SEAFOOD NEW ZEALAND
DEEPWATER COUNCIL

HOKI, HAKE & LING TRAWL SITUATION REPORT

PREPARED FOR MSC REASSESSMENT 2024

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SITUATION REPORT FOR THE MSC REASSESSMENT OF 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 information on ten Units of Certification (UoC), for hoki (HOK 1 East & West), hake (HAK 1, 4 & 7), and ling (LIN 3, 4, 5, 6 & 7) trawl fisheries as a basis for reassessment against FS v3.0.

It is Seafood New Zealand Ltd - Deepwater Council's (DWC) submission that these ten fisheries conform to MSC Fisheries Standard FS v3.0 as evidenced in the information and evidence provided below.

All cited references are available here: https://tinyurl.com/HAKHOKLIN

OVERVIEW OF FISHERY MSC CERTIFICATION

Hoki trawl certification details

Certification dates	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) UoC 5: HAK 7 (West Coast South Island), (self-suspended from 2021-2023)
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 UoCs based on the base model runs

Stock	Most recent assessment	Depletion [Year]	P > Target	P < Soft Limit	P < Hard Limit
HOK 1 East	2024	51 (41-62) [2024]	> 90%	< 1%	< 1%
HOK 1 West	2024	41 (34-50) [2024]	40-60%	< 10%	< 1%
HAK 1	2021	62 (50-75) [2021]	> 90%	< 1%	< 1%
HAK 4	2020	55 (46-66) [2020]	> 90%	< 1%	< 1%
HAK 7	2024	39 (23-69) [2024]	40-60%	< 10%	< 10%
LIN 3 & 4	2022	56 (47-66) [2022]	> 90%	< 1%	< 1%
LIN 5 & 6 & 6B	2024	66 (55-78) [2024]	> 99%	< 1%	< 1%
LIN 7WC	2023	55 (38-64) [2023]	> 90%	< 10%	< 1%

Stock status, TACC & catches by component UoCs

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

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

Update on stock status (FNZ, 2023)

HOK 1 East:

- B_{2024} was estimated to be 51% B_0; Very Likely (> 90%) to be above the lower end of the target range.
- B_{2024} is Exceptionally Unlikely (< 1%) to be below both the Soft and Hard Limits.
- The stock projection is that the biomass will remain within or above the target range over the next five years, with current catches or catch limits.

HOK 1 West:

- B_{2024} was estimated to be 41% B_0; About as Likely as Not (40 - 60%) to be above the lower end of the target range.
- B_{2024} 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, with current catches or catch limits and recent recruitment (FNZ, 2024).

TACC & catch trends (FNZ, 2023)

The catch limits and catch trends for the HOK 1E and HOK1 W stocks are provided in Table 2 for the period 2018-19 to 2022-23.

Table 2: Catch limits, ACE, catch and associated balances for the HOK 1E and HOK 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	48,942	60,063	56,494
	Balance	607	4,930	9,798	16,058	11,398	8,558
HOK 1W	Catch limit	90,000	55,000	55,000	45,000	45,000	
	ACE	99,157	55,000	57,141	45,000	45,000	
	Catch	56,953	53,030	46,338	42,767	45,550	48,928
	Balance	42,204	1,970	10,803	2,233	-550	11,332

TACCs and catches for the HOK 1E and HOK 1W stocks combined are illustrated below for the period 1989-90 to 2022-23 (Figure 1).

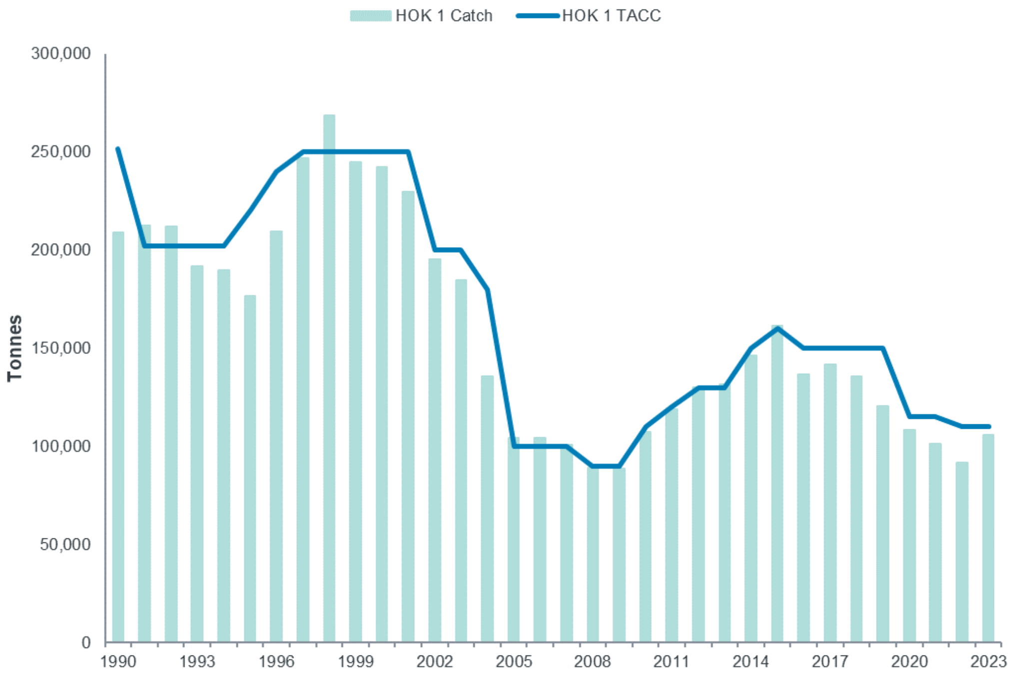
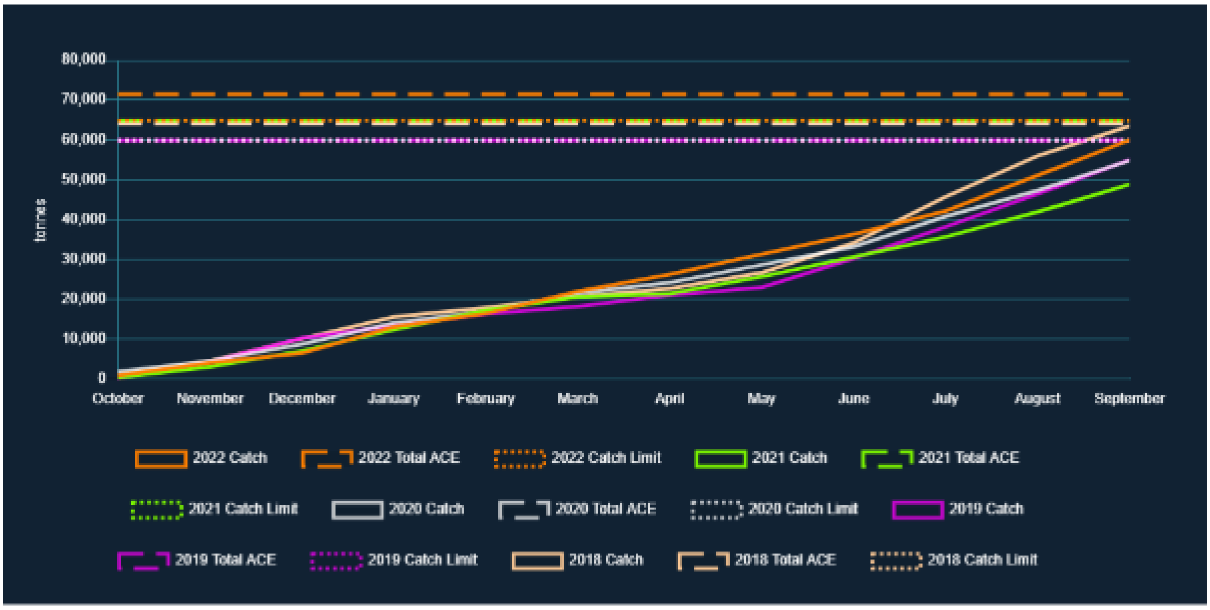


Figure 1: Total Allowable Commercial Catches and reported catches for HOK 1 (East & West combined), 1989-90 to 2022-23 (data source: FishServe KUPE system).

Catch trends by month indicate that HOK 1E catches are taken steadily throughout the year while HOK 1W catches are mainly taken during the spawn in July and August (Figure 2).



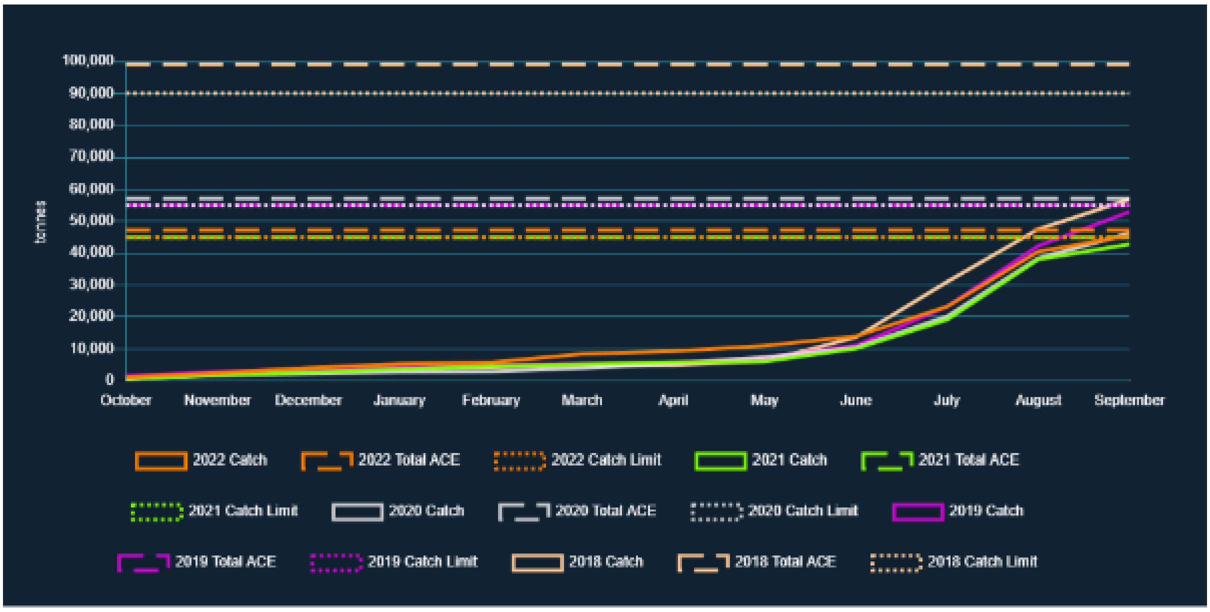


Figure 2: Catch trends and associated total allowable commercial catch for HOK1 East (top) and HOK1 West (bottom), (Source: FishServe KUPE system).

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 30,145 t ACE 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 asking 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, for 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 have been 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 of ACE. 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 5,000 t of HOK 1 E ACE, 5,000 t of HOK 1 W ACE and 1,038 t of under-caught ACE from 2021-22 (DWG, 2021).
- **2023-24 fishing year** - The HOK 1 TACC remained at 110,000 t. Quota owners agreed to fish the full amount, with catch limits of 65,000 t for HOK 1E and 45,000 t for HOK 1W (Table 3).

Table 3: ACE shelving arrangements and adjusted HOK 1E and HOK 1W catch limits (L. Campbell, FishServe, pers. Comm.).

HOK 1	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
TACC	150,000	115,000	115,000	110,000	110,000	110,000
HOK 1E ACE shelved*	-	-	10,043	9,839	5,973	597
HOK 1W ACE shelved*	-	-	9,462	-	5,065	506
HOK 1 ACE shelved*	30,145	-	19,505	9,839	11,055	1,106
HOK 1E agreed limit	60,000	60,000	50,000	55,000	55,000	65,000
HOK 1W agreed limit	70,000	55,000	45,000	45,000	45,000	45,000

*Includes under-caught ACE carried forward from the previous fishing year.

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 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).

The most recent stock assessment in 2024 updated the 2022 and 2023 assessments (McGregor et al., in prep.).

In all model runs, natural mortality (*M*) by sex was assumed to be constant over time, and the same for each stock, with female $M = 0.225\ y^{-1}$ and male $M = 0.30\ y^{-1}$. An alternative model was run with higher M for females match the value used in 2021, 2022, and 2023 assessments. The higher female M value used in the 2024 assessment was selected on the basis of parameter sensitivity analyses and to improve patterns in sex by age class.

The model used 17 selectivity ogives (11 for the eastern and western spawning and non-spawning fisheries and six for the trawl surveys on the Chatham Rise and Sub-Antarctic) and two migration ogives (Chatham Rise to Sub-Antarctic migration, defined separately for males and females).

