[0–11]	6	[0–17]	0	[0–3]
XNP	0	[0–3]	8	[1–19]	0	[0–4]
XCM	0	[0–2]	14	[4–30]	0	[0–4]
XYP	0	[0–0]	0	[0–0]	0	[0–0]
XPP	0	[0–0]	0	[0–1]	0	[0–0]
XNR	0	[0–2]	0	[0–6]	0	[0–2]
XLM	0	[0–2]	0	[0–3]	0	[0–3]
XGM	0	[0–2]	0	[0–3]	0	[0–3]
XGP	0	[0–2]	1	[0–4]	0	[0–2]
XCA	0	[0–0]	5	[0–31]	0	[0–0]
XSI	0	[0–0]	0	[0–0]	0	[0–0]
XBS	0	[0–2]	0	[0–14]	0	[0–3]
XKS	0	[0–0]	0	[0–0]	0	[0–0]
XBC	0	[0–0]	0	[0–0]	0	[0–0]
XFC	0	[0–0]	0	[0–0]	0	[0–0]
XPS	0	[0–0]	0	[0–0]	0	[0–0]
XPV	0	[0–6]	2	[0–21]	0	[0–6]
XFX	0	[0–0]	0	[0–0]	0	[0–0]
XSH	3	[0–8]	165	[105–293]	0	[0–4]

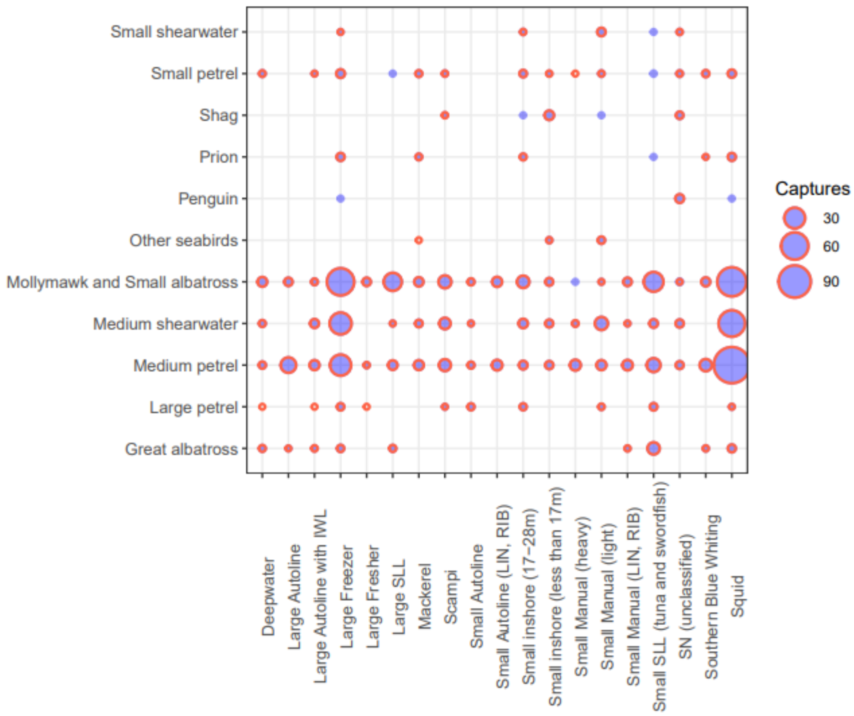

Figure 34:: Model fit to observed average annual captures (C 0 f,z) per species and fishery group combination, between 2006/07 and 2019/20. Model predicted values are represented by the posterior median of the sum across species per group and shaded in blue. Empirical values are represented by red circles (Source: Edwards et al., 2023).

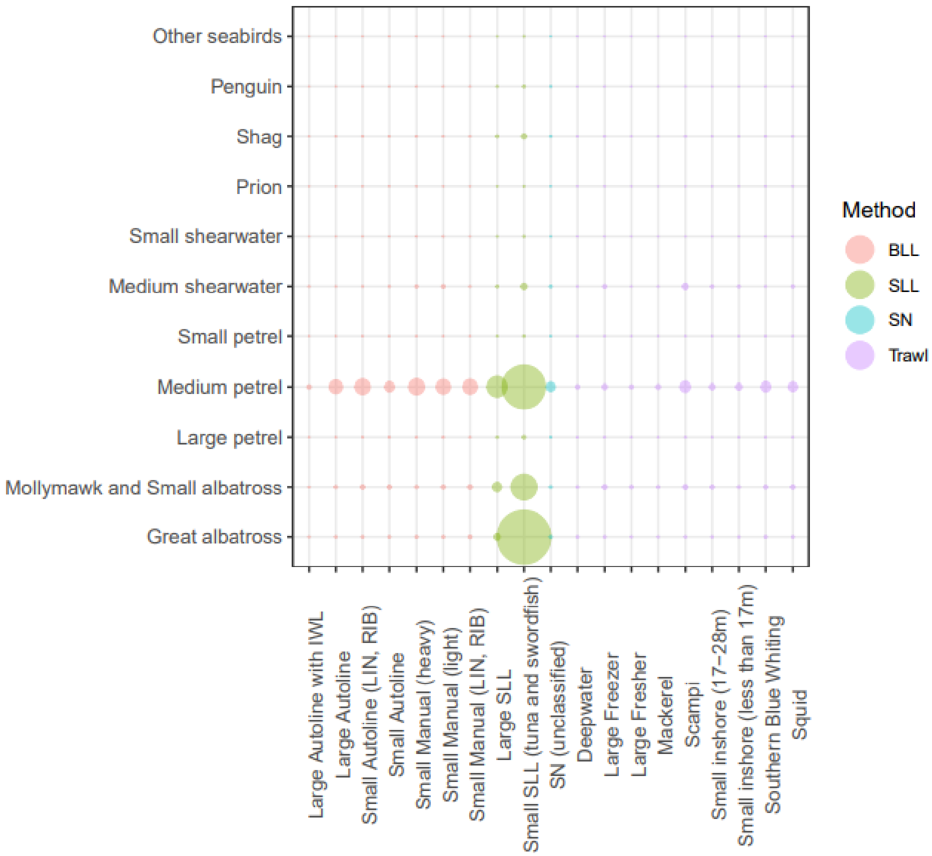

Figure 35: Catchability (qf,z) per species group and fishery group combination. Catchabilities are only comparable between methods and groups that share the same effort units (Source: Edwards et al., 2023).

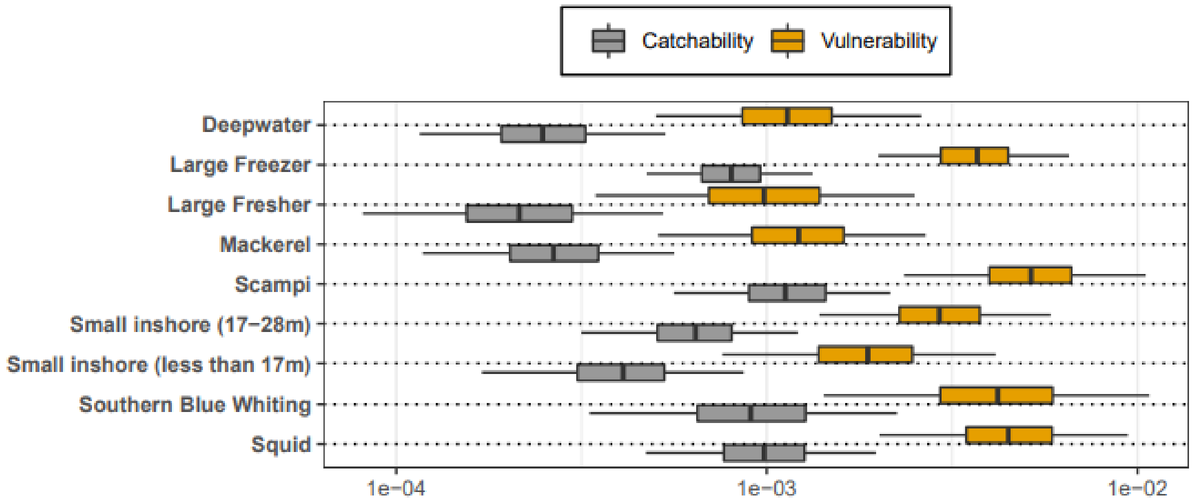

Figure 36: Marginal catchability (qf) and vulnerability (uf) per trawl fishing group assuming a geometric mean across species. Values are given on a log10-scale. Boxplots show the median, and 75% and 95% posterior quantiles (Source: Edwards et al., 2023).

DOC's current conservation status classification for the main species incidentally captured in the hoki, hake and ling trawl fisheries, and the risk categories emanating from the previous Spatially Explicit Fisheries Risk Assessment Framework (SEFRA), (Richard et al., 2020), are provided below in

Table 10 and

Table 11. The risk assessment noted a decline in interactions consistent with the declining effort in all trawl fisheries over the study period. Species with a median risk ratio <1 are not expected to hinder the achievement of population management targets.

Table 10. Change in DOC risk classification for the most prevalent incidental seabird captures in the hoki/hake/ling trawl fisheries.

Species	DOC Threat Classification 2012[2]	DOC Threat Classification 2016[3]	DOC Threat Classification 2021[4]	Status change
White-chinned petrel	At Risk - declining	Not Threatened	Not Threatened	No change
White-capped albatross	At Risk - declining	At Risk - declining	At Risk - declining	No change
Salvin's albatross	Nationally Critical	Nationally Critical	Nationally Critical	No change
Southern Buller's albatross	Naturally Uncommon	Naturally Uncommon	At Risk	Worse
Sooty shearwater	At Risk - declining	At Risk - declining	At Risk - declining	No change
Westland petrel	Naturally Uncommon	Naturally Uncommon	Naturally Uncommon	No change

[2] https://www.doc.govt.nz/documents/science-and-technical/nztcs4entire.pdf

[3] https://www.doc.govt.nz/documents/science-and-technical/nztcs19entire.pdf

[4] https://www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs36entire.pdf

Table 11: Threat and risk classifications for the most prevalent incidental seabird captures in the hoki/hake/ling trawl fisheries.

Species	Richard et al. 2017a risk ratio	2020 risk ratio version, data up to 2014-15	2020 risk ratio version, data up to 2016-17	SEFRA Risk Classification (all fisheries combined)	Trend in the risk ratio
White-chinned petrel	0.05 (0.03-0.09)	0.05 (0.03-0.09)	0.07 (0.03-0.16)	Low	Increasing
White-capped albatross	0.35 (0.21-0.58)	0.38 (0.22-0.62)	0.29 (0.18-0.46)	High	Decreasing
Salvin's albatross	0.78 (0.51-1.09)	0.79 (0.52-1.12)	0.65 (0.42-0.94)	High	Decreasing
Southern Buller's albatross	0.39 (0.22-0.66)	0.4 (0.22-0.69)	0.37 (0.21-0.6)	High	Decreasing
Sooty shearwater	0.00 (0.00-0.01)	0.00 (0.00-0.01)	0.00 (0.00-0.01)	Low	No change
Westland petrel	0.48 (0.18-1.19)	0.55 (0.21-1.28)	0.54 (0.26-1.12)	High	Increasing

The observed seabird mortalities by hoki-targeted tows are dominated by white-chinned petrels. Other prominent species include white-capped albatross, Salvin's albatross, southern Buller's albatross and sooty shearwater. A total of 83 observed seabird captures were live-released, dominated by white-chinned petrels and white-capped albatross.

Hoki-targeted trawl tows resulted in 113 observed captures of all seabirds in 2019-20, dominated by Salvin's albatross (40), white-chinned petrel (27) and sooty shearwater (22), southern Buller's albatross (8) and New Zealand white-capped albatross (8). The total estimated number of birds caught was 239 (FNZ, 2021a).

The estimated number of all seabird mortalities by hoki-targeted tows from 2017-18 to 2019-20 has shown a declining trend (Figure 42).

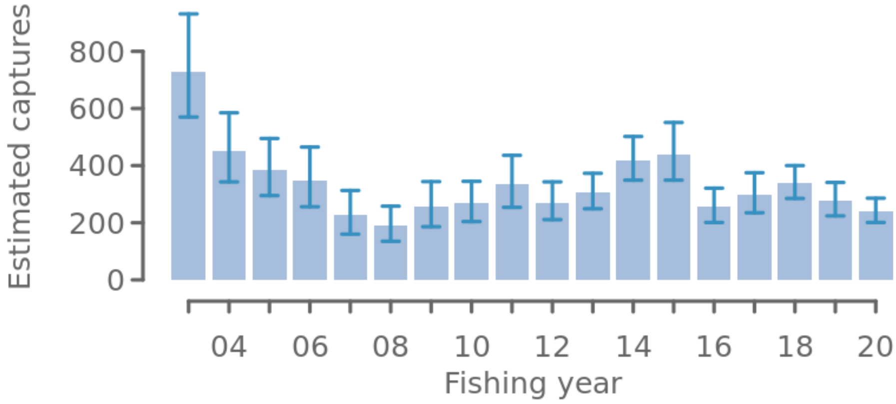

Figure 37: Hoki trawl fishery estimated total incidental seabird captures (dead and live released) 2002-03 to 2019-20.

Hake-targeted trawl tows have produced very few seabird captures in recent years, estimated at less than 5 per annum over the most recent four-year period (Figure 43) (FNZ, 2021a).