Prior distributions were assumed for all parameters. Bounds for the acoustic catchability parameters were calculated by O'Driscoll et al (2016) (who called them overall bounds); for YCS, bounds were set at the 0.001 and 0.999 quantiles of their distributions. Prior distributions for all other parameters were assumed to be uniform, with bounds that were wide enough so as not to affect point estimation, or, for some ogive parameters, deliberately set to constrain the ogive to a plausible shape.

The final models, which were taken to MCMC, are summarised in Table 4. Model 1 was considered the base model and was a two-stock model, with the Single Stock model assumed a sensitivity to the assumed stock structure of Model 1.

Table 4: Characteristics for final model runs.

Model	Main assumptions
Model 1	Two spawning stocks, that spawn on the CS and WC. Recruits from both stocks reside on CR as juveniles. Western-spawned fish migrate to SA (estimated ogive; further testing of this parameterisation required). Mature WC-stock fish migrate from SA to WC to spawn and mature CR-stock fish from CR to CS to spawn. After spawning, all mature fish return (WC to SA and CS to CR).
Single Stock	One spawning stock, that spawns on the CS and WC. Recruits from both spawning grounds reside on CR as juveniles. A fixed estimated proportion of fish by sex determined fish that migrate to SA. These fish effectively become 'western stock' fish as they never return to the CR. Mature fish migrate from SA to WC to spawn and similarly from CR to CS to spawn. After spawning, all mature fish return (WC to SA and CS to CR). This

model has one stock but retains spatial, temporal, and fishery structure of the base model.

Due to complications in calculating fishing intensity (U) when there are multiple fisheries and stocks, a simplified version was calculated as the catch in biomass divided by the estimated spawning stock biomass (*SSB*). For a given stock and run, the corresponding reference fishing intensities were estimated using the same equation (catch/*SSB*), and by running the model to equilibrium using a range of constant future catch levels, until the stock level at equilibrium was sufficiently close to the stock level reference point.

The 2024 assessment was conducted in two steps. First, a set of initial model runs was carried out to generate point estimates (which estimate the Mode of the Posterior Distribution). Their purpose was to investigate model structure and assumptions to decide which runs to carry forward as final runs. The final runs used MCMC parameter estimation.

Deterministic B_{MSY} estimates are no longer calculated, for the following reasons:

1. It assumes a harvest strategy that is unrealistic in that it involves perfect knowledge (current biomass must be known exactly, to calculate the target catch) and annual changes in TACC (which are unlikely to happen in New Zealand and not desirable for most stakeholders).
2. It assumes perfect knowledge of the stock-recruitment relationship, which is very poorly known (Francis 2009).
3. The closeness of B_{MSY} to the soft limit permits the limit to be breached too easily and too frequently, given, for example, a limited period of low recruitment.
4. It would be very difficult with such a low biomass target to avoid the biomass occasionally falling below 20% B_0, the default soft limit according to the Harvest Strategy Standard.

Instead, the target range of 35% B_0 to 50% B_0 is used as a proxy for the likely range of credible B_{MSY} estimates.

Model estimates are presented below for the spawning stock biomass (Table 5), fishing intensity (Figure 3), and biomass trajectories with projections (Figure 4).

Table 5: Estimates of spawning biomass ('000 tonnes) (medians of marginal posterior, with 95% confidence intervals in parentheses). B_{2024} is the biomass in mid-season 2024.

Model	Stock	B_0 ('000t)	B_{2024} ('000t)	B_{2024}/B_0
Model 1	East	696 205 (651 674, 742 884)	352 360 (268 881, 458 535)	0.51 (0.41, 0.62)
	West	1 197 680 (1 152 560, 1 250 742)	496 218 (392 378, 627 620)	0.41 (0.34, 0.50)
	Total	1 893 885 (1 804 234, 1 993 626)	852 671 (723 171, 999 497)	0.45 (0.40, 0.50)
Single Stock	Total	1 957 150 (1 902 730, 2 019 785)	893 634 (760 744, 1 050 893)	0.46 (0.40, 0.52)

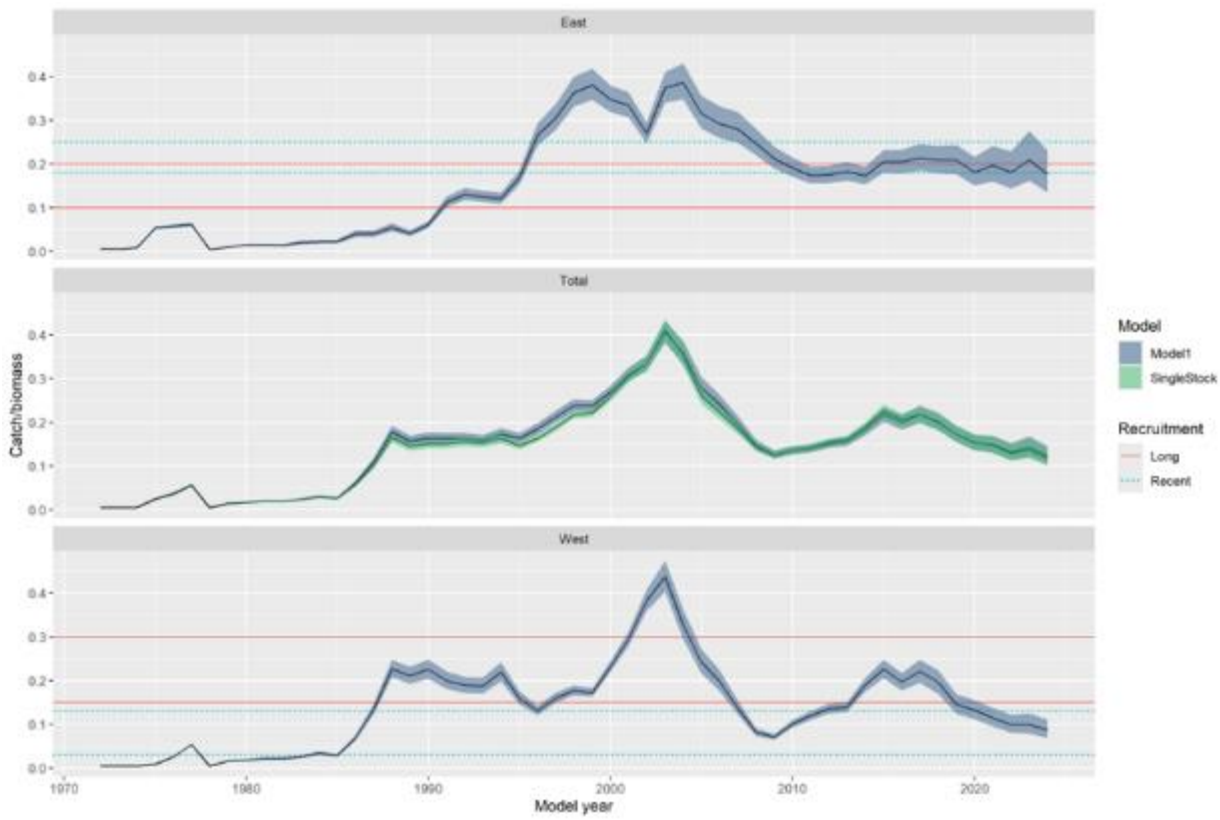


Figure 3: Fishing intensities, *U* (from MCMCs) for Model 1 (blue) and Single Stock (green), plotted by stock. Shown are medians (solid black line) with 95% confidence intervals (shaded area). Also shown with horizontal lines is the management range where the upper bound is the reference level $U_{35\%B_0}$ and the lower bound $U_{50\%B_0}$ which are the fishing intensities that would cause the spawning biomass to tend to 35% B_0 and 50% B_0, respectively, under recent recruitment (dashed) or long-term recruitment (solid). Reference *U* values were estimated in the 2022 assessment. Biomass is spawning stock biomass (SSB), (FNZ, 2024).

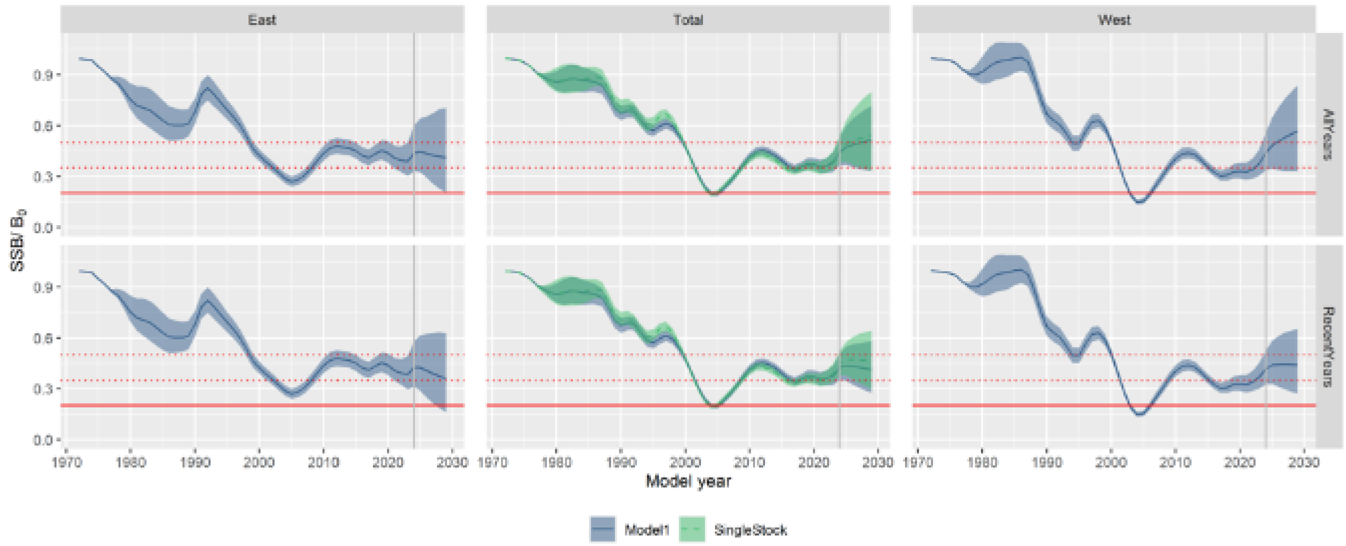


Figure 4: Projected spawning biomass (as % B_0) from Model 1 (blue) and Single Stock (green) under two recruitment scenarios: recent (2010–2019 (Model 1) 2010–2020 (Single Stock) (bottom); long-term (1975–2019 (Model 1) 1975–2020 (Single Stock) (top), for eastern stock (left), total (middle), and western stock (right), with catches assumed at the current TACC (110 000 tonnes). The horizontal dotted red lines represent the target management range of 35–50% B_0. The horizontal solid red line shows 20% B_0. Shaded areas give 95% CIs, and central line gives median SSB/B_0, (FNZ, 2024).

The assessed trajectories of fishing intensity and relative spawning biomass from 1972 to 2024 are illustrated below for the East stock (top) and West stock (bottom) (Figure 5) (FNZ, 2024).

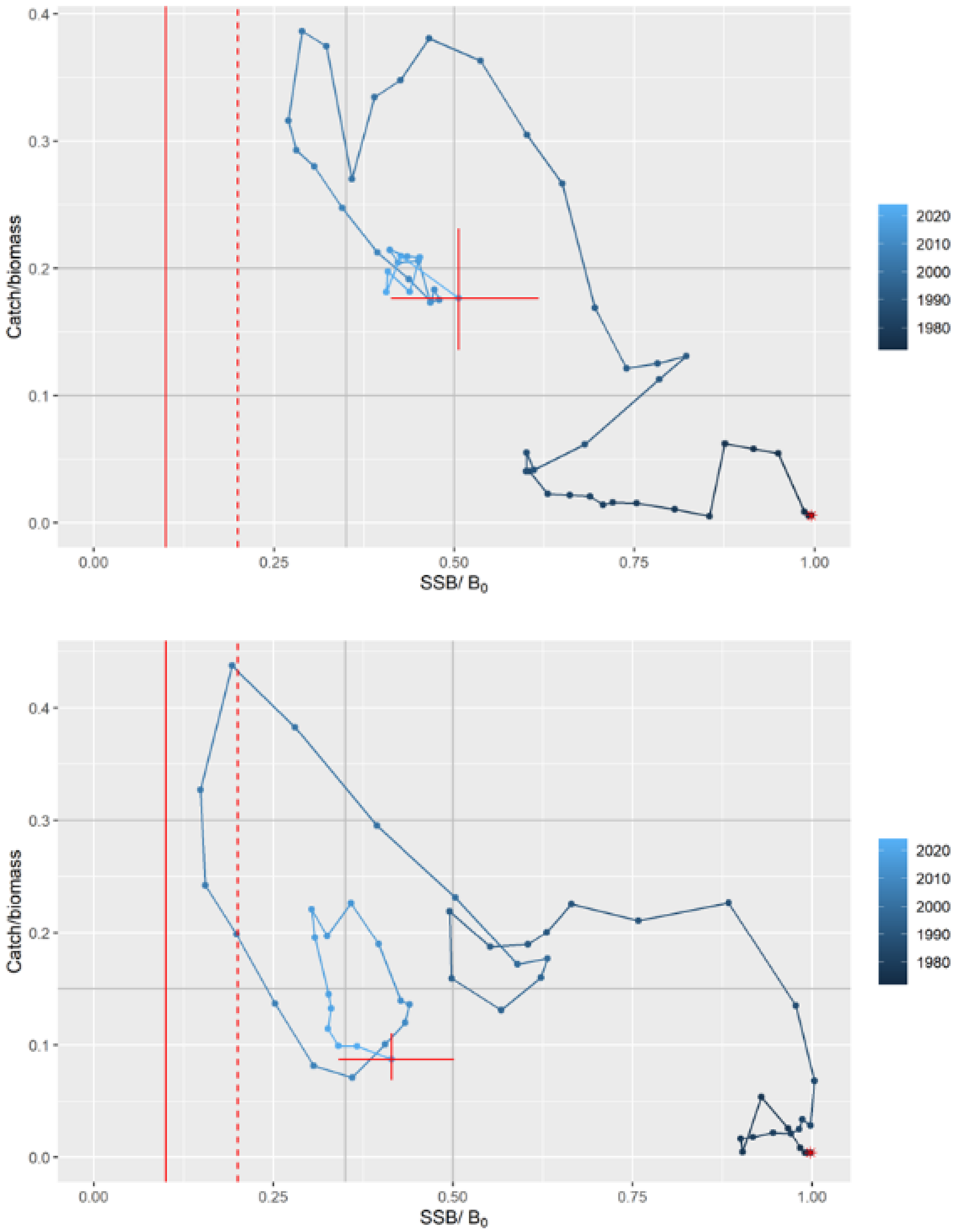


Figure 5: Trajectories over time of fishing intensity (U) and relative spawning biomass (SSB/SSB0), for the eastern hoki stock (top) and western hoki stock (bottom) from the start of the assessment period in 1972 (represented by a red asterisk) to 2024 (centre of red cross). The red solid vertical line 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 2022 assessment using long-term recruitment. Biomass and fishing intensity estimates are medians from MCMC results. Red cross represents 95% CIs for 2024 (FNZ, 2024).

Fishery independent surveys

- **Cook Strait** – the acoustic abundance index in 2023 was the lowest on record, at 58 000 t, down from 159 000 t in 2021, (FNZ, 2024).
- **Pegasus Canyon** – the acoustic abundance index in 2023 of 103 000 t was similar to that of 2021 (102 000 t), (FNZ, 2024).
- **West Coast South Island** – the trawl and acoustic abundance index in 2018 was the lowest in the time series at 123 000 t, down 47% on 2013 (FNZ, 2024).
- **Chatham Rise** - the trawl abundance index in January 2024 at 94 000 t was 5% higher than that in 2022 (89 000 t), relative biomass of recruited hoki (ages 3+ years and older) increased by 18% from that in 2022, although there was an average estimate for 2+ hoki (2021 year class), (FNZ, 2024).
- **Sub-Antarctic** - the trawl abundance index of 48 000 t in December 2023 was 55% higher than in 2021 (31 000 t), and was the highest since 2013 (FNZ, 2024).

UoC 3, 4 and 5 – HAK 1, HAK 4 and HAK 7 Trawl

	HAK 1	HAK 4	HAK 7
UoA share of TACC	100 %	100 %	100%
UoC share of TACC	94 %	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), B2020 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.

HAK 7:

- HAK 7 (West Coast South Island): B2024 was estimated to be 39% B0; About as Likely as Not (40-60%) to be at or above the target.
- B2024 was Very Unlikely (< 10%) to be below the Soft Limit and Very Unlikely (< 10%) to be below the Hard Limit.

Note: Management Strategy Evaluations and associated Harvest Control Rules are currently under development for HAK 1, HAK 4 & HAK 7 (Dunne, in prep.).

TACC & catch trends (FNZ, 2023)

Table 6, Figure 6, Figure 7, Figure 8, Figure 9, Figure 10 and Figure 11 show the TACC and catch trends for HAK 1, 4 & 7.

Table 6: TACC, catch limits, catch and associated balances for the HAK 1, 4 and 7 fisheries from 2018-19 to 2022-23. (data source: FishServe)

Stock	TACC	2018-19	2019-20	2020-21	2021-22	2022-23	5-year average
HAK 1	TACC	3,701	3,701	3,701	3,701	3,701	
	ACE	4,109	4,110	4,109	4,111	4,110	
	Catch	896	1,062	1,503	1,692	1,083	1,247
	Balance	3,213	3,048	2,606	2,419	3,027	2,863
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	124	158
	Balance	1,817	1,862	1,791	1,861	1,874	1,841

HAK 7	TACC	5,064	2,272	2,272	2,272	2,272	
	ACE	5,534	2,272	2,456	2,514	2,494	
	Catch	1,563	2,063	1,368	1,325	1,696	1,603
	Balance	3,971	209	1,088	1,189	798	1,451

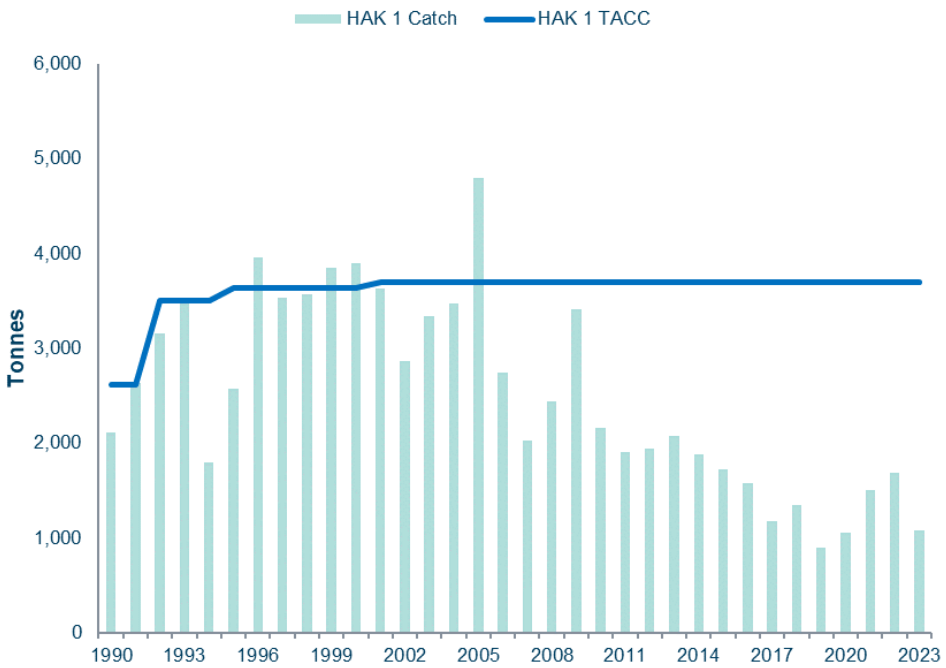


Figure 6: Total Allowable Commercial Catches and reported catches for HAK 1 (data source: FishServe KUPE system).

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.

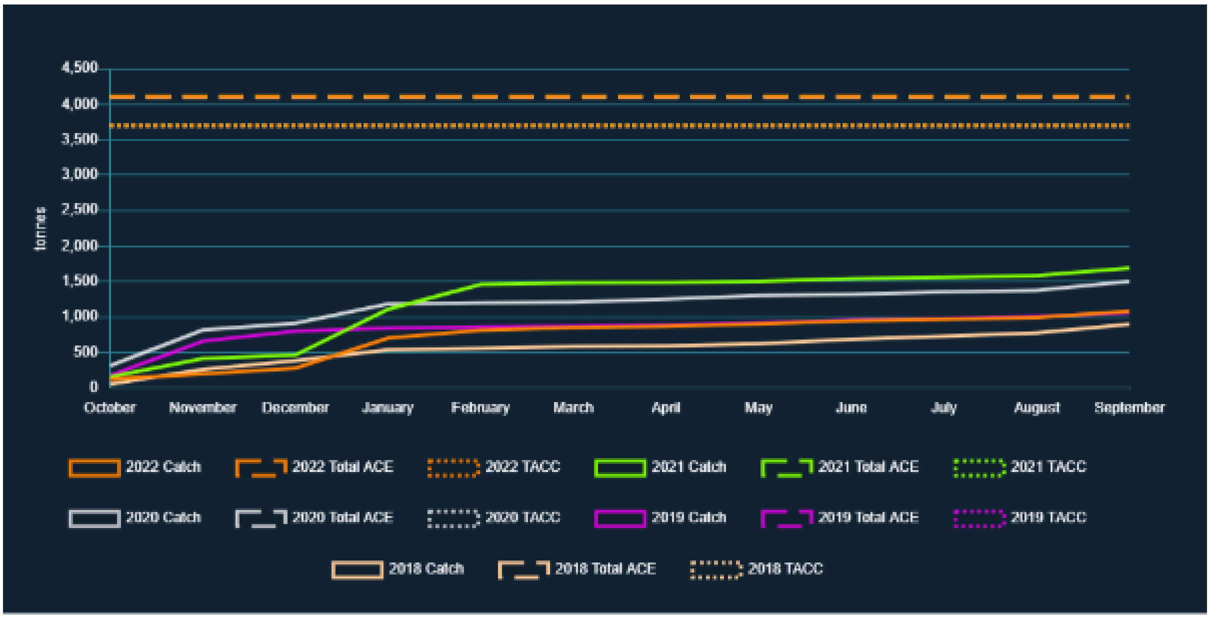


Figure 7: Reported commercial landings, total ACE and TACC for HAK 1 for fishing years 2018 – 2022. (Source: FishServe KUPE system)

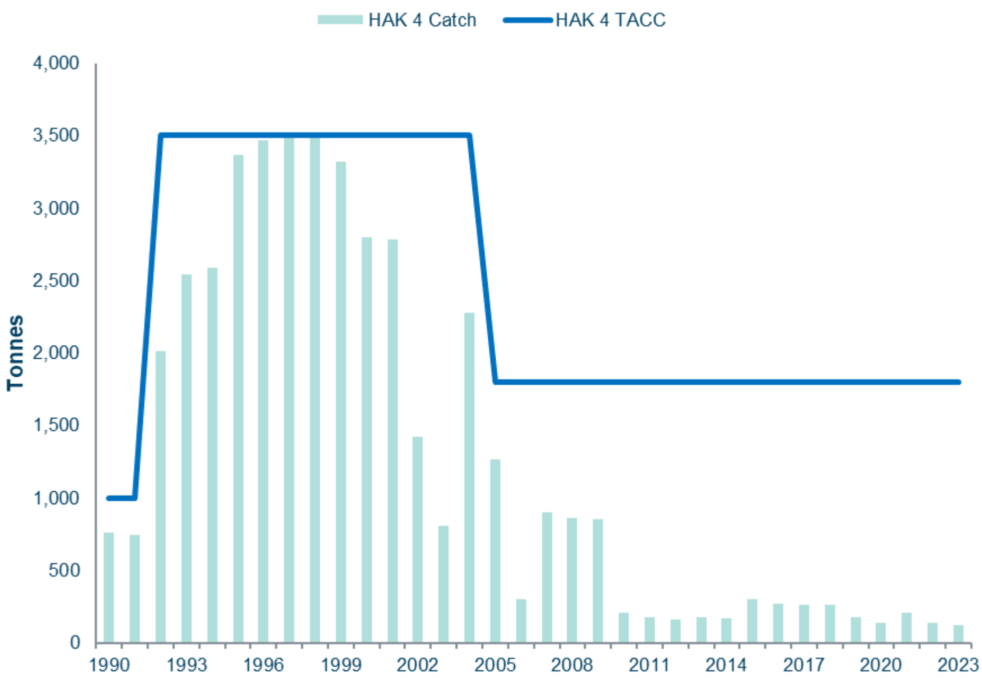


Figure 8: Total Allowable Commercial Catches and reported catches for HAK 4 (data source: FishServe KUPE system).