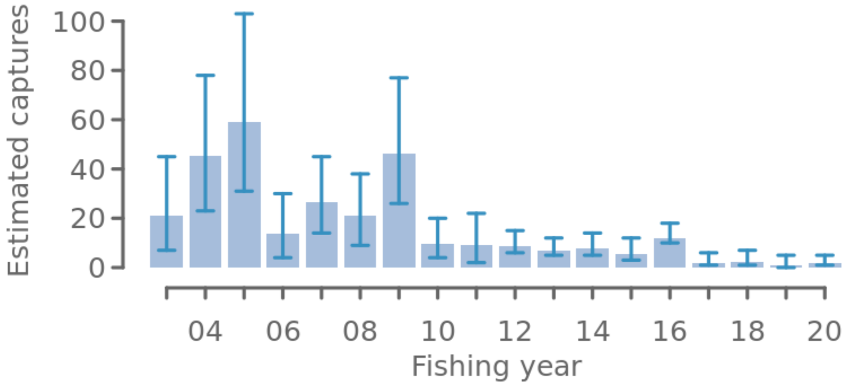

Figure 38: Hake trawl fishery estimated incidental seabird captures 2002-03 to 2019-20.

Ling-targeted trawl tows resulted in 11 observed captures of all seabirds in 2019-20, comprising white-chinned petrel (4), New Zealand white-capped albatross (3), Salvin's albatross (2), sooty shearwater (1) and broad-billed prion (1). Around 45 seabirds were estimated captured in 2019-20 and there has been a slight decreasing trend in captures since 2013-14 (Figure 44), (FNZ, 2021a).

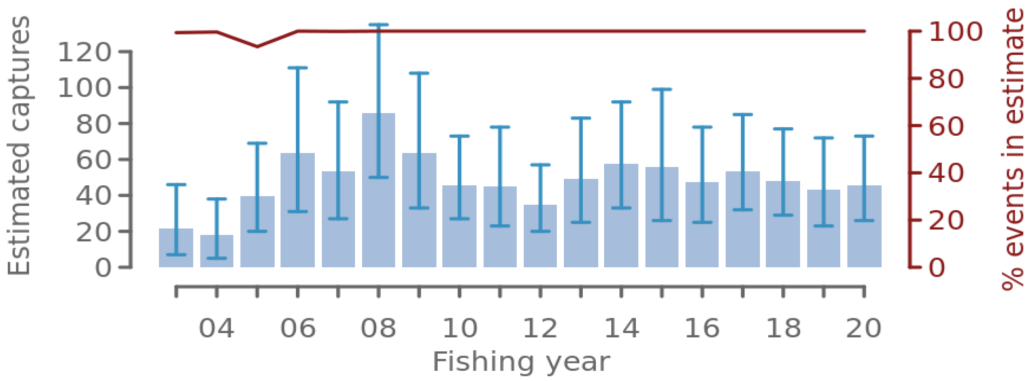

Figure 39: Ling trawl fishery estimated incidental seabird captures 2002-03 to 2019-20.

Between 2014-15 and 2018-19, approximately 88% of observed seabird captures on deepwater trawl vessels were classed as 'net captures', of which 37% were released alive. Smaller seabirds (e.g., petrels or shearwaters) may get trapped inside the net when they dive into its mouth, while other species (e.g. Albatrosses) tend to get tangled in the net mesh from the outside when they try to seize fish (FNZ, 2021b).

Seabird species section

The following species-specific information has been provided for the most prevalent incidental seabird captures in the hoki/hake/ling trawl fisheries.

A research plan outlining seabird risk assessment, monitoring and mitigation projects to be undertaken from 2020 to 2024 is provided in the NPOA Seabirds 2020 Implementation Plan (FNZ, 2020b).

Salvin's albatross

Censuses undertaken, by aerial surveys, of Salvin's albatross at their breeding colonies on Bounty Islands show that the number of breeding pairs increased between 2010 and 2013 and that their raw numbers have steadily increased from around 43,000 in 2010 to around 60,000 in 2018 (Baker & Jensz, 2019).

DOC has been reviewing the methodology used to survey Salvin's albatross on the Bounty Islands. Recent ground based surveys are resulting in different survey results as a result of differences and inherent uncertainties in methods. This is resulting in difficulties to assess population status (Taylor 2000; Baker et al. 2014; Sagar et al. 2015; Parker & Rexer-Huber 2020).

Table 12: Censuses of Salvin's albatross at Bounty Islands.

Census Year	Breeding Pairs	Raw Counts	95% CI
2010	31,786	42,826	42,212-43,240
2013	39,995	53,893	53,429-54,357
2018	Not estimated	60,419	59,927-60,911

Observed captures of Salvin's albatross by hoki-targeted trawl tows over the most recent 5-year period 2015-16 to 2019-20 have ranged between 12 and 40, with an average of ~20 birds per annum. The rate of capture in hoki-targeted tows spiked in 2019-20 for reasons unknown (Figure 40), (FNZ, 2021a). Hake- and ling-targeted tows have negligible captures., has reduced by 45% since a peak in 2013-14 (FNZ, 2021a) (Figure 40).

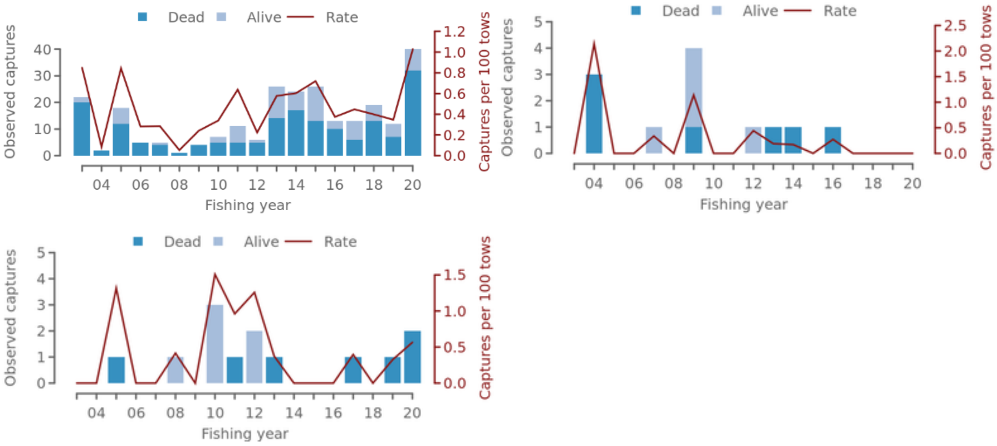

Figure 40: Observed captures and capture rates of Salvin's albatross by hoki, hake and ling trawl fisheries 2002-03 to 2019-20.

The estimated number of Salvin's albatross captured by hoki-targeted tows has ranged between approximately 60 to 80 per annum over the recent 5-year period (Figure 41), (FNZ, 2021a).

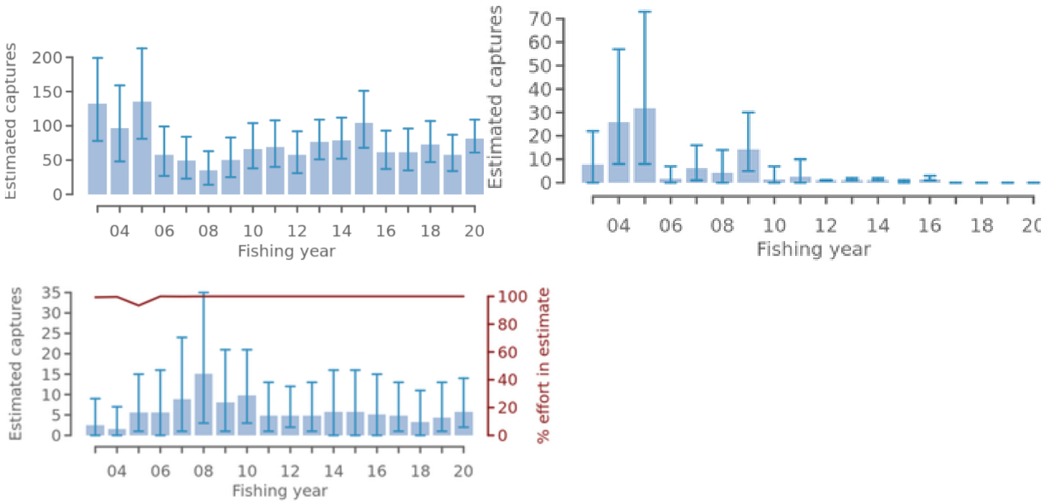

Figure 41: Estimated incidental captures of Salvin's albatross by hoki, hake and ling trawl fisheries 2002-03 to 2019-20.

White-chinned petrel

This study suggests that there was an average of 46,000 pairs of white-chinned petrels nesting on Antipodes Island between 2008 and 2020. There has been a 27% increase in the population between 201 and 2021 (.

Table 13: Censuses of White-chinned petrel on Antipodes Islands.

	Burrow Density ha^{-1} (mean ± sd)	Burrow Occupancy % (mean ± sd)	Population Estimate	se	95% CI
2008–09	177.7 ± 144.4	19.2 ± 18.0	45135	6723	31957 - 58313
2009–10	115.3 ± 63.0	27.8 ± 15.8	44924	9979	25366 - 64482
2010–11	133.3 ± 76.0	24.7 ± 20.5	39670	7895	24195 - 55145
2020-21	87.0	58.7	54945	8458	38379 - 71535

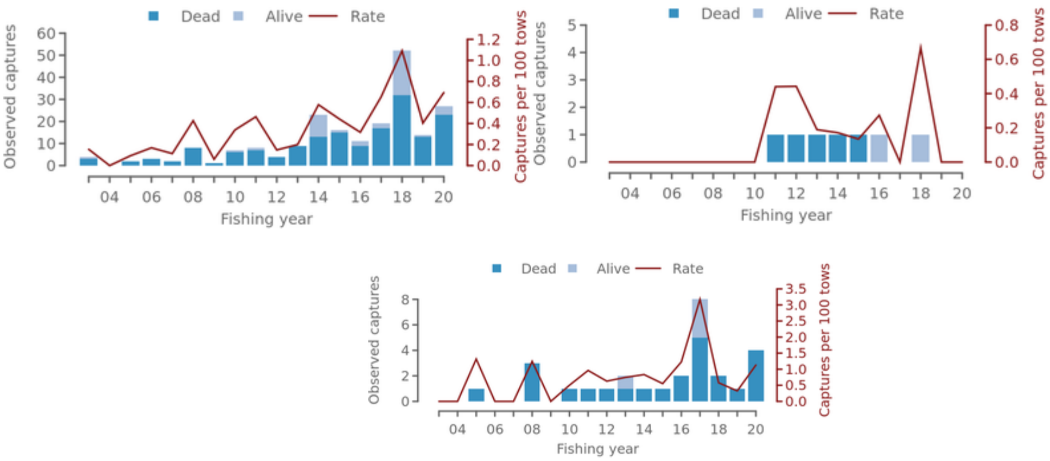

Figure 42: Observed captures and capture rates of White-chinned petrel by hoki, hake and ling trawl fisheries 2002-03 to 2019-20.

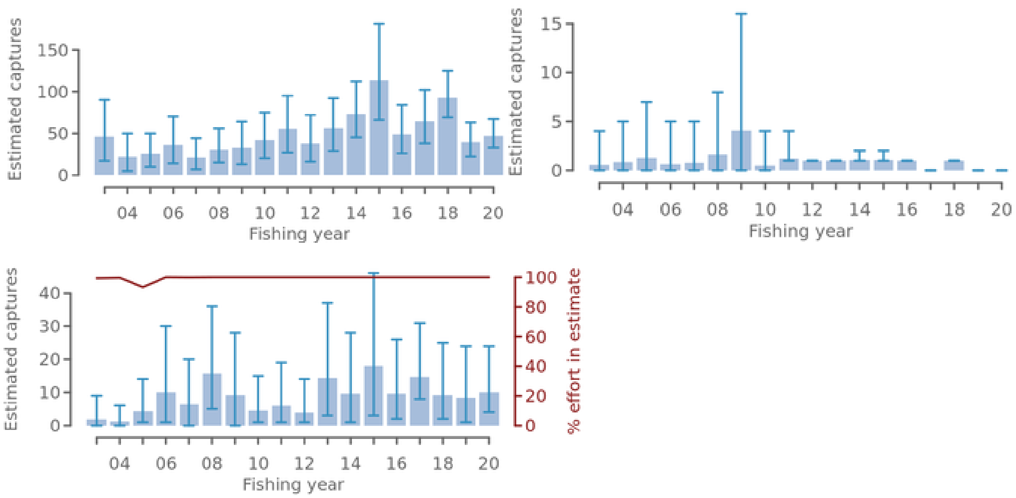

Figure 43: Estimated incidental captures of White-chinned petrel by hoki, hake and ling trawl fisheries 2002-03 to 2019-20.

White-capped albatross

Count data over nine years show strong inter-annual fluctuations, a characteristic we have observed for many other seabird species. stable population remains tenable and is probably a reasonable interpretation (Baker er al., 2015). Current research is focussed on estimating adult survival, documenting a study set up to quantify productivity, and drone trials to assess the suitability of drones for quantifying the breeding population size.