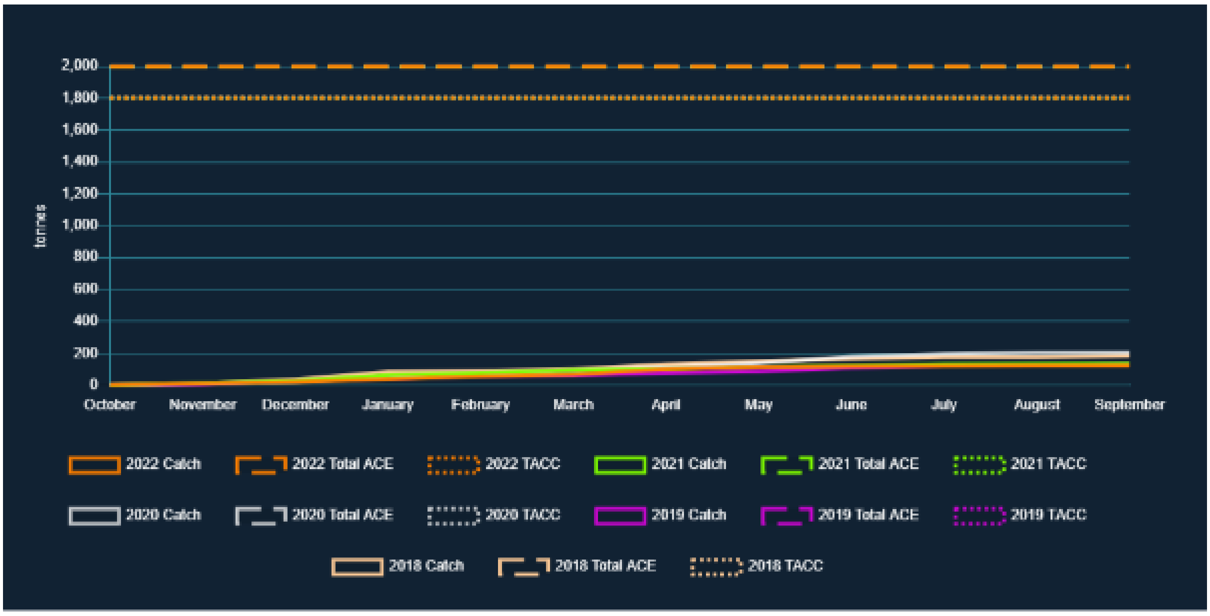


Figure 9: Reported commercial landings, total ACE and TACC for HAK 4 for fishing years 2018 – 2022. (Source: FishServe KUPE system)

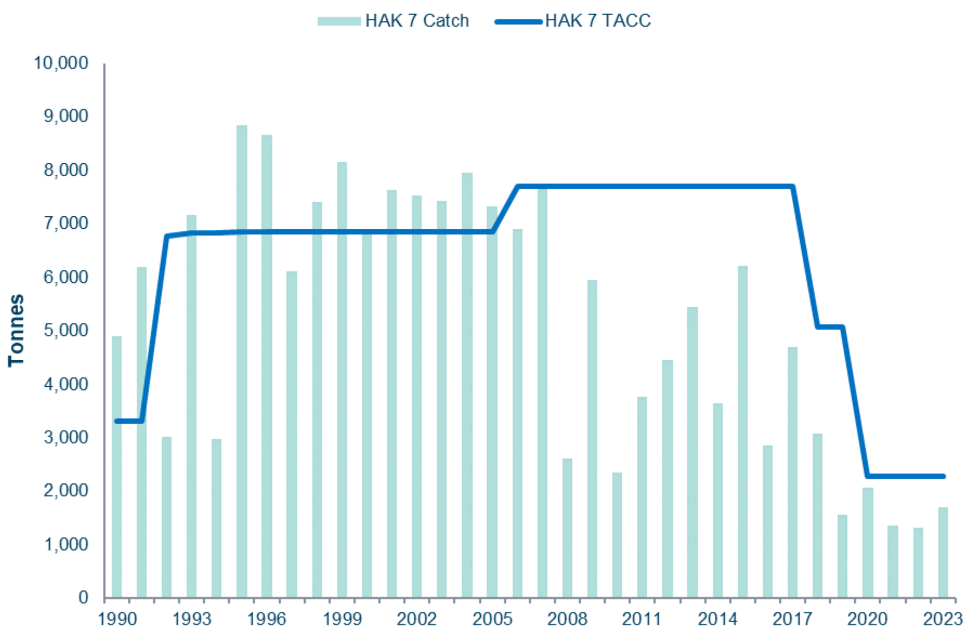


Figure 10: Total Allowable Commercial Catches and reported catches for HAK 7 (data source: FishServe KUPE system).

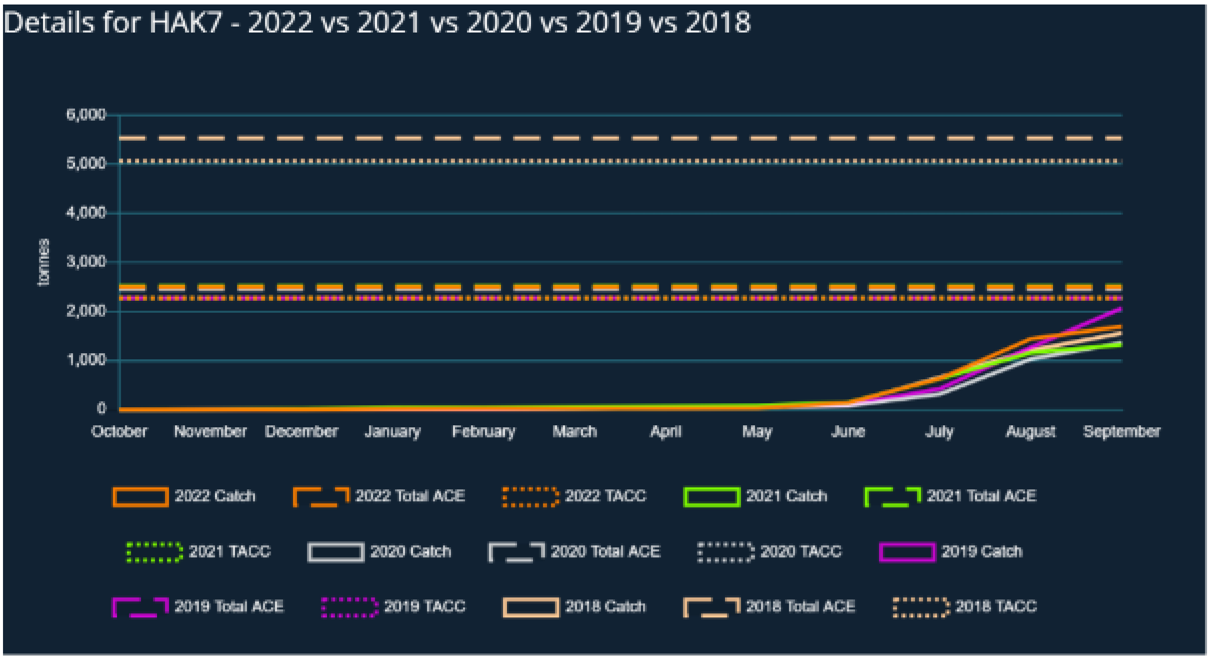


Figure 11: Reported commercial landings, total ACE and TACC for HAK 7 for fishing years 2018 – 2022. (Source: FishServe KUPE system)

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 used.

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 12, Table 7 and Table 8). 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 13). 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.

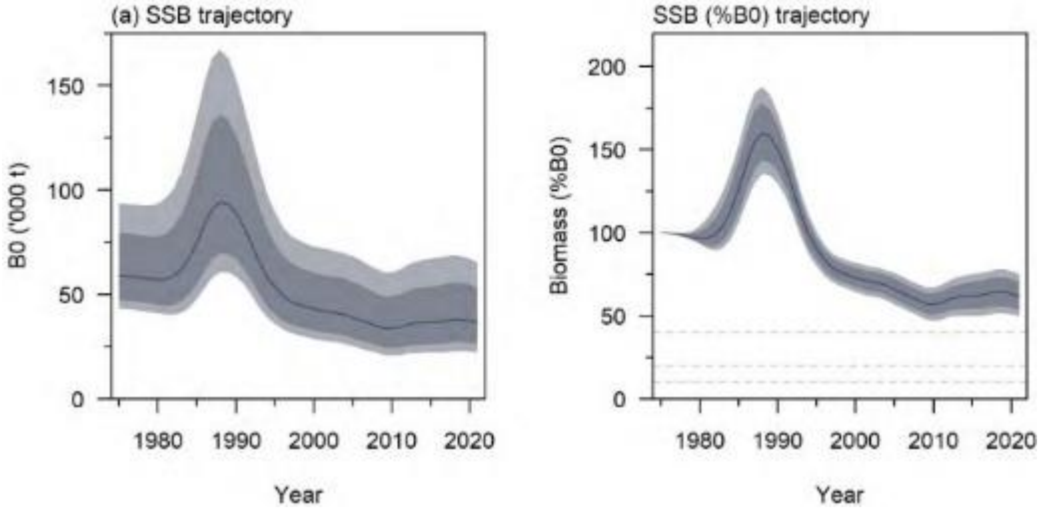


Figure 12 Reference model MCMC trajectories for absolute spawning stock biomass and spawning stock biomass as a percentage of B0. Dark shaded areas represent the 80% CIs, and light shaded areas the 95% CIs. The management target (40% B0, upper dotted horizontal line), soft limit (20% B0, middle dotted horizontal line), and hard limit (10% B0, lower dotted horizontal line) are shown on the right-hand panel. (Source: FNZ, 2023)

Table 7 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 8 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

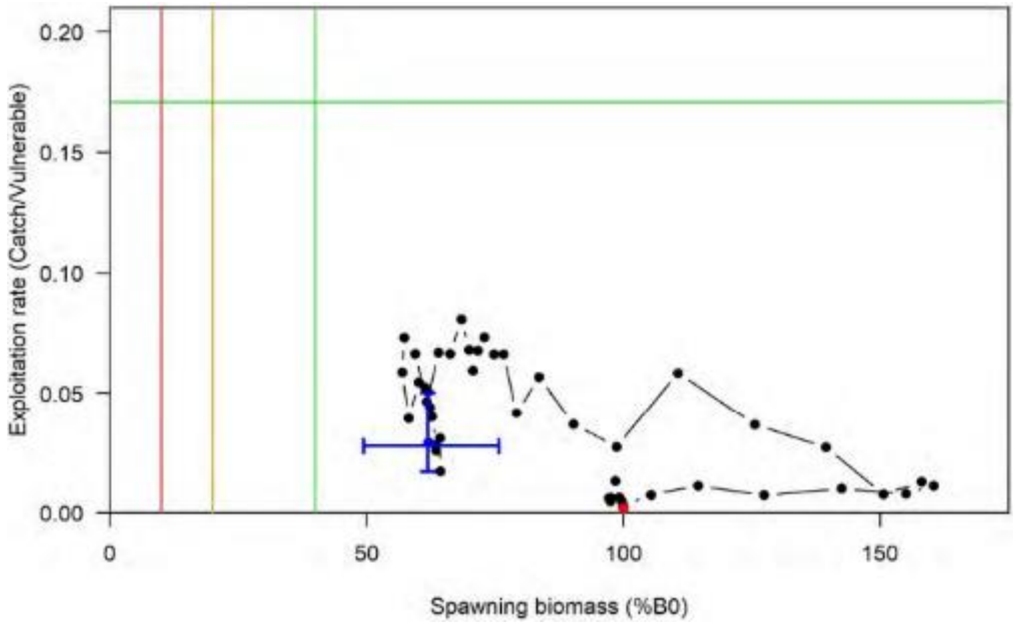


Figure 13 Trajectory over time of exploitation rate (U) and spawning biomass (%B0), for the Sub-Antarctic stock reference model from the start of the assessment period in 1974 (represented by a red point), to 2021 (blue cross). The red vertical line at 10% B0 represents the hard limit, the orange line 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 results. (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 14). 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.

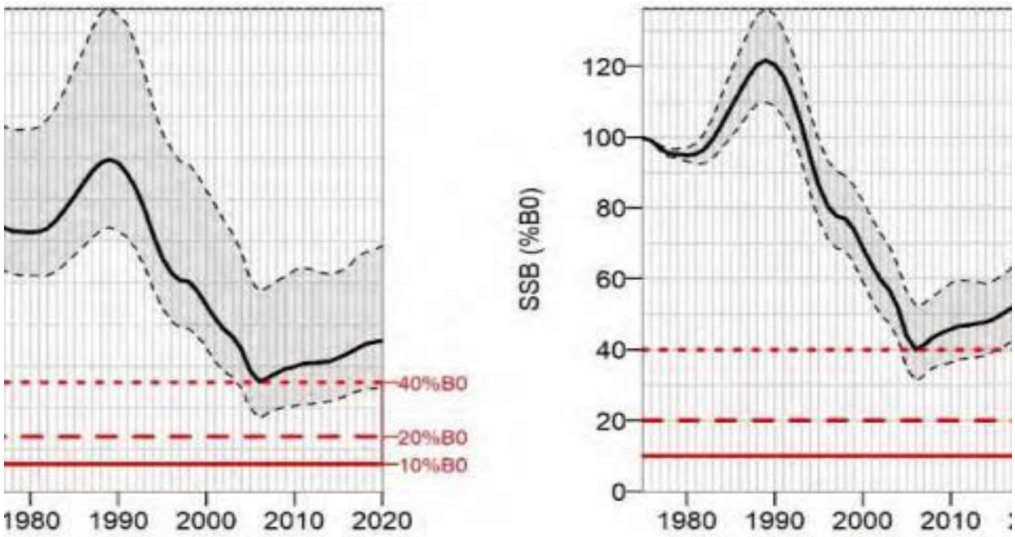


Figure 14: Estimated median trajectories (with 95% credible intervals shown as dashed lines) for the Chatham Rise base case model for absolute biomass and stock status (biomass as a percentage of B0) (Source: FNZ, 2023)

The historical stock status trajectory and current status are illustrated below (Figure 15).

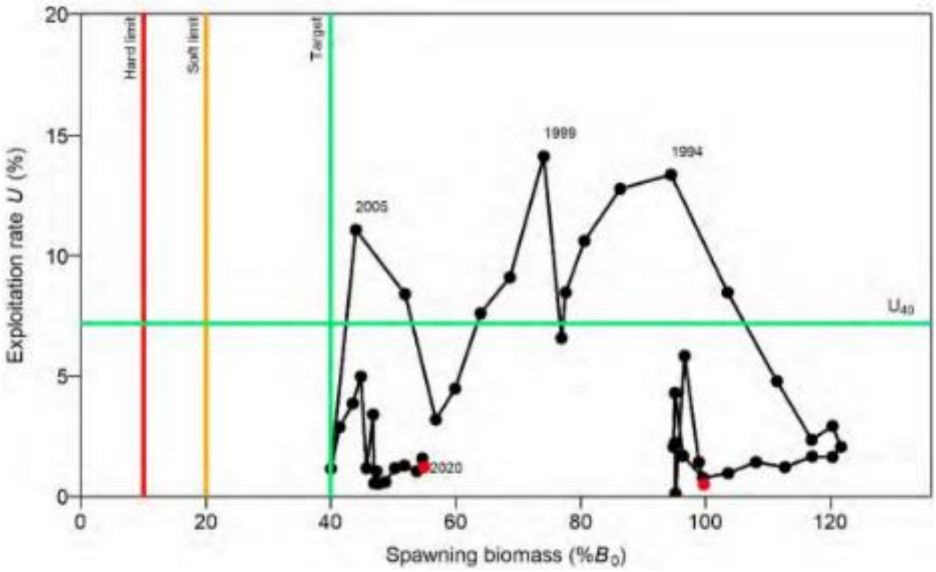


Figure 15: Trajectory over time of exploitation rate (U) and spawning biomass (% B0), for the HAK 4 stock base model from the start of the assessment period in 1975 (represented by a red point), to 2020 (red and labelled). The red vertical line at 10% B0 represents the hard limit, the orange line at 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)

HAK 7 (West Coast South Island stock)

The HAK 7 stock assessment was revised in 2023 (Dunn et al., 2023) and updated in 2024 (Dunn, in prep.) with an additional year's catch and commercial age composition data. While historical assessments used standardised Catch Per Unit Effort (CPUE) as an index of abundance (Dunn 1998), more recent assessments did not use CPUE because it was not considered to be a reliable index of abundance. Research survey data from the deepwater west coast South Island survey by the

RV *Tangaroa* collected over the period 2000–2021 (Table 18) showed that the trends in abundance from CPUE and the survey had diverged to the point that they could not be reconciled within a single stock assessment model (Horn 2017). The 2024 assessment used only the survey indices and modelled the fishery from 1974–75 to 2023–24, using catches and catch age composition data from the commercial trawl fishery and the *Tangaroa* research survey biomass indices and age composition data for the core strata (300–650 m) from 2000 to 2021.

Due to variable estimates in the numbers of hake of length less than about 67 cm in both the *Tangaroa* research survey and commercial length frequency data, ages for hake of less than 5 years were excluded from the commercial catch-at-age data, and the survey biomass and age data used in the model. Analyses showed that the amount of catch associated with these size classes was low, made up a negligible proportion of the total catch, and did not appear represent a consistent index of juvenile hake in either the *Tangaroa* research survey or the commercial catch data over time.

The base case stock assessment model estimated spawning stock biomass declined throughout the late 1970s when there were relatively high catch levels. The biomass then increased through the mid-1980s, after which it steadily declined to a low point in 2018–19 because of the higher levels of exploitation and below-average recruitment between 2000–01 and 2014–15 (Figure 16). The stock followed the general trend shown by the trawl survey index.

The sensitivity models produced similar trends in the biomass trajectory and in the pattern of year class strength. The base case model estimated the status in the lowest year (2018–19) to be 21.0% B_0 (95% CIs 16–30%) of initial biomass (B_0), and the current status (2024) to be 47% B_0 (95% CIs 35–67%). Assuming recent year classes were the same as for the period from 2007-16 (the most recent 10-years estimated), gave a lower estimate of current stock status (2024) to be 39 % B_0 (95% CIs 23–69%), (FNZ, 2024).

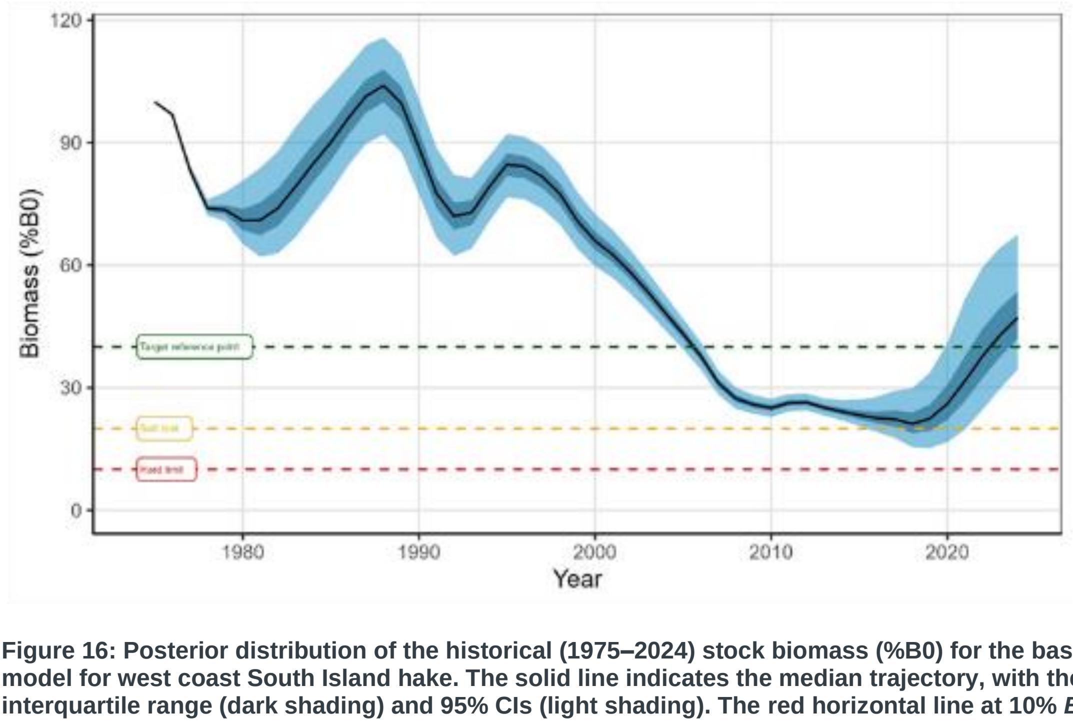


Figure 16: Posterior distribution of the historical (1975–2024) stock biomass (%B0) for the base case model for west coast South Island hake. The solid line indicates the median trajectory, with the interquartile range (dark shading) and 95% CIs (light shading). The red horizontal line at 10% B_0 represents 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).

Projections with the base case model using the 2007–2016 recruitment series indicated that spawning biomass will continue to rebuild towards the target biomass for both the current catch and if catches were at the TACC. The projected stock status in relation to the limits and target are presented below (Table **9**).

Table 9: Estimates of B_{2024} (t and as a percent of B_0) and 95% credible intervals (95% CIs) for the estimated projected status (B_{2027} in tonnes and as a percent of B_0) for 2024 and 2027 for the base case model (R2.4) for west coast South Island hake, with assumption of future recruitment either equal to the average over all years (1975–2016), the most recent 10 years (2007–2016), and assuming future catch equals either mean of the most recent 3 years catch (1462 t) or the TACC (2272 t). YCS is year class strength.

Future catch (t)	Future YCS	B_{2024}		B_{2027}	B_{2027} (% B_0)
1462	1975–2016	35 269 (19 894–59 276)	46.7 (27.3–74.5)	43 810 (25 404–69 521)	57.9 (34.6–88.6)
1462	2007–2016	29 698 (16 314–56 044)	39.3 (22.7–69.5)	33 104 (19 033–60 728)	44.0 (25.9–75.4)
2772	1975–2016	35 269 (19 894–59 276)	46.7 (27.3–74.5)	42 082 (23 694–67 789)	55.6 (32.3–86.4)
2772	2007–2016	29 698 (16 314–56 044)	39.3 (22.7–69.5)	31 379 (17 303–59 010)	41.7 (23.5–73.3)

The historical stock status trajectory and current status are illustrated below (Figure 17).

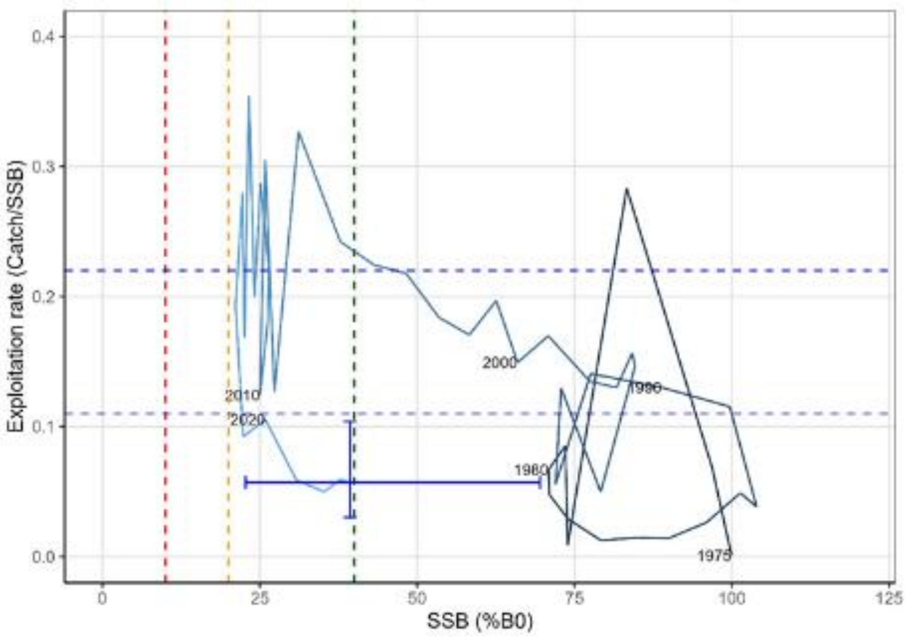


Figure 17: Trajectory over time of exploitation rate (*U*) and spawning biomass (% B_0), for the HAK 7 base case model, from the start of the assessment period in 1975 (represented by a yellow point), to 2024. The red vertical line at 10% SSB_0 represents the hard limit, the orange line at 20% SSB_0 is the soft limit, and green lines are the %SSB_0 target (40% SSB_0) and the corresponding exploitation rate $U_{ssb\ 40\%B0}$=0.22 based on all YCS (dark blue dashed horizontal line) and $U_{ssb\ 40\%B0}$=0.11 based on the most recent estimated 10-years YCS (light blue dashed horizontal line). Biomass and exploitation rate estimates are medians from MCMC results.

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

	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]	87 %[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 56% B_0
- Very Likely (> 90%) to be above the management target of 40% B_0 (base case run)
- B_{2022} is Exceptionally Unlikely (< 1%) to be below the Soft Limit and Hard Limits.
- The stock projection is that the biomass will remain within the target range over the next five years.

LIN 5 & 6 & 6B (i.e. including Bounty Plateau):

- LIN 5 & 6 & 6B (Sub-Antarctic incl. Bounty Plateau): B_{2024} was estimated to be 66% B_0
- Virtually Certain (>99%) to be above the target of 40% B_0
- B_{2024} is Exceptionally Unlikely (< 1%) to be below the Soft and Hard Limits.
- Stock status is unlikely to change over the next 5 years at recent catch levels (9 317 t) and to reduce at the level of the TACC (13 713 t), but remain well above the target.