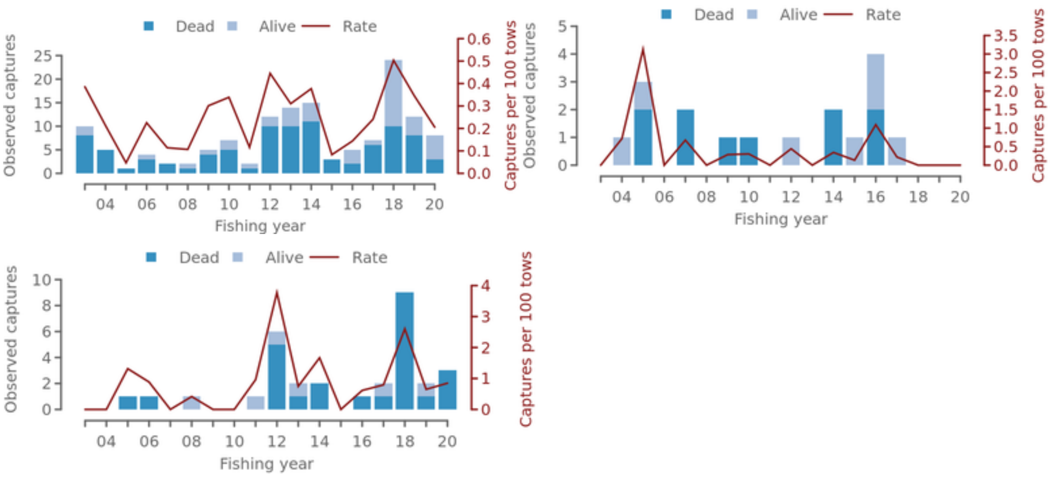

Figure 44: Observed captures and capture rates of White-capped albatross by hoki, hake and ling trawl fisheries 2002-03 to 2019-20.

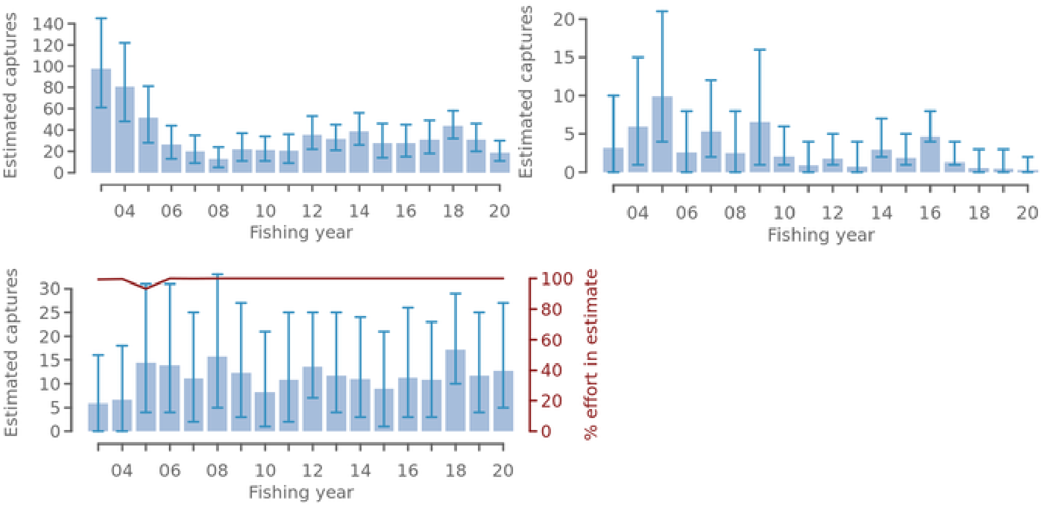

Figure 45: Estimated incidental captures of White-capped albatross by hoki, hake and ling trawl fisheries 2002-03 to 2019-20.

Southern Buller's albatross

Demographic studies at the three study colonies on Northeast Island have been undertaken annually from 1992 to 2022. The population is reportedly showing marked annual variations since 2006 with the most recent breeding pairs count have shown increases for Mollymawk Bay and Upper Punui Bay.

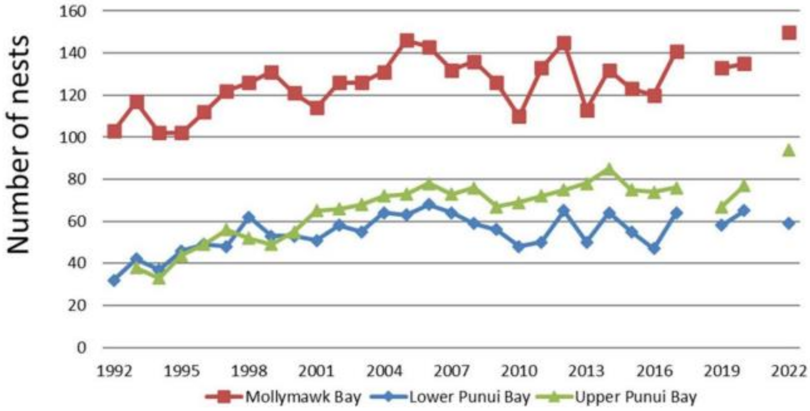

Figure 46: Count of Southern Buller's albatrosses breeding pairs (nests) at three study colonies, Tini Heke the Snares 1991-2022.

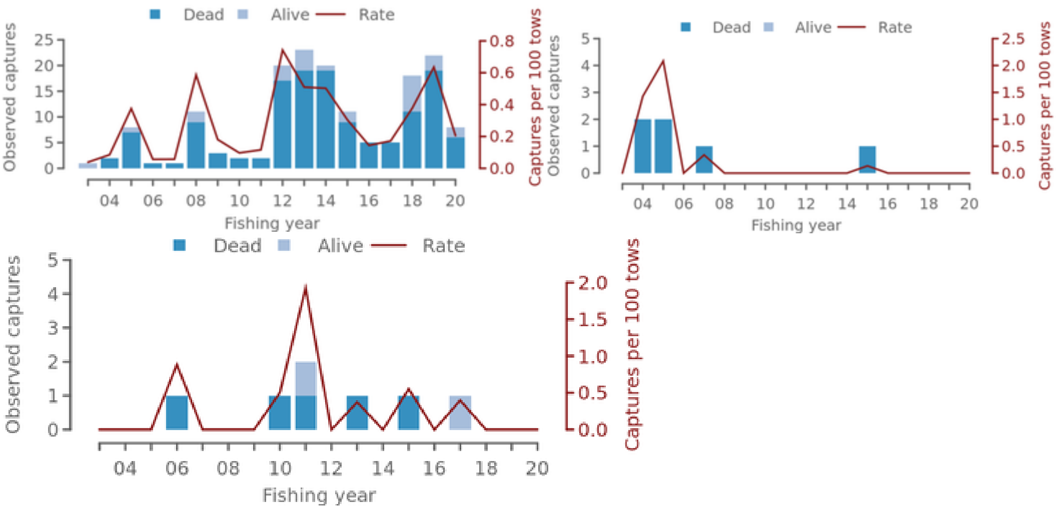

Figure 47: Observed captures and capture rates of Southern Buller's albatross by hoki, hake and ling trawl fisheries 2002-03 to 2019-20.

Sooty shearwater

Ongoing population monitoring of flesh-footed shearwaters on Ohinau and Lady Alice Islands, and Titi Island are undertaken by DOC. The 2021/22 breeding success results show it is static for Ohinau (59%) and Lady Alice Islands (51%).

The Titi Islands population estimate by Burgin & Lamb (2022) is slightly higher than the previous estimate carried out by Baker et al. (2010) and Waugh et al. (2014) (

).

Table 14: Current and previous flesh-footed shearwater population estimate comparisons

Island	Current Estimate			Previous Estimates			Difference between estimates
	Year	Estimated Occupied Burrows	95% Confidence Interval	Paper/Report	Estimated Occupied Burrows	95% Confidence Interval	
Titi Island	2022	528	250 – 806	*Baker et al. (2010)*	*337*	*0 – 950*	+191
				Waugh et al. (2014)	*157*	*N/A*	+371

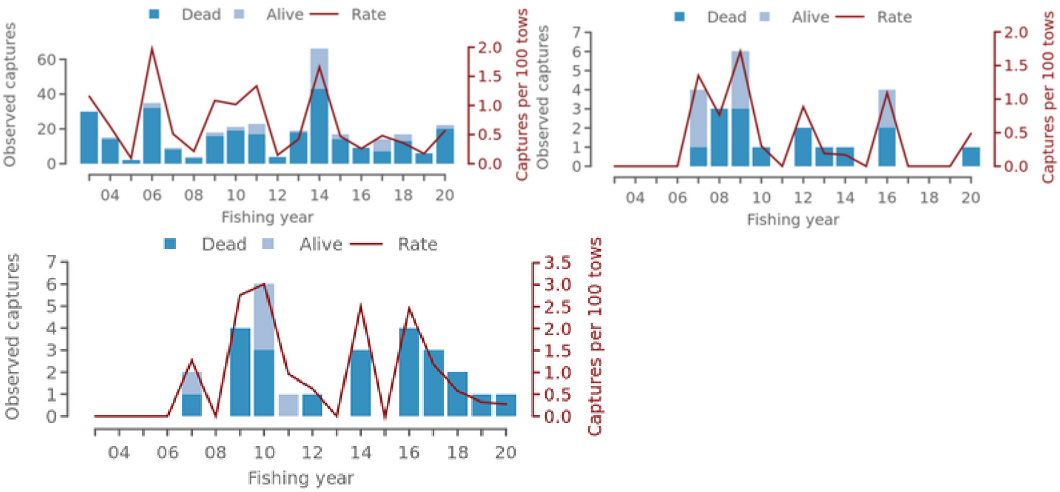

Figure 48: Observed captures and capture rates of Sooty shearwater by hoki, hake and ling trawl fisheries 2002-03 to 2019-20.

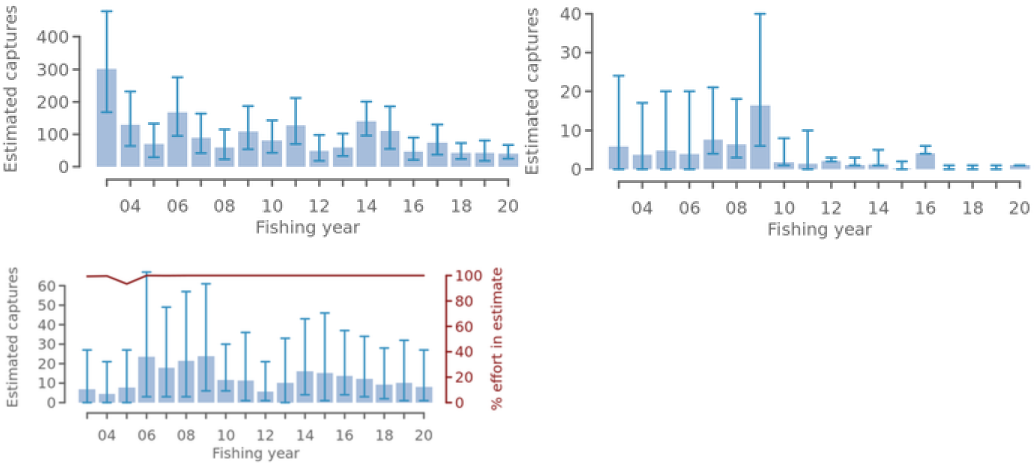

Figure 49: Estimated incidental captures of Sooty shearwater by hoki, hake and ling trawl fisheries 2002-03 to 2019-20.

Westland petrel

The Westland petrel population is considered to be stable at around 4,000 breeding pairs (Waugh & Bartle, 2013), and the population is estimated to be stable or slightly increasing, based on demographic studies at the largest colony (Waugh et al., 2015).

The hoki/hake/ling mixed-trawl fisheries captured on average three Westland petrels per annum (observed captures) over the seven year period 2013-14 to 2019-20 (Figure 50), (six captures in

2018-19 and one in 2019-20). At an average observer coverage rate of 33% (Table 1), this is illustrative of a low threat level to Westland petrel by these fisheries. Their median Annual Potential Fatality (APF) rate of 180 for all trawl and longline fisheries combined, is well below their estimated Population Sustainability Threshold (PST) of 350 (Richard et al., 2020).

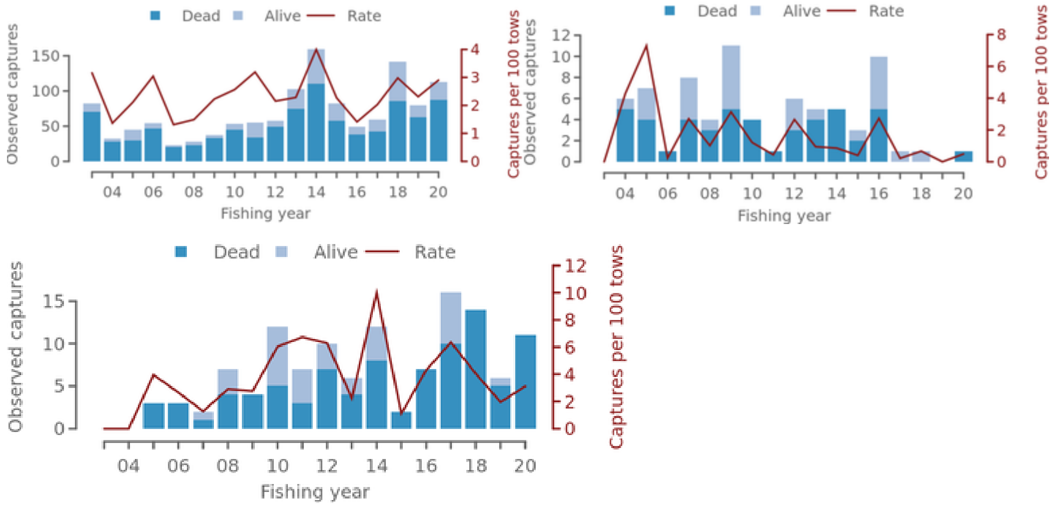

Figure 50: Observed incidental captures of Westland petrel by all trawlers > 28 m from 2002-03 to 2017-18.