LIN 7:

- Three alternative model runs were presented, with B_{2023} estimated to be about 55% B_0, Very Likely (>90%) to be at or above the management target of 40%B_0.
- B_{2023} is Very Unlikely (< 10%) to be below the Soft Limit and Exceptionally Unlikely (< 1%) to be below the Hard Limit.
- Stock status is declining but Very Likely (> 90%) to remain above the target over the next 5 years at the current catch levels.

TACC & catch trends (FNZ, 2023)

The catch limits and catch trends for the LIN 3, LIN 4, LIN 5, LIN 6 & LIN 7 stocks are provided in Table 10 for the period 2018-19 to 2022-23.

Table 10: TACC, catch limits, catch and associated balances for the LIN fisheries 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	1,366	1,546
	Balance	88	456	763	1,077	898	656
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	1,892	2,089
	Balance	2,557	2,813	2,523	2,022	2,727	2,528
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	4,949	5,049	4,906	4,836
	Balance	210	266	49	208	510	249
LIN 6	TACC	8,505	8,505	8,505	8,505	8,505	
	ACE	9,420	9,419	9,399	9,370	9,389	
	Catch	3,706	3,972	3,916	3,881	4,780	4,051
	Balance	5,714	5,447	5,483	5,489	4,609	5,348
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	3,540	3,290
	Balance	59	230	308	370	200	233

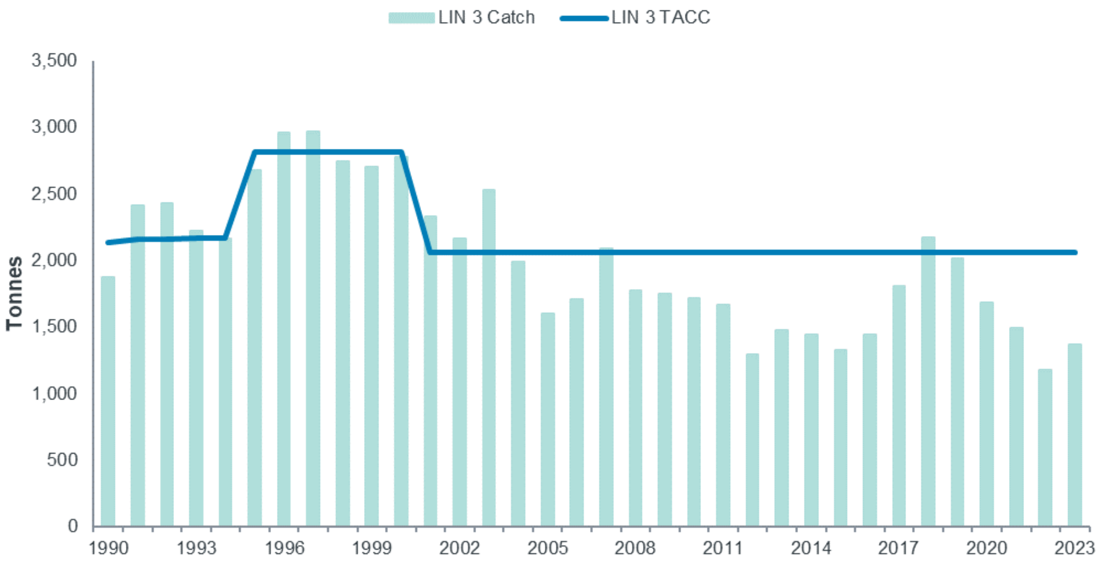


Figure 18: TACCs and reported catches for LIN 3 (all gear types) (FNZ, 2024).

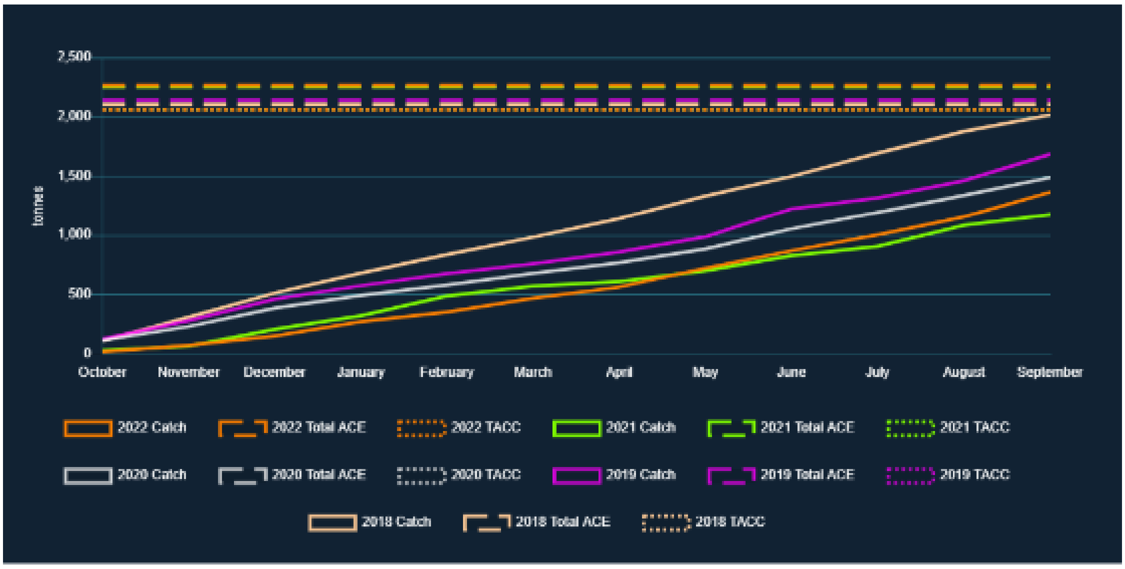


Figure 19: Reported commercial landings, total ACE and TACC for LIN 3 for fishing years 2018 – 2023. (Source: FishServe KUPE system)

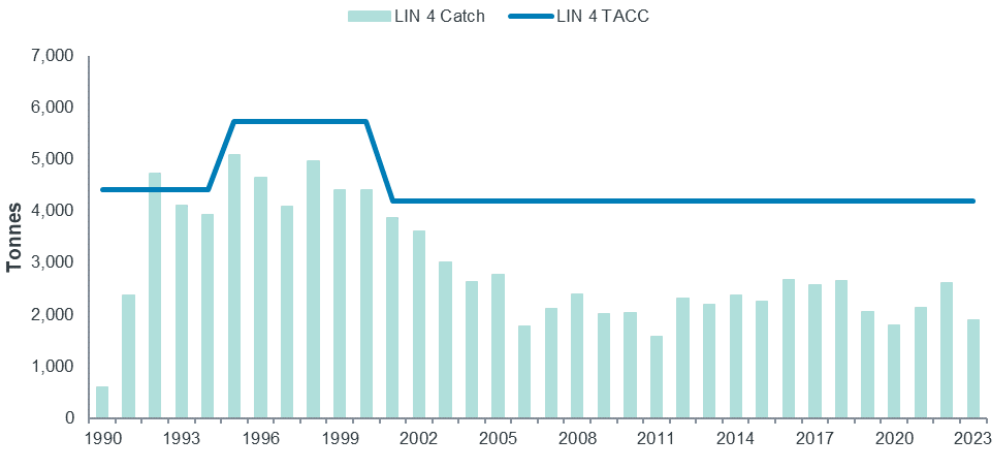


Figure 20: Total Allowable Commercial Catches and reported catches for LIN 4 (all gear types). Note: The LIN 4 trawl catch is largely a bycatch in the much larger eastern hoki trawl fishery and catch trends are therefore subject to forces other than ling abundance (FNZ, 2024).

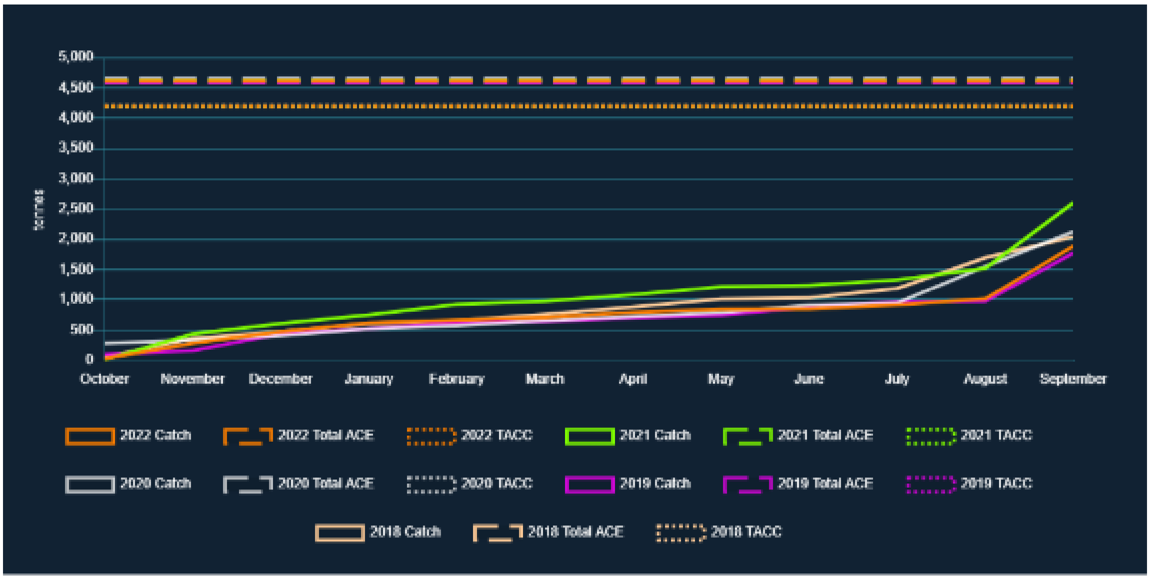


Figure 21: Reported commercial landings, total ACE and TACC for LIN 4 for fishing years 2018 – 2023. (Source: FishServe KUPE system)

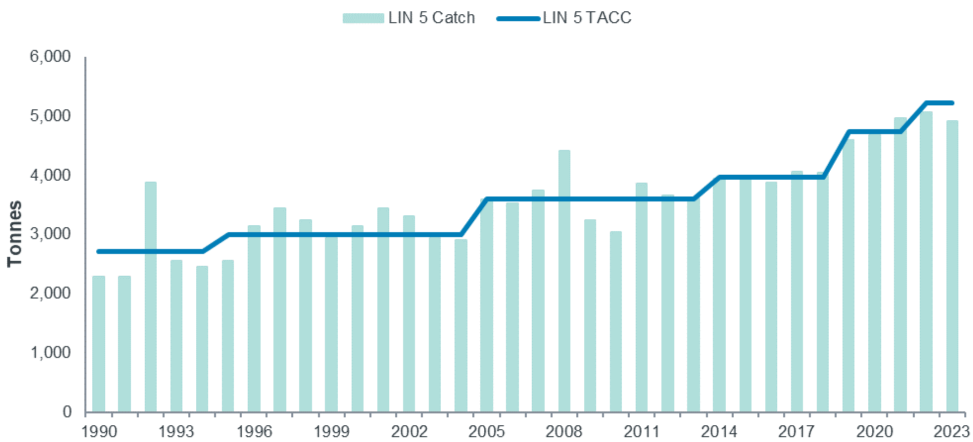


Figure 22: Total Allowable Commercial Catches and reported catches for LIN 5 (all gear types) (FNZ, 2024).

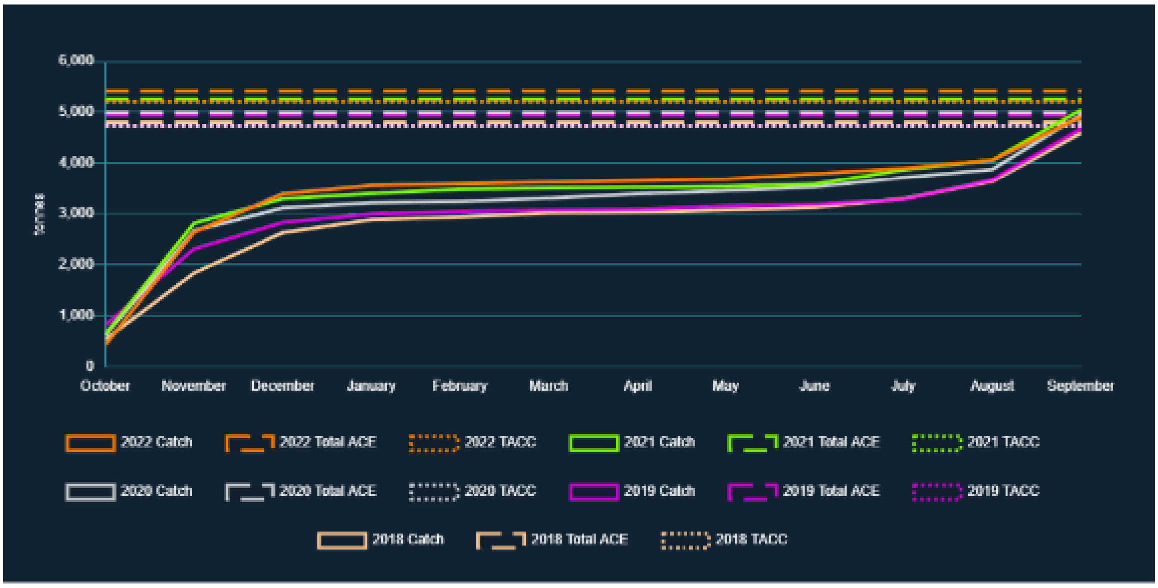


Figure 23: Reported commercial landings, total ACE and TACC for LIN 5 for fishing years 2018 – 2023. (Source: FishServe KUPE system).

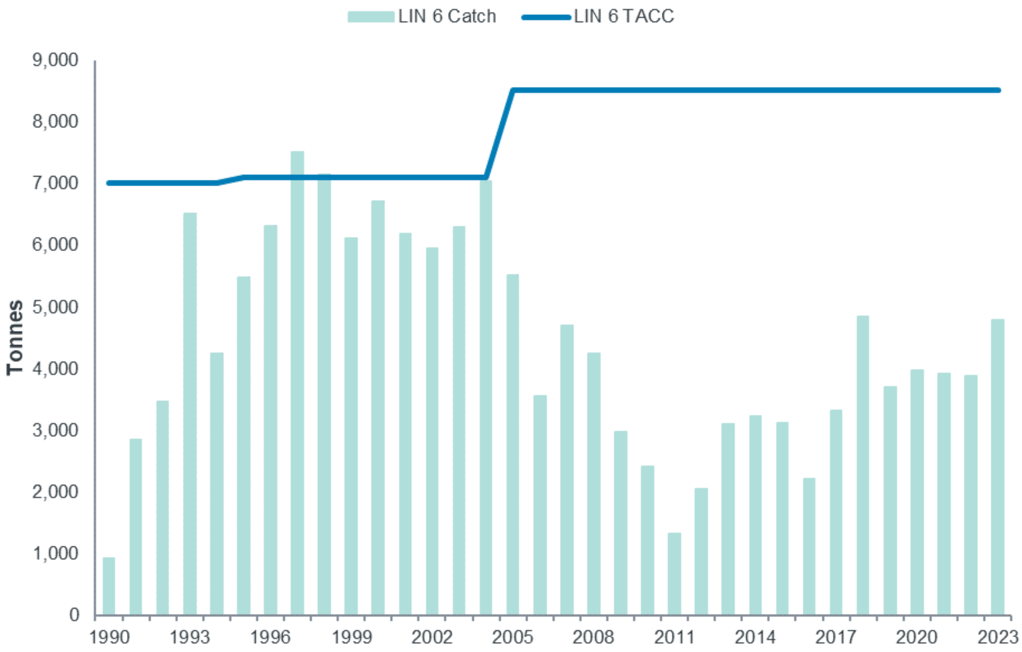


Figure 24: Total Allowable Commercial Catches and reported catches for LIN 6 (all gear types). Note: The LIN 6 trawl catch is largely a bycatch in the much larger western (sub-Antarctic) hoki trawl fishery and catch trends are therefore subject to forces other than ling abundance (FNZ, 2024).

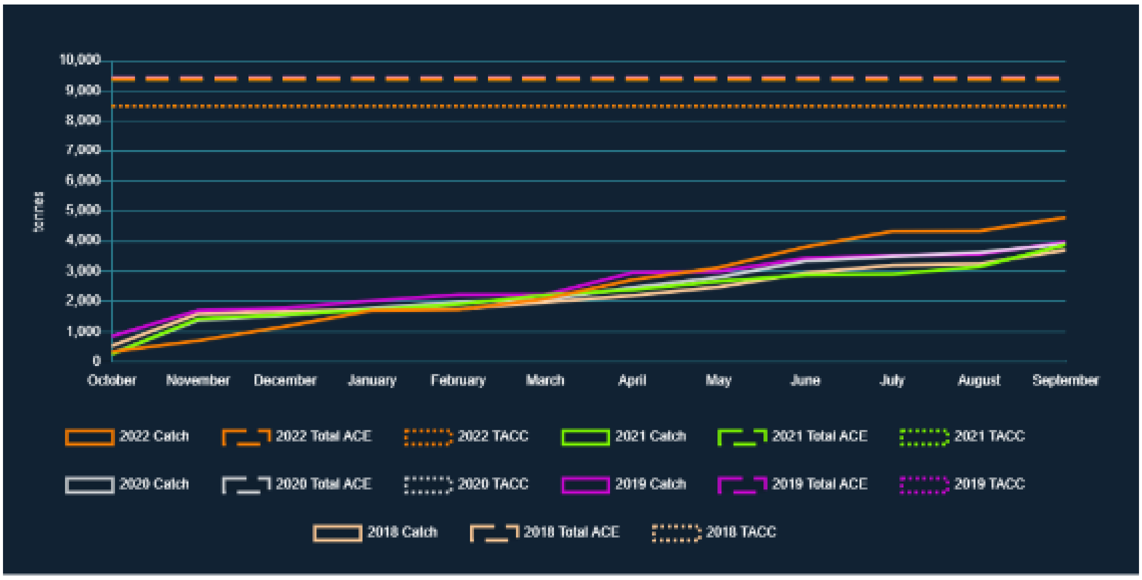


Figure 25: Reported commercial landings, total ACE and TACC for LIN 6 for fishing years 2018 – 2023. (Source: FishServe KUPE system).

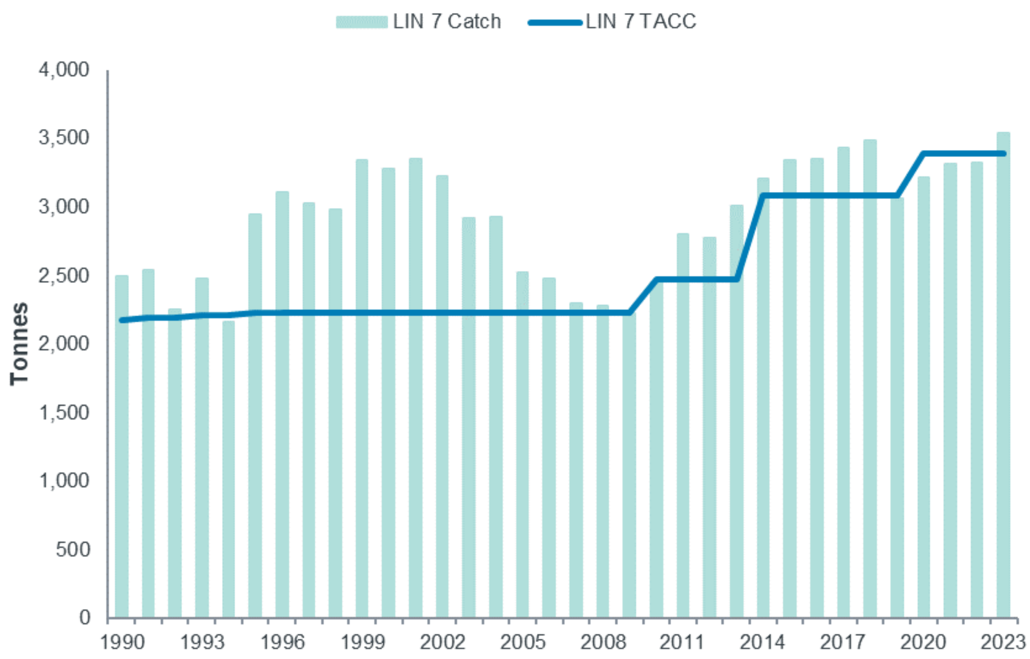


Figure 26: Total Allowable Commercial Catches and reported catches for LIN 7 (all gear types) (FNZ, 2024).

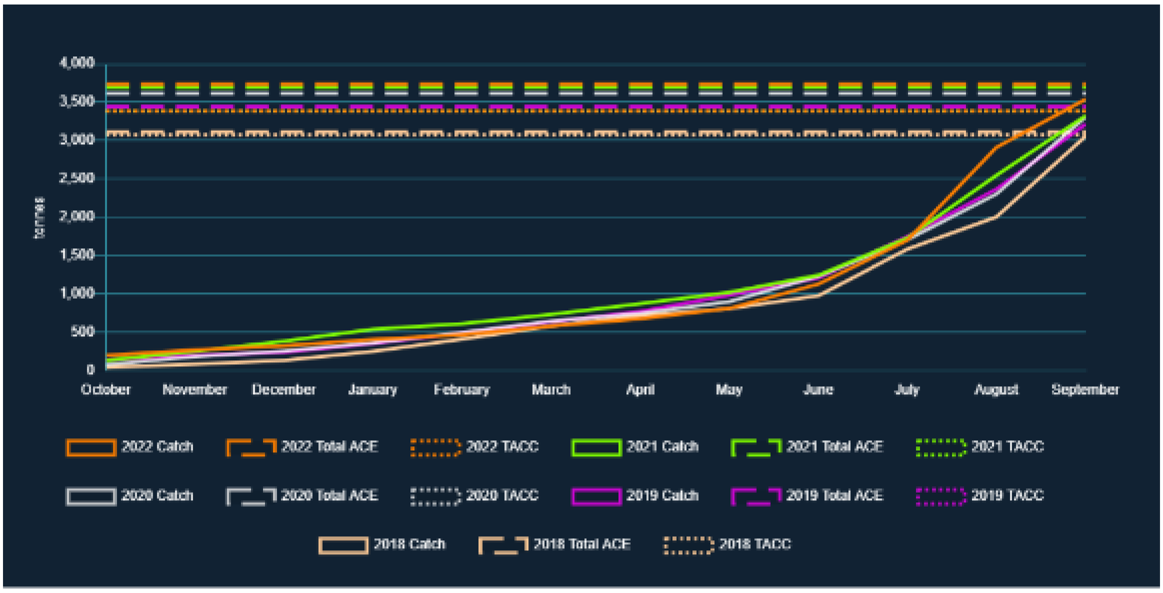


Figure 27: Reported commercial landings, total ACE and TACC for LIN 7 for fishing years 2018 – 2023. (Source: FishServe KUPE system)

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 28). Annual landings from the LIN 3&4 stock have been less than 4 600 t since 2004, markedly lower than the 6 000–8 000 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. 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 - 41% B0 (Table 11).

Table 11: LIN 3 & 4: Bayesian median and 95% credible intervals (in parentheses) of B_0 and B_{2022} (in tonnes and as a percentage of B_0) for the Base model run and one sensitivity run, and the probability that B_{2022} is above 40% of B_0 or below 20% of B_0.

Model run	B_0		B_{2022}		B_{2022} (% B_0)		P(>40% B_0)	P(<20% B_0)
Base case model (survey)	110 040	(100 660–129 890)	61 380	(47 400–85 810)	55.8	(46.9–66.3)	1.000	0.000
Sensitivity (CPUE)	92 190	(88 450–96 520)	30 860	(24 720–39 080)	33.5	(27.1–41.2)	0.052	0.000

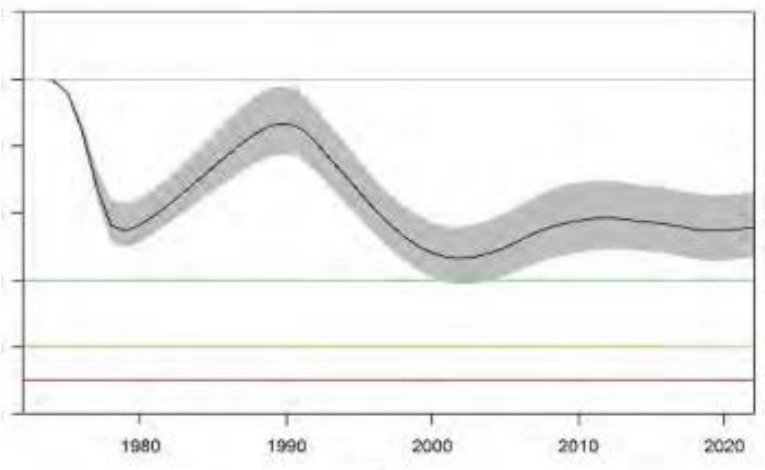


Figure 28: LIN 3 & 4 base model. Estimated median trajectory (with 95% credible intervals shown as grey band) for biomass as a percentage of B_0. The red horizontal line at 10% B_0 represents the hard limit, the orange line at 20% B_0 is the soft limit, and the green line is the %B_0 target (40% B_0) (FNZ, 2023a).

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.

The historical stock status trajectory and current status are illustrated below (Figure 29).