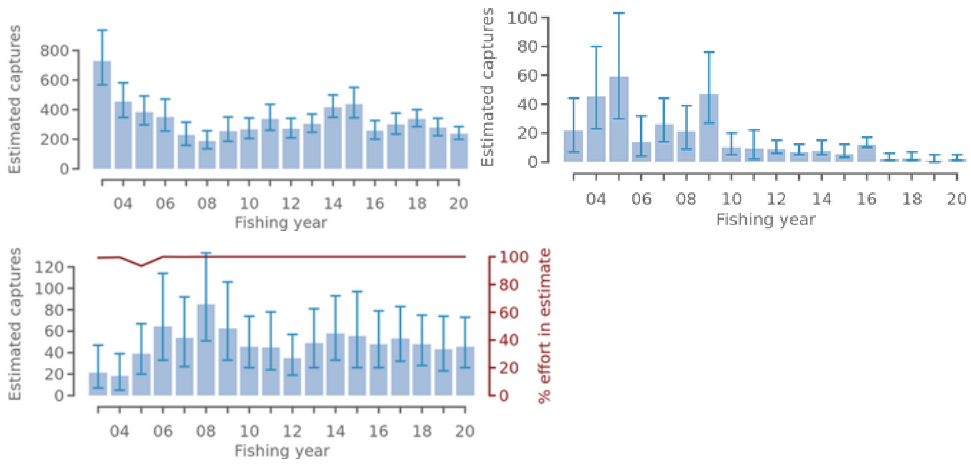

Figure 51: Estimated incidental captures of Sooty shearwater by hoki, hake and ling trawl fisheries 2002-03 to 2019-20.

New Zealand fur seal

The New Zealand fur seal is abundant and classified as 'least concern' by DOC. The current population is estimated to be around 100,000 and numbers are increasing. The most recent multi-species marine mammal risk assessment in 2017 showed the level of this risk from fisheries to the New Zealand fur seal is unlikely to pose a threat to the NZ fur seal population sustainability (AEBR, 2021). The DOC threat classification status for fur seals is 'Not Threatened' and their population size is believed to be increasing (Baker et al., 2019).

Research completed under DOC's CSP funding model has been completed to determine the utility of using drones for aerial surveyors to quantify NZ fur seals populations sizes at the Bounty Islands.[5]

Over the last five years, there have been on average around 30 observed captures of New Zealand (NZ) fur seals per year in the hoki trawl fishery, with a small fraction being released alive (Figure 53).

[5] Rexer-Huber K., Parker G.C. 2020. Bounty Islands drone trials: feasibility for population assessment of NZ fur seal. POP2019-05 final report for the Conservation Services Programme, Department of Conservation. Parker Conservation, Dunedin. 18 p.

Figure 33 shows NZ fur seal captures are low across the hoki, hake and ling trawl fisheries. Increasing observer rates provide increased confidence in the results (Figure 34).

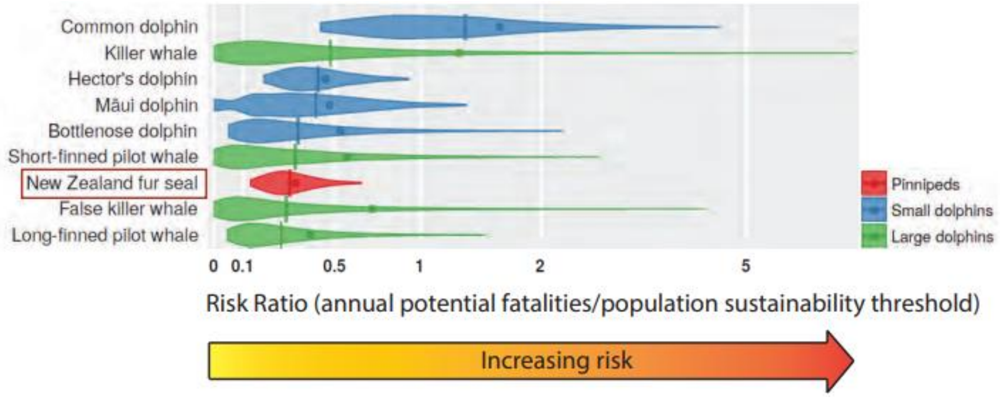

Figure 52: New Zealand fur seal risk ration as calculated by the 2017 Assessment of the risk to New Zealand marine mammals from commercial fisheries (Abraham et al, 2017).

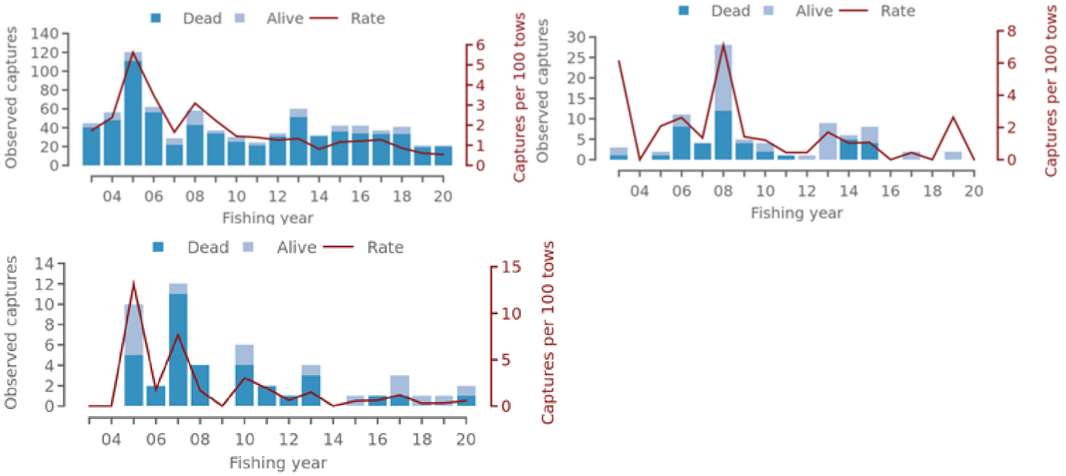

Figure 53: New Zealand observed fur seal captures by the hoki, hake and ling trawl fisheries from 2002-03 to 2019-20.

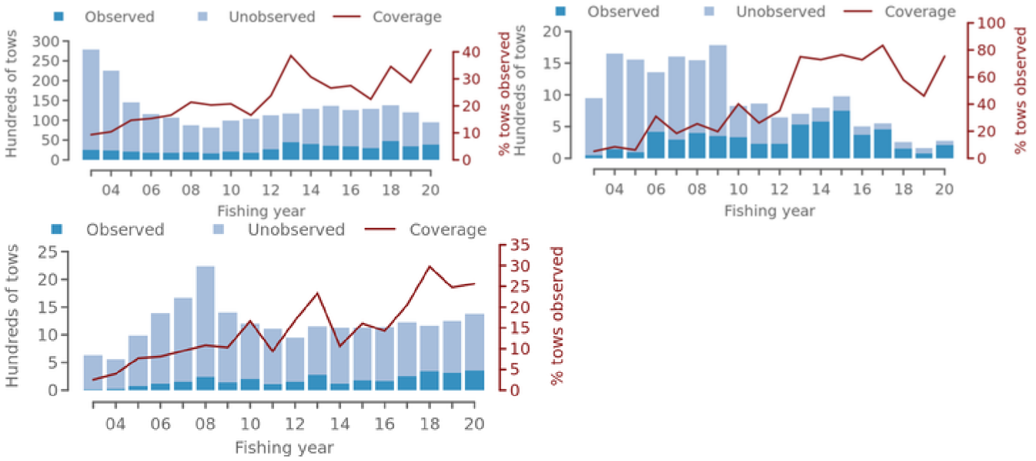

Figure 54: Fishing effort and observations of the hoki, hake and ling trawl fisheries 2002-03 to 2019-20.

New Zealand sea lion

The New Zealand sea lion is listed as 'Threatened – Nationally Vulnerable' (Baker et al., 2019; FNZ., 2022). A New Zealand Sea Lion Threat Management Plan (TMP) was finalised in 2017 (DOC, 2017) with a vision to "promote recovery and ensure the long-term viability of New Zealand sea lions".

Capture rates in relevant fisheries declined and stabilised after the full adoption of Sea Lion Exclusion Devices (SLEDs)). Observer coverage in squid fisheries has increased up to near 100%

No observed captures of New Zealand (NZ) sea lion have been reported in the hoki/hake/ling trawl fisheries in the most recent 5-year period from 2015-16 to 2019-20 (FNZ, 2021a, FNZ 2021b). One sea lion was reported captured by a ling trawler in 2018-19 (see Table 2). Sea lion captures by these fisheries were incorporated into the TMP and were not considered to pose a threat to the sea lion population (DOC, 2017).

The sea lion population has been recovering and are now breeding on Stewart Island and on the Otago and Southland coastlines. Following an unexplained decline in pup counts between 2007-08 and 2008-09, annual pup production has been relatively stable over the 13-year period 2008-09 to 2021-22 (Young & Manno, 2022), (Figure 55). Note that no estimates of pup production were obtained in 2020-21 due to Covid-19-related cancellation of the field season.

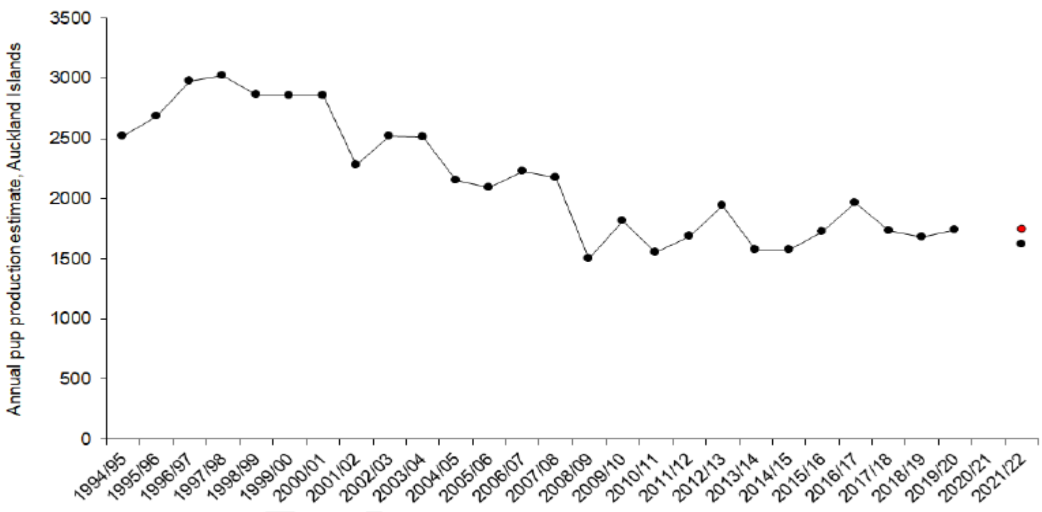

Figure 55: Total estimated sea lion pup production at the Auckland Islands (all colonies combined) 1994-95 to 2021-22. Two estimates are presented for 2021-22: a minimum estimate based on direct counts and mark-recapture (black) and an adjusted estimate based on direct counts and mark-recapture (red).

Sharks

Very few protected sharks have been reported captured by hake, hoki and ling trawl fisheries; a single basking shark (*Cetorhinus maximus*) capture was reported in 2014-15, while two were reported in each of 2018-19 and 2019-20 and three in 2020-21 (G. Lydon FNZ, pers. comm.). No white pointer (great white) sharks have been reported captured in these fisheries (

). DWG’s Sharks OP provides guidelines for returning protected sharks to the sea unharmed wherever possible (DWG, 2022).

Table 15: Industry-reported protected shark species captures in the hake, hoki and ling trawl fisheries in 2018-19 and 2019-20.

Fishery	2018-19		2019-20		2020-21	
	BSK	WPS	BSK	WPS	BSK	WPS
HAK	1	0	0	0	1	0
HOK	1	0	2	0	1	0
LIN	0	0	1	0	1	0

Table 16: Observed and industry reported captures of protected shark species from the core deepwater fishing fleet between the 2015/16 and 2020/21 fishing years.

Species		15/16	16/17	17/18	18/19	19/20	20/21
Basking shark	Observed	1	5	1	7	11	3
	Fisher-reported	5	8	1	7	12	4
Smalltooth sandtiger shark	Observed	-	-	-	-	-	1
	Fisher-reported	-	-	-	-	-	1
White pointer shark	Observed	1	3	5	3	9	4
	Fisher-reported	1	4	5	3	9	4

Table 17: Details of QMS shark species landed by the core deepwater fleet during the 2020/21 fishing year (tonnes).

Species	Total landings [56]	Landed green	Landed processed (exc MEA)	Mealed	Discarded under observer approval[57]	Returned dead (6TH schedule)	Returned alive (6th schedule)	Accidental loss
Blue shark	-	-	-	-	<1	5	1	<1
Elephant fish	4	<1	2	2	1			-
Ghost shark	447	17	375	55	66			<1
Mako shark	-	-	-	-	<1	7	3	-
Pale ghost shark	749	9	562	177	8			<1
Porbeagle shark	<1	-	-	<1	<1	20	4	-
Rig	16	<1	14	1	2		<1	<1
Rough skate	174	31	84	58	9		53	<1
School shark	168	<1	147	21	12		6	1
Smooth skate	311	5	241	65	7		64	2
Spiny dogfish	1,083	30	61	992	1	2,677		47
Total	**2,950**	**93**	**1,486**	**1,372**	**107**	**32**[58]	**130**[59]	**51**

A review of basking shark interactions in New Zealand found that while captures were greater for tows deeper than 400 m and for net headline heights that exceeded 4 m, there was no clear understanding of when/where encounters were likely to occur. Basking sharks may undergo very extensive migrations, both within ocean basins and trans-equatorially (Francis, 2017).

Shark retention policy

The Fisheries (Commercial Fishing) Regulations 2001 prohibit shark finning and require that any shark fins landed must be naturally attached to the remainder of the shark (or artificially in the case of blue shark). However, an exception to the fins attached requirement is provided for seven QMS species to allow at-sea processing to continue. (https://www.mpi.govt.nz/dmsdocument/3644-Landing-shark-fins-subject-to-a-ratio). The conditions that apply to the different shark species is shown in the table below.

Table 18: Summary of conditions that apply if fishers wish to land shark fins.

Approach	Description	Applicable species
Ratio	Fins must be stored and landed separately by species. The weight of fins landed must not exceed a specified percentage of the greenweight of the shark. Weight of fins must be reported on landing returns. The ratio applies to landings on a trip-by-trip basis.	Elephant fish
		Dark ghost shark
		Mako shark
		Pale ghost shark
		Porbeagle shark
		Rig
		School shark
Fins artificially attached	After being processed to the dressed state, fins must be re-attached to the shark by some artificial means. Landings to be reported with landed state of SFA (shark fins attached).	Blue shark
Fins naturally attached	After being processed to the headed and gutted state, the fins must remain attached to the body by some portion of uncut skin. Landings to be reported with landed state of SFA (shark fins attached).	Spiny dogfish
		All non-QMS species

Whales & dolphins

There were three reported incidental captures of common dolphin (*Delphis delphis*), and one of a long-finned pilot whale (*Glopicephala melas*) in the hoki mixed species trawl fishery in the five-year period 2013-14 to 2017-18, (Dragonfly, 2019). The pilot whale was in a state of decomposition when caught, indicating it may have died of natural causes (R. Wells, DWG, pers. comm.). In 2018-19 there were two common dolphin captures involving a single incident, while in 2019-20 there were two common dolphin captures, one dusky dolphin (*Lagenorhynchus obscurus*) capture and one pilot whale capture (see Table 2), (G. Lydon FNZ, pers. comm.). The pilot whale was a retention of a previously dead animal as there was evidence of significant flesh loss to the head region (J. Cleal, ELO, pers. comm.). In 2020-21 there were seven dolphin captures by hoki target trawls and one by a ling target trawl (G. Lydon FNZ, pers. comm.).

Benthic species

Corals are rarely encountered by hoki, hake and ling trawlers. Observed coral bycatch in these fisheries averaged 155 kg/year over the 6-year period 2013-14 to 2017-18 and 2020-21 (

Table 19: Catch of all corals from observed tows, the number of observed tows and the average catch of coral per tow by hoki /hake/ling trawl fisheries).

). Observed coral captures in 2018-19 and 2019-20 amounted to 16 kg and 3 kg respectively (G. Lydon FNZ, pers. comm.). The impact of these fisheries on corals is negligible.

Table 19: Catch of all corals from observed tows, the number of observed tows and the average catch of coral per tow by hoki /hake/ling trawl fisheries).

	2013-14	2014-15	2015-16	2016-17	2017-18	2020-21	Average
Coral catch (kg)	65.4	465.4	190.4	63	78.5	69.4	155.2
No. tows with coral	68	96	67	105	79	10	71
No. observed tows	5,252	4,921	4,282	3,902	5,524	4,059	4,657
% tows with coral	1.3%	2.0%	1.6%	2.7%	1.4%	0.2%	1.5%
Catch rate (kg/tow)	0.01	0.09	0.04	0.02	0.01	0.02	0.03

Table 20: Observed and industry reported catch of benthic species (kg) by the core deepwater fleet between the 2017/18 and 2021/21 fishing years

	17/18		18/19		19/20		20/21	
	Observed	Industry Reported	Observed	Industry Reported	Observed	Industry Reported	Observed	Industry Reported
Anemones	18,463	5,754	7,773	4,275	5,064	9,249	7,852	14,312
Corals (COU)	240	82	631	163	2,656	35	3,860	20
Corals, Sponges, Bryozoans (CSB)[62]	2,166	2,926	8,141	27,928	1,024	1,488	938	5,350
Hydroids	23	-	18	-	65	-	10	
Sea pens	169	-	104	-	125	-	95	
Sponges	47,692	89,452	18,752	78,622	30,639	57,909	33,772	49,936

Table 21: Industry reported ETP[6] coral catch in the 2018/19 and 2019/20 fishing years for HOK, HAK, LIN and SBW trawl fishery[7]

ETP corals catch	2018/19				2019/20			
	HOK	HAK	LIN	SBW	HOK	HAK	LIN	SBW
Coral catch (kg)	12	4	0	0	2	0	1	0
No. tows with coral	4	4	0	0	2	0	1	0
No. observed tows	3,486	70	294	748	3,589	205	327	348
% tows with coral	0.03%	2.48%	0.00%	0.00%	0.02%	0.00%	0.08%	0.00%
Catch rate (kg/tow)	0.001	0.025	0.000	0.000	0.000	0.000	0.001	0.000

[6] Endangered, threatened, and protected species

[7] There was no fisher reported ETP coral capture for SBW or WWA fisheries during 2018/19 and 2019/20 fishing years.

Benthic interactions

Trawl footprint

The trawl footprint of New Zealand's trawl fisheries is assessed annually to monitor their interactions with the benthic habitat. The latest trawl footprint report was released in July 2023 and presents the spatial analysis of bottom-contacting trawl effort by commercial trawlers within the New Zealand 200 n. mile Exclusive Economic Zone and Territorial Sea (EEZ+TS), in waters open to trawling down to 1600 m in depth (the 'fishable area'), for different time periods, based on available data.

The latest trawl footprint analysis shows that for the deepwater data between 1990 – 2007 the annual footprint was 1.2 - 2.0% of the EEZ and TS, representing 3.4 - 5.8% of the fishable area. Whilst in the most recent years 2008 – 2021 the annual footprint has declined to 1.0 - 1.2% of the EEZ and TS - representing 2.9 - 3.6% of the fishable areas (MacGibbon and Mules, 2023). The data shows there has been a decrease in the total number of bottom-contacting tows by year for the Deepwater Tier 1 species (Figure 56).

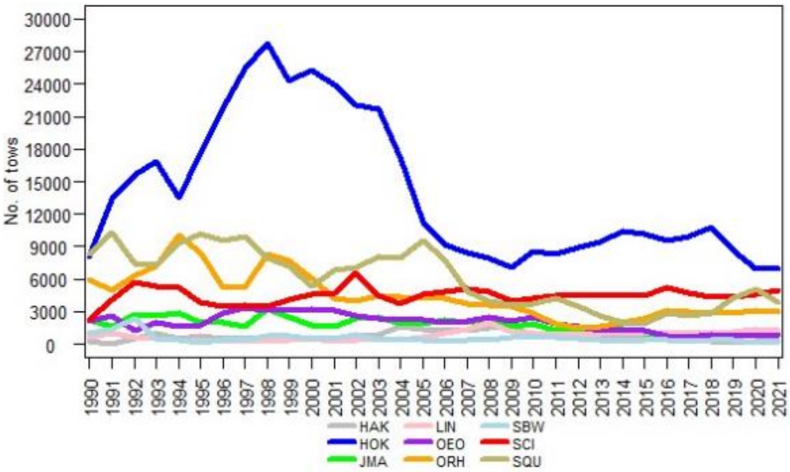

Figure 56: The number of bottom-contacting tows by year for the Deepwater Tier 1 species (MacGibbon and Mules, 2023)

The trawl footprint for HOK, HAK, LIN, SWA and WWA target trawls represented 54% of the deepwater trawl footprint. The combined spatial coverage of the trawl footprint was:

- 4.6% of the EEZ+TS (annual range 0.5–1.4%)
- 13.8% of the fishable area (annual range 1.5–4%)

The latest report shows that there is a declining trend in the size of the trawl footprint with the two most recent fishing years having the second and third lowest footprints in the time series (21,115 km2 and 23,274 km2 in 2020 and 2021, respectively).

By target species for the most recent fishing year, 2021, the following key observations were made:

- **HOK**
    - The 2021 estimated footprint for HOK bottom-contacting trawls was 20,497.9 km2 representing 51.5% of the total Tier 1 footprint of 39,813.1 km2.
    - Between 1990—2001 HOK bottom-contacting trawls represented 6.4% of the total Tier 1 footprint
    -
    - Table **22** shows that the preferred depths for HOK tows were the 400 – 600 and 600 – 800 depth zones and these represented only 0.13% and 0.18% of the 2021 footprint. Table 23 Table 24provides the trawl contact by depth for each target species for the time series 1990 – 2021.

- **HAK**
    - The 2021 estimated footprint for HAK bottom-contacting trawls was 733.5 km2 representing 1.8% of the total Tier 1 footprint of 39,813.1 km2.
    - Between 1990—2001 HAK bottom-contacting trawls represented 6.4% of the total Tier 1 footprint.
    - Table 22 shows that the preferred depths for HAK tows were the 400 – 600 and 600 – 800 depth zones and these represented only 5.66% and 2.65% of the 2021 footprint. Table 23 provides the trawl contact by depth for each target species for the time series 1990 – 2021.
- **LIN**
    - The 2021 estimated footprint for HAK bottom-contacting trawls was 1,660.6 km2 representing 4.2% of the total Tier 1 footprint of 39,813.1 km2.
    - Between 1990—2001 LIN bottom-contacting trawls represented 8.7% of the total Tier 1 footprint
    - Table 22 shows that the preferred depths for LIN tows were the 400 – 600 and 600 – 800 depth zones and these represented only 0.32% and 0.37% of the 2021 footprint. Table 23 provides the trawl contact by depth for each target species for the time series 1990 – 2021.

Table 24 shows that for all target species in 2021 (HOK, HAK and LIN) the bottom contact was targeted at the preferred habitat. This is supported by the observation for HOK that the aggregate area and footprint values for 2021 are lower than the overall time series, indicating hoki target fishing is concentrated in a smaller area.

The latest report advances the precision of trawl footprint analysis by using GPR data and showed that for deepwater trawls it resulted in an increase from 39,403 km^2 to 41,462 km^2. The difference is expected to be a result of moving from the 'traditional methodology' for ERS data which assumes a straight line between start and end positions and the use of GPR tracks to better inform the spatial footprint. See Table 32 of AEBR 316 for a full comparison of the footprint and aggregate area for the GPR swept areas and the equivalent area for ERS data.

Table 22: The total area of the seafloor in each depth zone within 'fishable' waters, all depth zones ≤ 1600 m combined, and the percentage of each depth zone covered by the 2021 trawl footprint for each Tier 1 target species and for the Tier 1 targets combined. – indicates no overlap (MacGibbon & Mules, 2023).

Depth zone (m)	Area (km^2)	Footprint area overlap (%)									
		HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU	Tier 1
< 200	249 341.90	0.01	0.06	1.10	0.05	–	0.00	–	0.01	1.09	2.30
200–400	98 295.90	0.04	0.73	0.06	0.32	–	0.00	0.01	2.73	1.07	4.81
400–600	253 939.20	0.13	5.66	0.00	0.37	–	0.00	0.21	0.75	0.12	7.07
600–800	185 161.60	0.18	2.65	0.00	0.12	0.00	0.06	–	0.00	0.00	2.94
800–1000	166 645.00	0.01	0.20	–	0.00	0.09	1.91	–	0.00	0.00	2.22
1000–1200	144 930.50	0.00	0.00	–	–	0.08	1.13	–	–	–	1.21
1200–1400	168 376.80	–	0.00	–	–	0.01	0.23	–	–	–	0.24
1400–1600	124 988.80	–	0.00	–	–	0.00	0.07	–	–	–	0.08
≤ 1600	1 391 679.70	0.05	1.47	0.20	0.12	0.02	0.39	0.04	0.33	0.29	2.86

Table 23: The total seafloor area in each depth zone within 'fishable' depth zones ≤ 1600 m, and the percentage of each depth zone contacted by the 1990–2021 Tier 1 footprint (MacGibbon & Mules, 2023).

Depth zone (m)	Area (km^2)	Footprint area overlap (%) HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU	Tier
< 200	249 341.90	0.1	5.3	15.8	1.2	0.0	0.1	0.0	0.7	9.9	27.4
200–400	98 295.90	1.2	18.6	6.1	7.0	0.1	0.2	3.7	9.5	8.0	36.7
400–600	253 939.20	5.1	28.0	0.4	4.8	0.1	0.2	7.6	3.6	2.1	40.1
600–800	185 161.60	3.0	28.6	0.2	3.3	0.7	0.9	0.2	0.2	1.7	31.3
800–1000	166 645.00	0.6	5.3	0.0	0.2	5.2	12.2	0.0	0.1	0.3	21.4
1000–1200	144 930.50	0.0	1.3	0.0	0.0	3.5	9.6	0.0	0.1	0.2	13.3
1200–1400	168 376.80	0.0	0.3	0.0	0.0	0.9	3.2	0.0	0.0	0.1	4.1
1400–1600	124 988.80	0.0	0.3	0.0	0.0	0.3	1.5	0.0	0.1	0.1	2.0
≤ 1600	1 391 679.70	1.5	12.0	3.4	2.1	1.3	3.2	1.7	1.5	3.0	23.6

Table 24: The total area of each 'preferred habitat' (probability of capture) and the percentage of each species 'preferred habitat' (probability of capture) area for HAK, HOK and LIN covered by the 1990–2021 and 2021 bottom-contact trawl footprint. – indicates no data. (MacGibbon & Mules, 2023).

Probability occurrence (%)	HAK area (km^2)	HAK footprint overlap (%) 1990–2021	HAK footprint overlap (%) 2021	HOK area (km^2)	HOK footprint overlap (%) 1990–2021	HOK footprint overlap (%) 2021	LIN area (km^2)	LIN footprint overlap (%) 1990–2021	LIN footprint overlap (%) 2021
0	157 798.9	157 798.90	0.15	59 927.6	0.27	<0.01	16 384.1	0.02	-
0.1–1.0	143 613.4	143 613.40	0.16	191 141.7	0.55	<0.01	421 963.7	0.03	-
1.1–5.0	372 123.2	372 123.20	0.13	232 065.7	1.23	0.01	123 925.6	0.09	<0.01
5.1–10.0	157 588.0	157 588.00	0.23	94 978.0	3.25	0.02	70 480.9	0.27	<0.01
10.1–0.0	136 822.9	136 822.90	0.40	107 078.6	3.71	0.03	106 096.8	0.70	0.02
20.1–30.0	89 636.3	89 636.30	0.57	47 646.2	5.77	0.07	70 823.3	2.18	0.07
30.1–40.0	71 790.2	71 790.20	1.10	38 300.4	6.60	0.14	43 367.4	3.67	0.15
40.1–50.0	64 748.6	64 748.60	2.50	31 571.6	8.43	0.23	33 728.4	4.66	0.27
50.1–60.0	60 031.3	60 031.30	3.88	27 614.6	10.20	0.31	36 340.8	3.95	0.28
60.1–70.0	55 069.8	55 069.80	5.84	31 773.8	8.59	0.43	31 498.5	4.65	0.34
70.1–80.0	53 189.8	53 189.80	11.53	35 949.5	10.54	0.57	42 477.3	4.10	0.22
80.1–90.0	26 263.0	26 263.00	16.67	58 122.5	11.16	0.92	96 312.2	4.54	0.22
90.1–95.0	2 801.7	2 801.70	10.04	118 974.0	17.30	1.75	129 835.6	6.41	0.35
95.1–99.0	202.6	202.60	2.05	316 535.4	35.30	5.44	168 444.9	5.46	0.36
0.0–99.0	1 391 679.7	1.52	0.05	1 391 679.7	12.01	1.47	1 391 679.7	2.33	0.13

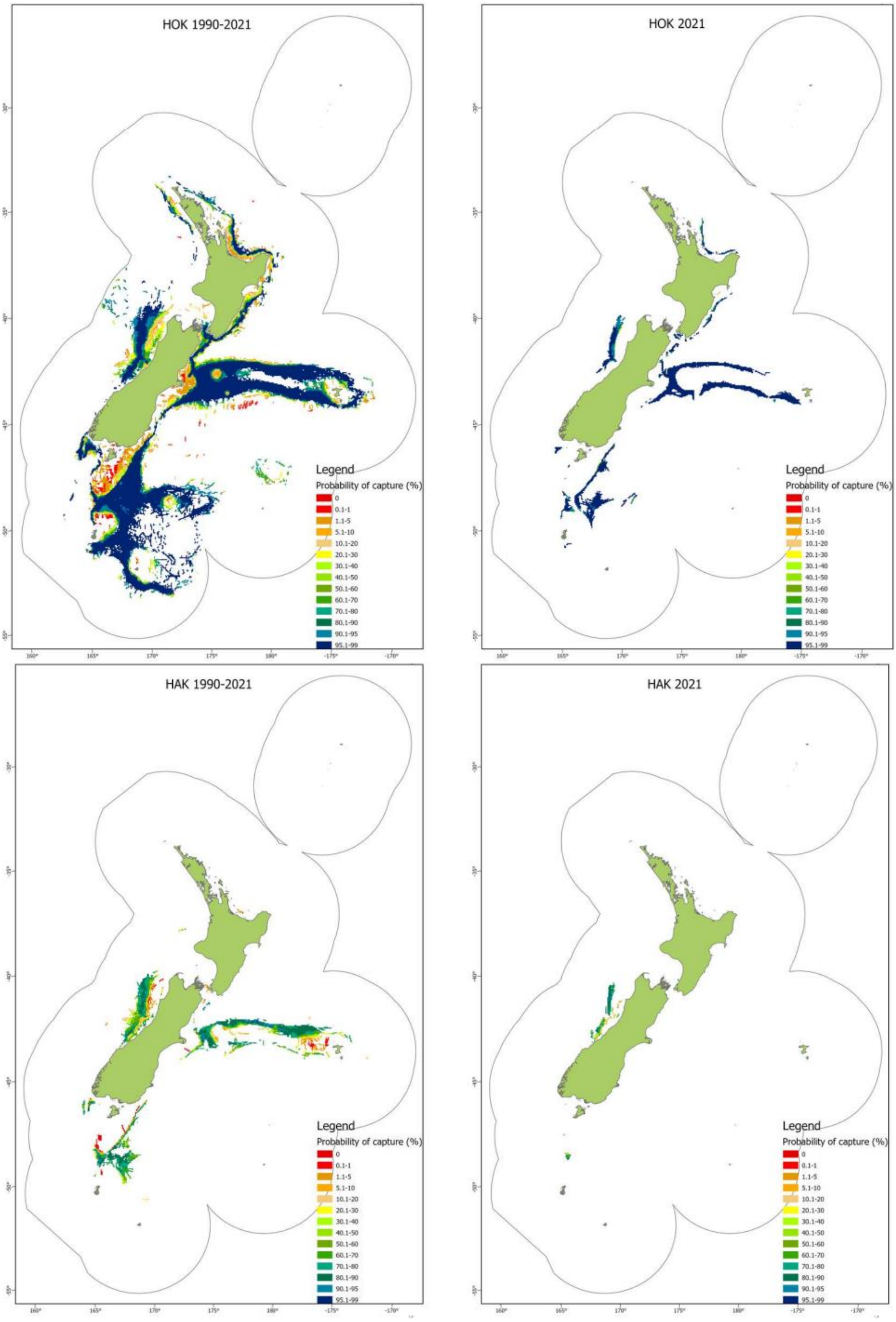

Figure 57: Distribution of the 1990–2021 (left) and the 2021 trawl footprints (right) for hoki (top) and hake (bottom), displayed by 25-km2 contacted cell, relative to the probability of capture for that species (after Leathwick et al. 2006).

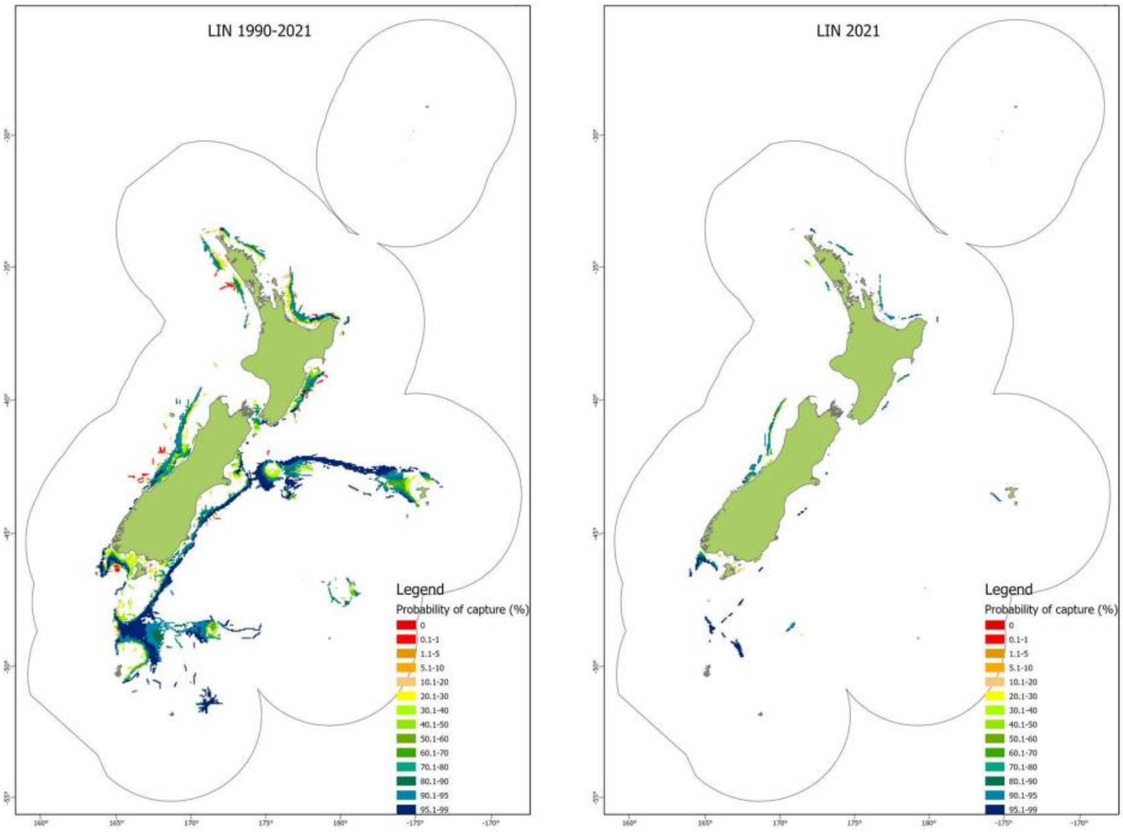

Figure 58: Distribution of the 1990–2021 (left) and the 2021 trawl footprints (right) for ling, displayed by 25-km2 contacted cell, relative to the probability of capture for that species (after Leathwick et al. 2006).

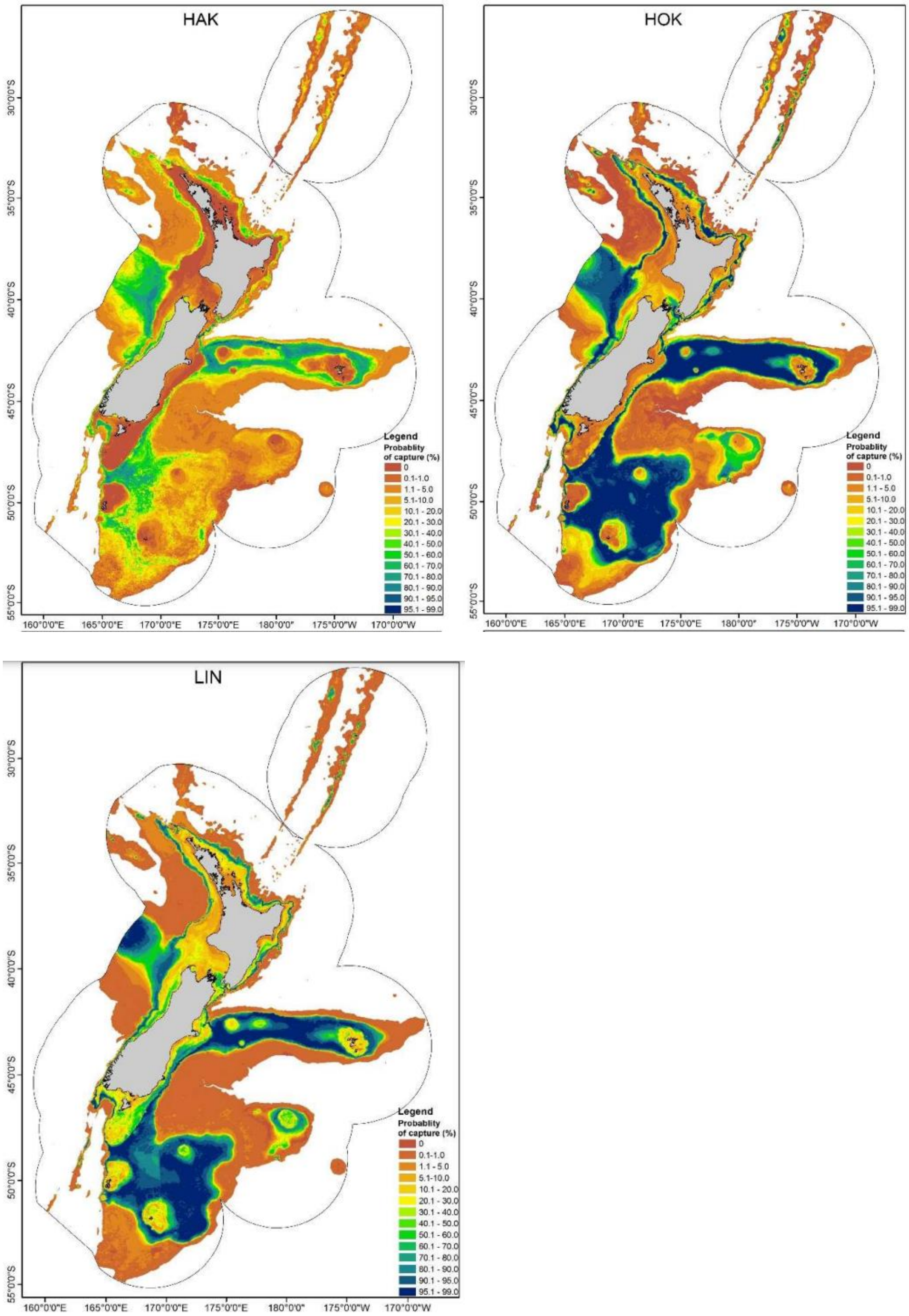

Figure 59: The extent of the predicted distribution of the preferred habitat for hake (upper left), hoki (upper right and ling (lower left) (after Leathwick et al. 2006), where the preferred habitat represents the probability of capture of that species in a standardised trawl in waters down to 1950 m depth.

New Zealand's strategy to guard against adverse impacts on the benthic environment includes multiple area closures in the EEZ. A total of 17 Benthic Protection Areas (BPAs), representatively distributed around the EEZ, and 17 'seamount' closures, collectively close 30% of the EEZ to bottom fishing (Helson et al., 2010). The area closures protect:

- 28 percent of underwater topographic features (including seamounts)
- 52 percent of seamounts over 1000 metres in height
- 88 percent of known active hydrothermal vents.

Aquatic environment and biodiversity research initiatives related to the benthic effects of fishing are detailed in the Annual Operational Plan for Deepwater Fisheries (FNZ, 2021) and the Aquatic Environment and Biodiversity Annual Review report (FNZ, 2022), and include the following in-progress projects:

- The extent and intensity of seabed contact by mobile bottom fishing in the New Zealand Territorial Sea and Exclusive Economic Zone (trawl footprint), (Project BEN2020-01)
- The extent and intensity of trawl effort on or near underwater topographic features in New Zealand's Exclusive Economic Zone (Project BEN2020-07)[8]
- Quantitative photographic surveys of benthic invertebrate communities on features in the Graveyard knolls complex (Project ZBD2020-07)
- Spatial decision support tool development for managing the impacts of bottom fishing on vulnerable or sensitive habitats (Project BEN2019-05).
- INT2021-02 Characterisation of protected coral interactions (Proteus)

Coral

Corals are rarely encountered by hoki, hake and ling trawlers. Observed coral bycatch in these fisheries averaged 155 kg/year over the 6-year period 2013-14 to 2017-18 and 2020-21 (

[8] https://www.mpi.govt.nz/dmsdocument/37038-AEBR-227-Biodiversity-of-Benthic-Protection-Areas-and-Seamount-Closure-Areas-a-description-of-available-benthic-invertebrate-data-and-a-preliminary-evaluation-of-the-effectiveness-of-BPAs-for-biodiversity-protection

Table 19: Catch of all corals from observed tows, the number of observed tows and the average catch of coral per tow by hoki /hake/ling trawl fisheries).

). Observed coral captures in 2018-19 and 2019-20 amounted to 16 kg and 3 kg respectively (G. Lydon FNZ, pers. comm.). The impact of these fisheries on corals is negligible.

Table 25: Catch of all corals from observed tows, the number of observed tows and the average catch of coral per tow by hoki /hake/ling trawl fisheries)

	2013-14	2014-15	2015-16	2016-17	2017-18	2020-21	Average
Coral catch (kg)	65.4	465.4	190.4	63	78.5	69.4	155.2
No. tows with coral	68	96	67	105	79	10	71
No. observed tows	5,252	4,921	4,282	3,902	5,524	4,059	4,657
% tows with coral	1.3%	2.0%	1.6%	2.7%	1.4%	0.2%	1.5%
Catch rate (kg/tow)	0.01	0.09	0.04	0.02	0.01	0.02	0.03

Table 26: Observed and industry reported catch of benthic species (kg) by the core deepwater fleet between the 2017/18 and 2021/21 fishing years

	17/18		18/19		19/20		20/21	
	Observed	Industry Reported	Observed	Industry Reported	Observed	Industry Reported	Observed	Industry Reported
Anemones	18,463	5,754	7,773	4,275	5,064	9,249	7,852	14,312
Corals (COU)	240	82	631	163	2,656	35	3,860	20
Corals, Sponges, Bryozoans (CSB)[62]	2,166	2,926	8,141	27,928	1,024	1,488	938	5,350
Hydroids	23	-	18	-	65	-	10	
Sea pens	169	-	104	-	125	-	95	
Sponges	47,692	89,452	18,752	78,622	30,639	57,909	33,772	49,936

Table 27: Industry reported ETP[9] coral catch in the 2018/19 and 2019/20 fishing years for HOK, HAK, LIN and SBW trawl fishery[10]

ETP corals catch	2018/19				2019/20			
	HOK	HAK	LIN	SBW	HOK	HAK	LIN	SBW
Coral catch (kg)	12	4	0	0	2	0	1	0
No. tows with coral	4	4	0	0	2	0	1	0
No. observed tows	3,486	70	294	748	3,589	205	327	348
% tows with coral	0.03%	2.48%	0.00%	0.00%	0.02%	0.00%	0.08%	0.00%
Catch rate (kg/tow)	0.001	0.025	0.000	0.000	0.000	0.000	0.001	0.000

[9] Endangered, threatened, and protected species

[10] There was no fisher reported ETP coral capture for SBW or WWA fisheries during 2018/19 and 2019/20 fishing years.

ETP species capture mitigation

ETP species capture information, as reported by vessels and by MPI observers, is summarised in the Aquatic Environment and Biodiversity Annual Review report (FNZ, 2022), and on the Protected Species Capture webpage (FNZ, 2021a). The database provides open access to multi-year records of ETP species captures by fishery sector and fishing method, based on MPI observer data, and is updated annually through FNZ's Science Working Group process.

A range of management measures, including industry-led, non-regulatory initiatives, are employed to monitor environmental interactions in deep water fisheries and to reduce the risk of any adverse effects on protected species populations. Measures relating to the deepwater industry's monitoring of ETP species are described in DWG's Operational Procedures (OPs) and Vessel Management Plans (VMPs), (DWG, 2022), which include:

- Hoki OPs
- Hoki OPs Coastal Trawl Fisheries
- Marine Mammals OPs
- Reporting OPs
- Seabirds OPs
- Sharks OPs
- Benthic OPs (implemented in 2021-22)
- Deepwater Trawl VMP (template)
- Trawl Vessel Protected Species Risk Management Plan (template)
- Ten Commandments for:
    - Fresh Fish Hoki
    - Marine Mammals
    - Saving Seabirds
- Ten Golden Rules for Protected Species Reporting.

DWG Liaison Programme for ETP Species Risk Management

During 2018-19, DWG's Environmental Liaison Officer (ELO) visited 28 factory vessels, five fresh fish trawlers (> 28 m) and 14 seasonal hoki trawlers (< 28 m). During 2019-20, the Covid-19 pandemic restricted vessel visits to an extent and the ELO visited 24 factory vessels, five fresh fish trawlers (> 28 m) and 12 seasonal hoki trawlers (< 28 m). During 2020-21, 25 factory vessels, five fresh fish trawlers (> 28 m) and 10 seasonal hoki trawlers (< 28 m) were visited (Cleal, 2019, 2020, 2021).

The purpose of these vessel visits is to:

- Organise and deliver environmental training resources to senior crew and associated managers.
- Monitor vessel operator's adherence to the agreed environmental risk Operational Procedures (OPs)
- Maintain fleet database of vessels, operators, target species, ports, skippers etc.
- Undertake port call and vessel visits to a minimum of 90% of the fleet
- Analyse all FNZ audits of Vessel Management Plans (VMPs) and OPs, contacting operators with feedback for each and every audit
- Provide expert advice on vessel-specific options for fish waste management and warp mitigation systems and ensure this is documented
- Maintain strong liaison with government – particularly with FNZ, DOC and DOC's Inshore Liaison Officer Programme
- Review VMPs, ensuring each vessel has an effective vessel-specific seabird risk management programme.
- Provide full induction into DWG programmes to new skippers and/or vessel operators who have moved to new fisheries or have started on new vessels.
- Produce an end-of-year summary report to DWG, FNZ and DOC.

The ELO additionally visits any vessel that has reported trigger-point captures in order to assess the possible reasons for the captures, whether they could have been prevented, and to educate the skipper on how to reduce the risk of such events re-occurring. The ELO is on-call 24/7 for any communications or requests for support, including for trigger capture events (Cleal, 2019, 2020, 2021).

Regulatory requirements for seabird mitigation, for application by all vessels 28 metres or greater in length, include:

- Deployment of at least one type of seabird scaring device during all tows (i.e., bird bafflers, tori lines or warp deflectors)
- Management of fish waste discharge so as not to attract seabirds to risk areas (i.e., no discharge during shooting/hauling; mincing and batch-discharge while towing; installation of mincers/hashers/batching tanks/meal plants; gratings/trap systems to reduce fish waste discharge through scuppers/sump pumps)
- Seabird risk associated with trawl nets is minimised by:
    - Removal of stickers before shooting
    - Minimising the time fishing gear remains at/near the surface
    - Seabirds caught alive in/on the net are correctly handled and released to ensure maximum chance of survival.
- Seabird risk associated with deck landings and vessel impacts is minimised by:
    - Ensuring deck lighting does not attract/disorientate seabirds
    - Prompt removal of fish waste from the deck
    - Seabirds that land on the deck or impact with the vessel are correctly handled and released to ensure maximum chance of survival.

In summary, the existing seabird mitigation strategy applied by the hoki/hake/ling trawl fisheries has a high probability of ensuring the UoCs do not hinder nor threaten the recovery of any seabird populations.

All trawl vessels >28 m are required to notify DWG should they capture more than a given number of seabirds (or marine mammals) within a defined time period. These are known as trigger point notifications and are required to be reported to DWG within 24 hours. DWG's Environmental Liaison Officer (ELO) then contacts the vessel to determine the cause (e.g., mitigation measure failure, mechanical breakdown or weather conditions) and then determines what additional mitigation measures the vessel should take (if any).

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P3 - OVERVIEW OF MANAGEMENT INFORMATION

Legal & customary framework

New Zealand's fisheries management is centred on the Quota Management System (QMS), a system introduced in 1986 based on Individual Transferrable Quota (quota), Total Allowable Catch (TAC) limits and Total Allowable Commercial Catch (TACC) limits.

Quota provides a property right to access commercial fisheries and has been allocated to Māori as part of the Treaty of Waitangi Settlements that acknowledge the Treaty guaranteed Māori *"full exclusive and undisturbed possession of their…fisheries."*

Quota is a tradable property right that entitles the owner to a share of the TACC. At the commencement of each fishing year, quota gives rise to Annual Catch Entitlements (ACE) which are tradable, expressed in weight, and entitle the holder to land catch against them. The QMS enables sustainable utilisation of fisheries resources through the direct control of harvest levels based on the best available science. The QMS is administered by MPI through the Fisheries Act 1996.

New Zealand has implemented one of the most extensive quota-based fisheries management systems in the world, with over 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.

At an operational level, these fisheries are managed in accordance with the National Fisheries Plan for Deepwater Fisheries (FNZ, 2019). There are species-specific chapters for hake, hoki and ling within this plan (MPI, 2010a; MPI, 2011; MPI, 2013).

The National Deepwater Plan consists of three parts:

- Fisheries management framework and objectives:
  - Part 1A - strategic direction for deep water fisheries
  - Part 1B - fishery-specific chapters and management objectives at the fishery level
- Annual Operational Plan (AOP) – detailing the management actions for delivery during the financial year
- Annual Review Report – reporting on progress towards meeting the five-year plan and on the annual performance of the deep water fisheries against the AOP.

The deepwater fisheries management system undergoes periodic reviews to ensure it is able to deliver on its objectives and to identify opportunities to maximise its effectiveness. The most recent review was conducted in 2018 (IQANZ, 2018).

Fisheries Change Programme

The programme has 3 parts:

- Introducing mandatory electronic catch and position reporting to improve the collection and reliability of fisheries information
- Changing fishing rules and policies to make them simpler, fairer and more responsive, while also incentivising better fishing practice
- Improving monitoring and verification capabilities, including the use of on-board cameras, to better observe fishing practice. (https://www.mpi.govt.nz/fishing-aquaculture/commercial-fishing/fisheries-change-programme/)

The Fisheries Amendment Act has been passed into law with the vision that it will encourage better fishing practices, and modernise and strengthen New Zealand's fisheries management system by:

- strengthening the commercial fishing rules relating to the landing and discarding of fish
- introducing new graduated offences and penalties, including enabling the creation of an infringement regime for less serious offences and a system of demerit points

- enabling the further use of on-board cameras
- creating a new defence to help save marine mammals and protected sharks and rays
- streamlining the adjustment of recreational management controls.

Collaboration

In 2006, DWG and FNZ (then MPI), entered into a formal partnership to enable collaboration in the management of New Zealand's deep water fisheries. This partnership was updated in 2008 and 2010 (MPI, 2010), and has directly facilitated improved management of the hake/hoki/ling trawl fisheries through:

- A close working relationship under a shared and agreed vision, objectives and collaborative work plans
- Real-time, open communication between DWG and FNZ on information relevant to management measures, particularly from the FNZ Observer Programme and commercial catching operations.

FNZ and DOC actively consult with interested parties to inform management decisions through their open scientific working groups and public consultation processes.

Compliance & enforcement

FNZ maintains a comprehensive compliance programme, which includes both encouraging compliance through support and creating effective deterrents. This strategy is underpinned by the VADE model, which focuses on all elements of the compliance spectrum as follows:

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 and recognises that some individuals may deliberately choose to break the law and require formal investigation and prosecution.

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 FNZ to monitor all hake/hoki/ling/southern blue whiting vessel locations at all times. Paper based catch reporting was also required by all fishing vessels operating in NZ's EEZ. These systems have now been replaced by near real time Geospatial Position Reporting and daily Electronic Catch Reporting. FNZ still combines this functionality with at-sea and aerial surveillance, supported by the New Zealand Defence Force. This independently provides surveillance of activities of deep-water vessels through inspection and visual capability to ensure these vessels are fully monitored and verified to ensure compliance with both regulations and with industry-agreed Operational Procedures.

All commercial catches from QMS stocks must be reported and balanced against ACE at the end of the month. It is illegal to discard or not to report catches of QMS species. Catches may only be landed at designated ports and sold to Licensed Fish Receivers (LFRs). Reporting requirements for hake/hoki/ling trawl vessels include logging the location, depth, main species caught for each tow, and total landed catch for each trip.

MPI Fishery Officers carried out a total of 122 in-port and at-sea inspections for the period 1 January 2019 to 31 December 2021. These inspections relate to both inshore and deep-water vessels that were engaged in the HOK, HAK, LIN and SBW trawl fisheries and the LIN longline fishery. Inspections during 2020 and 2021 were lower than usual due to restricted access to vessels during the Covid epidemic (Table 28) (G. Lydon FNZ, pers. comm.).

Table 28: In-port and at-sea compliance inspections of hake, hoki and ling fishing vessels by MPI Fishery officers during the period 1 January 2019 to 31 December 2021.

		Number of inspections		
Year	**Inspection type**	**HAK/HOK/LIN trawl**	**LIN longline**	**SBW trawl**
2019	In port (inshore vessels)	25	15	
	In port (deep-water vessels)	9	2	3
	At sea	6	6	0
	Total	**40**	**23**	**3**
2020	In port (inshore vessels)	10	9	
	In port (deep-water vessels)	9	1	1
	At sea	2	1	0
	Total	**21**	**11**	**1**
2021	In port (inshore vessels)	5	13	0
	In port (deep-water vessels	4	0	0
	At sea	3	2	0
	Total	**12**	**15**	**0**
	Grand total	**73**	**49**	**4**

Areas monitored during in-port inspection included one or more of the following:

- Carton weights
- Adherence to state for HGT and DRE product (for HOK, HAK and LIN)
- ER reporting and landing documentation
- Verification of landing
- Compliance checks of mitigation devices for NFPS (e.g., SLEDS and tori lines)
- Inspection of PRB equipment
- Fish to meal.

Some minor non-compliance was detected during in-port inspections in relation to ER reporting including the non-reporting of discards and LIN tail cuts greater than 60mm for dressed product. Other compliance issues such as no fishing permit or certificate of registration onboard the vessel was detected and followed up by Fisheries Officers at the time with the skipper and later with the permit holder if required.

MPI Fishery Officers conducted three at-sea RNZN patrols in 2019. These patrols covered vessels operating on the East Coast of the North Island/Upper East Coast of the South Island and the West Coast South Island Hoki fishery. During these operations a total of 88 vessels were boarded and inspected, observed by RNZN helicopter and/or hailed if boarding was not possible. Of the 88 vessels, twelve had been operating in the HOK, HAK, or LIN fisheries. The Fishery Officers were briefed to examine possible compliance risks in these fisheries including one or more of the checks listed above.

Due to the COVID-19 pandemic all NZ borders and entry ports were closed to non-residents in March 2020. This resulted in fewer in-port and at sea inspections of fishing vessels throughout 2020 due to the tight restrictions of people movement and inspection criteria. In November 2020 one at sea RNZN patrol was conducted in the Northland area. During the patrol one LIN longline vessel was boarded and two trawlers with by-catch of LIN. No compliance issues were identified during these inspections.

FNZ audits commercial vessel catch-effort and landing reports, reconciles these against multiple sources including VMS records, data collected by onboard FNZ observers, and catch landing records from LFRs to ensure that all catches are reported correctly. Areas of compliance risk and/or concern are communicated to deepwater operators annually by MPI Compliance (MPI, 2019, 2020). In addition, MPI's Management and Compliance teams meet with DWG personnel and vessel operators annually to discuss and evaluate any issues of concern (DWG, 2019, 2020). Any identified risks are communicated to the fleet along with proposed remedial action to be undertaken.

Commercial fishermen face prosecution and risk severe penalties, which include automatic forfeiture of vessel and quota upon conviction of breaches of the fisheries regulations (unless the court rules otherwise). Financial penalties are also imposed in the form of deemed values to discourage fishermen from over-catching their ACE holdings.

The extensive Regulations governing these fisheries are complemented by additional industry-agreed non-regulatory measures, known as DWG's Operational Procedures (DWG, 2021). The Minister for Fisheries relies on the effectiveness of both regulatory and non-regulatory measures to ensure the sustainable management of these fisheries.

To facilitate implementation and monitoring of performance of DWG's Operational Procedures, DWG has an Environmental Liaison Officer (ELO) whose role is to train vessel operators and skippers on ETP species mitigation methods, use of mitigation equipment, safe handling and release of incidental captures and prompt reporting of trigger-level captures to DWG and to FNZ. The ELO is on-call 24/7 to respond to any ETP species capture issues and maintains active liaison with both vessel operators and FNZ towards ensuring effective implementation of the Operational Procedures and the National Plans of Action for Seabirds (FNZ, 2020) and Sharks (MPI, 2013a).

Fisheries plan

The National Fisheries Plan for Deepwater and Middle-depth fisheries is a statutory document approved by the Minister of Fisheries. This Plan provides an enabling framework outlining agreed management objectives, timelines, performance criteria and review processes. There is a fisheries-specific chapter for the southern blue whiting fisheries within this Plan.

The actual management measures and delivery outcomes in the Plan are specified in MPI's Annual Operational Plan (AOP), which is reviewed and updated annually. In addition, an Annual Review Report assesses performance against the AOP and is publicly available.

National Plans of Action (NPOAs)

New Zealand has a responsibility to act in accordance with the objective of International Plans of Action for Seabirds and Sharks. The two NPOAs applicable to deepwater fisheries are:

1. **NPOA-Sharks 2022**

   New Zealand's first NPOA-Sharks was in 2008 and the most recent one was NPOA-Sharks 2013. The 2013 NPOA has been reviewed and the NPOA-Sharks 2022 has been consulted on and a draft NPOA circulated. The final NPOA-Sharks 2022 is imminent.

   The review of NPOA-Sharks 2013 identified that overall, there has been good progress was made on implementing the NPOA-Sharks 2013. A major achievement since the release of the

NPOA was the elimination of shark finning – the removal of fins from the shark and returning the carcass to the sea (either dead or alive). Since 2014, it has been illegal for fishers to remove fins from sharks and then discard the bodies into the sea.

The specific feedback on Objective 2.4 Eliminate shark finning in New Zealand fisheries by 1 October 2015, with one exception shows that the combined approach of; (a) fins-attached approach, whereby fins must be naturally or artificially attached to the body of the shark; and (b) a ratio approach, whereby retained shark fin weight must be within a specified percentage of shark greenweight, has provided the best balance between eliminating shark finning and minimising disruptions on fishing operations.

The review identified that this pragmatic approach is providing an effective deterrent to shark finning. Prior to the ban, the highest volume of QMS sharks caught and retained were spiny dogfish, school shark, blue shark, elephant fish and rig. Since the ban, there are substantial decreases in retained catch for these species as reported on Monthly Harvest Returns that fishers provide to Fisheries New Zealand (FNZ, 2022b). FNZ's view is that the ban has resulted in stopping the landings of fins alone for rig and school shark, with one or two exceptions across all fisheries that have been identified and addressed).

The NPOA-Sharks 2022 sets out the desired future state for shark conservation and management in New Zealand. Underpinning this, goals have been developed for a range of areas where improvements in current management arrangements can be achieved, and objectives are aligned to each of the goals.

Table 29 outlines the Management categories and species for New Zealand shark species. Notably a consultation in 2022 sought to amend aspects of shark fin management measures ('fins artificially attached' approach) in order to allow changes to the species subject to this approach to be implemented via circular rather than regulation. This was a recognition in the Discussion document: Proposed technical amendments to fisheries regulations and Summary of proposed technical amendments to fisheries regulations that an administrative change was needed to reduce the resource intensive and time-consuming nature of extending or changing the species covered by the fins artificially attached approach.

The Deepwater Group's (DWG) Sharks Operational Procedures provide the deepwater fleet with guidance on processes to minimise harm to protected shark species and maximise their chance of survival on return to the sea.

2. NPOA-Seabirds

New Zealand's first NPOA was published in 2004 and a revised NPOA-Seabirds published in 2013. The NPOA Seabirds 2020 is New Zealand's third iteration of a national plan of action

The NPOA Seabirds 2020's vision is *New Zealanders work towards zero fishing-related seabird mortalities*. Its four goals are:

- Avoiding bycatch — effective bycatch mitigation practices are implemented in New Zealand fisheries.
- Healthy seabird populations — direct effects of New Zealand fishing do not threaten seabird populations or their recovery.
- Research and information — information to effectively manage direct fisheries effects on seabirds is continuously improved.
- International engagement — New Zealand actively engages internationally to promote measures and practices that reduce impacts on New Zealand seabirds.

Table 29: Management categories and species in each category (including species listed on Schedule 6 of the Fisheries Act) (FNZ, 2022)

Protected	Schedule 4C	Quota Management System (QMS)	Open Access (species not included in QMS or on Schedule 4C)
(species for which utilisation is not considered appropriate)	(may not be targeted)		
Basking shark (*Cetorhinus maximus*)	Hammerhead shark (*Sphyrna zygaena*)	Spiny dogfish (*Squalus acanthias*)*	All others not listed elsewhere on this table
Whale shark (*Rhincodon typus*)	Sharpnose sevengill shark (*Heptranchias perlo*)	Dark ghost shark (*Hydrolagus novaezelandiae*)	
Oceanic whitetip shark (*Carcharhinus longimanus*)		Pale ghost shark (*H. bemisi*)	
White pointer shark (aka white or great white shark; *Carcharodon carcharias*)		Smooth skate (*Dipturus innominatus*)*	
Deepwater nurse shark (*Odontapsis ferox*)		Rough skate (*Dipturus nasutus*)*	
Manta ray (*Manta birostris*)		School shark (*Galeorhinus galeus*)*	
Spinetail devil ray (*Mobula japanica*)		Elephantfish (*Callorhinchus milii*)	
		Rig (spotted dogfish; *Mustelus lenticulatus*)*	
		Mako shark (*Isurus oxyrinchus*)*	
		Porbeagle shark (*Lamna nasus*)*	
		Blue shark (*Prionace glauca*)*	

** Species listed on Schedule 6 of the Fisheries Act 1996. With some exceptions, all catches of QMS species must be landed. One specific exception is for species that are listed on the 6th Schedule of the Fisheries Act, which may be returned to the sea*

Research plans

Research needs for deepwater fisheries are driven by the objectives of the National Fisheries Plan for Deepwater Fisheries and delivered through the Medium-Term Research Plan for deepwater fisheries (MTRP), (FNZ, 2020d). The MTRP provides a five-year schedule of science and monitoring projects (e.g., biomass surveys and stock assessments), required to support the sustainable management of deepwater fisheries.

All research projects are reviewed by FNZ's Science Working Groups and assessed against FNZ's Research and Science Information Standard for New Zealand Fisheries (MFish, 2011) and the Harvest Strategy Standard (MPI, 2008).

FNZ's Annual Operational Plan for Deepwater Fisheries 2021/22 (Tables 8-11 and 16) provides FNZ and DOC research projects to be undertaken during 2020-21 that relate to deep water species (FNZ, 2021). FNZ's NPOA Seabirds 2020 – Implementation Plan outlines the seabird risk assessment, monitoring and mitigation projects to be undertaken from 2020 to 2024 (FNZ, 2020a).

A comprehensive review of progress achieved against aquatic environment-related research projects and environmental objectives is undertaken by FNZ annually (FNZ, 2022b).

There are three deepwater and middle-depth wide-area trawl surveys which cover the three main deepwater fishing grounds: Chatham Rise, Sub-Antarctic, and the West Coast of the South Island (WCSI). The surveys are optimised to provide information on relevant Tier 1 middle-depth fish stocks, but also provide valuable information on a range of Tier 2 and non-QMS species, including data that informs risk assessments for sharks, and important ecosystem data (e.g. sea temperature, stomach sampling) in these key fishery areas (Table 30 and Table 31) (FNZ, 2021). In addition, HOK focussed acoustic surveys are carried out in the Cook Strait and Pegasus every two years.

For HOK stock assessments are completed annually whilst Hake are currently assessed on a three-year cycle (Table 32). HAK 4 is the exception as a stock assessment is only completed when the catch meets threshold values of a catch greater than 360 tonnes for two consecutive years of a catch of greater than 720 tonnes in a single year.

For LIN the key stocks are assessed on a three-year cycle with the exception of LIN 6B which uses a catch threshold greater than 200 tonnes in two consecutive years to trigger consideration for an assessment. Recent LIN 6B catches meant it was due for an assessment in 2020/21 but was deferred to the 2022/23 financial year (Table 33).

Table 30: Wide-area trawl survey schedule by financial year (incl. month of delivery) (FNZ, 2021)

	2021/22	2022/23	2023/24	2024/25	2025/26
Chatham Rise	Jan 2022 (MID2018-01)		Jan 2024 (MID2021-02)		Jan 2026 (MID2021-02)
Sub-Antarctic		Dec 2022 (MID2021-02)		Dec 2024 (MID2021-02)	
WCSI	June/July 2021 (MID2018-01)			June/July 2024 (MID2021-02)	

Table 31: Cook Strait and Pegasus hoki survey schedule (FNZ, 2021)

	2021/22	2022/23	2023/24	2024/25	2025/26
Cook Strait		July/Aug 2023		July/Aug 2025	

Table 32: Hake Assessment schedule (FNZ, 2021)

	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
HAK 1	Assessment			Assessment		
HAK 4			~~Assessment~~			~~Assessment~~
HAK 7		Assessment			Assessment	

Table 33: Ling Assessment schedule (FNZ, 2021)

	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
LIN 3/4		Assessment			Assessment	
LIN 5/6	Assessment			Assessment		
LIN 6B	~~Characterisation~~	~~Characterisation~~	Characterisation			
LIN 7			Assessment			Assessment

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