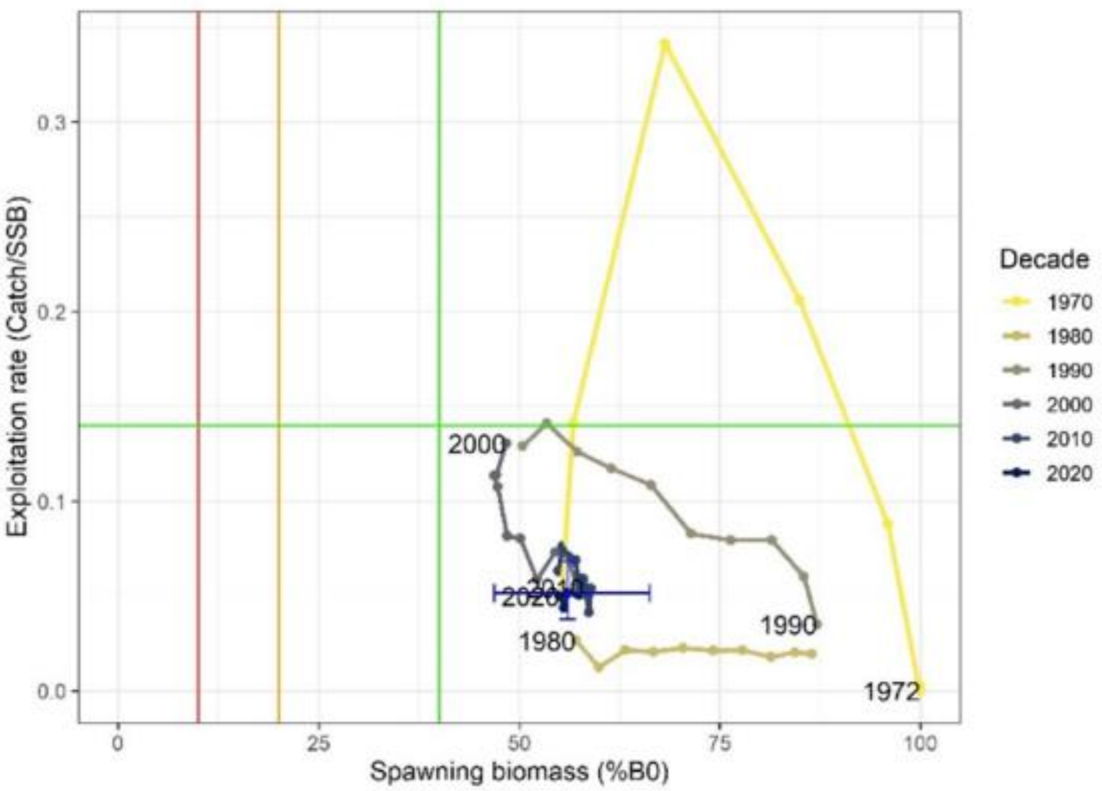


Figure 29: Trajectory over time of exploitation rate (U) and spawning biomass (% B0), for the LIN 3&4 base model from the start of the assessment period in 1972 to 2022. The red vertical line at 10% B0 represents the hard limit, the orange line at 20% B0 is the soft limit, and green lines are the % B0 target (40% B0) and the corresponding exploitation rate (U40 = 0.14 calculated using CASAL CAY function). Biomass and exploitation rate estimates are medians from MCMC posteriors for the base model. The blue cross represents the limits of the 95% confidence intervals of the estimated ratio of the SSB to B0 and exploitation rate in 2022.

Sub-Antarctic, LIN 5 & LIN 6 & LIN 6B (i.e. including Bounty Plateau)

An age-based stock assessment model assuming a Beverton-Holt stock-recruit relationship for LIN 5 & 6 & 6B (Sub-Antarctic) was carried out in 2024 (Mormede et al., in prep). This was the first time LIN 6B was incorporated in the Sub-Antarctic stock model, and the first time the Sub-Antarctic ling stock was assessed using Casal2. LIN 6B was included as a separate fishery in the model, sharing the LIN 5 & 6 bottom longline selectivity and the LIN 5 & 6 biological parameters and recruitment. The age composition data and fisheries CPUE from LIN 6B were deemed to poorly determined to be useful and were omitted. Although potting is becoming an important part of this fishery, there are no age data available for potting in LIN 5 & 6 and potting was assumed to have the same selectivity as bottom longline, as assumed in the other ling stocks that include potting catch.

The 2024 base case model was similar to that of the previous assessment in 2021 (Mormede et al., 2021b). The main changes were:

- The addition of LIN 6B as an additional fishery of the Sub-Antarctic stock
- The removal of the longline CPUE index
- The estimation of catchability parameters (q) as free parameters
- The move from a model year starting in September to starting in January.

Biomass estimates for the stock declined through the 1990s, were stable between the early 2000s and 2016, and have been declining again since (**Figure 30**). The biomass trajectory from the sensitivity runs was different for those sensitivity runs with either high or low natural mortality only (Table 12).

Table 12: LIN 5 & 6 & 6B, Bayesian median and 95% credible intervals of B_0 (tonnes) and B_{2024} as a percentage of B_0, and the probability that B_{2024} is above 40% and below 20% of B_0 from the Base model and sensitivity runs.

Model run	B_0		B_{2024} (% B_0)		P(>40% B_0)	P(<20% B_0)
Base model	204 628	171 734 – 258 458	66.3	55.3 – 78.3	1.000	0.000
M=0.16	158 380	142 888 – 179 277	52.1	42.3 - 62.3	0.993	0.000
M=0.20	304 797	226 047 – 419 980	76.7	65.1 – 88.3	1.000	0.000
length-based M	205 664	174 120 – 255 506	64.5	53.9 – 75.7	1.000	0.000
Additional catch	208 772	175 345 – 262 784	66.3	55.3 – 78.4	1.000	0.000
Base + CPUE	180 575	157 476 – 215 386	54.3	45.5 – 64.0	0.999	0.000
Base - BLL AF	212 692	175 995 – 275 733	69.3	57.6 - 82.1	1.000	0.000

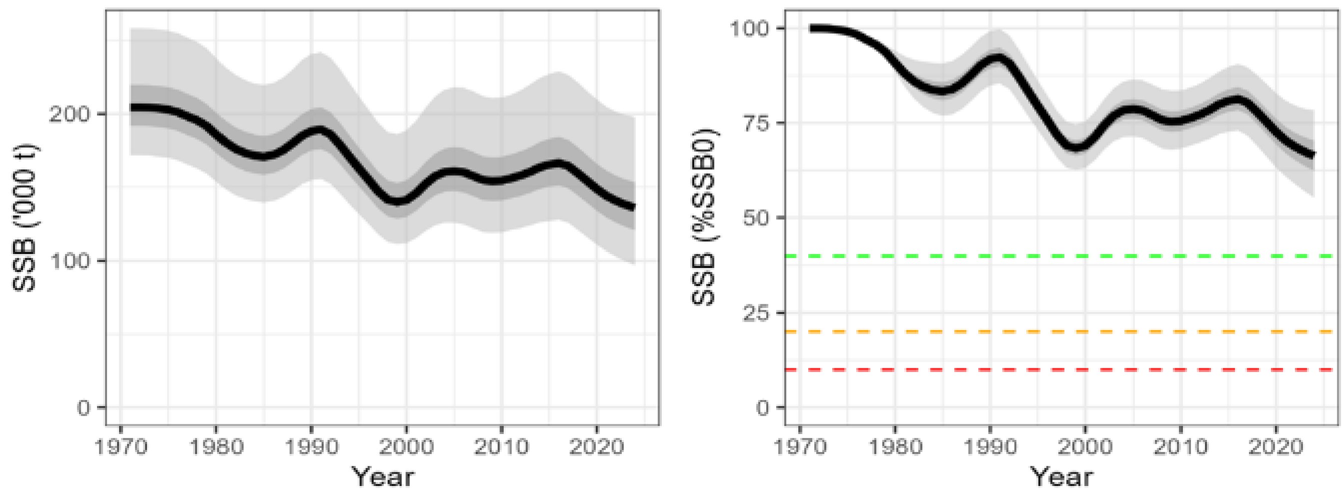


Figure 30: LIN 5 & 6 & 6B base model. Estimated median trajectories (with interquartile range shown as dark grey bands and 95% credible intervals as light grey bands) for absolute biomass and biomass as a percentage of B_0. The red horizontal line at 10% B_0 represents the hard limit, the orange line at 20% B_0 is the soft limit, and the green line is the % B_0 target (40% B_0), (FNZ, 2024).

The historical stock status trajectory and current status are illustrated below (Figure 31).

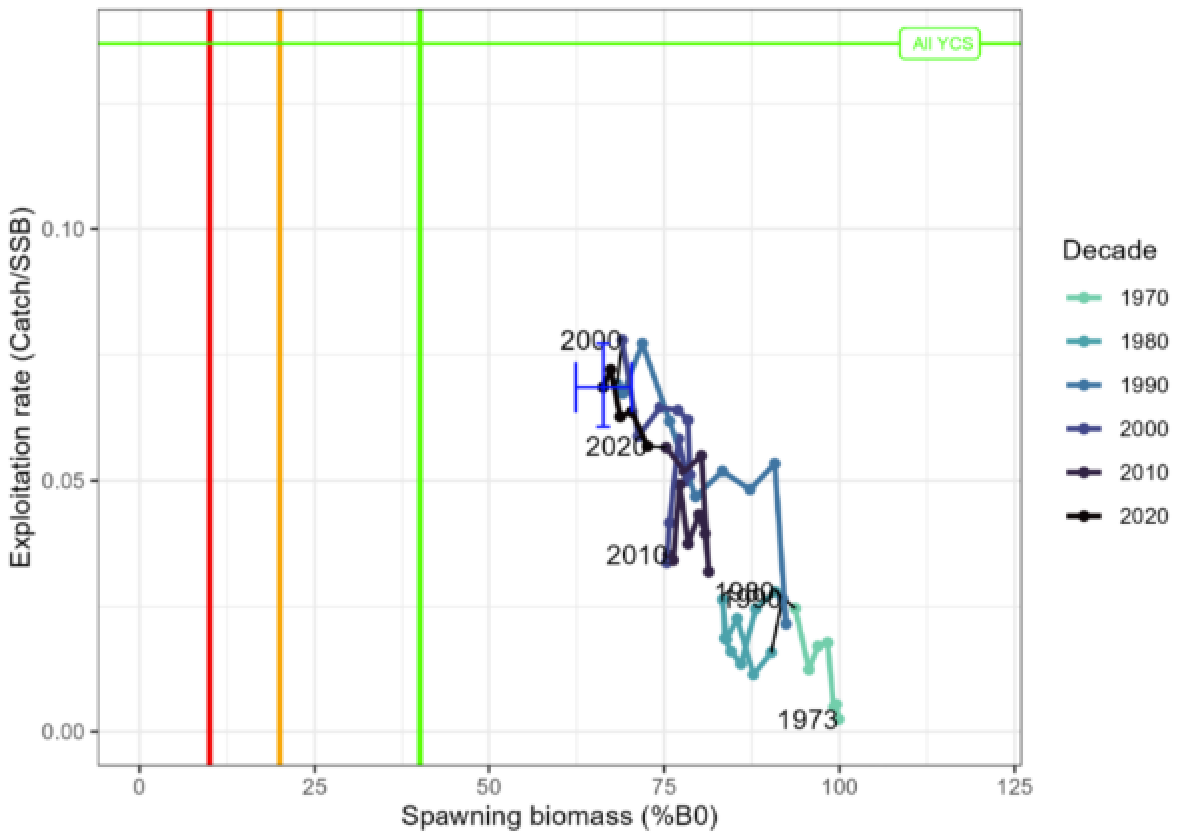


Figure 31: Trajectory over time of exploitation rate (catch / SSB) and spawning biomass (% B0), for the LIN 5&6&6B base model from the start of the assessment period in 1973 to 2024 (in blue). The red vertical line at 10% B0 represents the hard limit, the orange line at 20% B0 is the soft limit, and green lines are the % B0 target (40% B0) and the corresponding exploitation rate (U40 = 0.139). Biomass and exploitation rate estimates are medians from MCMC results. The blue cross represents the limits of the 95% credible intervals of the estimated ratio of the SSB to B0 and exploitation rate in 2024.

LIN 7

West coast South Island, LIN 7WC

The stock assessment for LIN 7WC (west coast South Island) was updated in 2023 (Mormede et al., in prep.). Population age groups were partitioned into age groups 1 to 28 with a plus group, and sex in the partition. The immature/mature partition in the previous model was removed because the immature selectivity was very poorly estimated. The catch history was updated to include Statistical Area 032 (an area adjacent to the southern boundary of the LIN 7 quota management area), and all fishing methods including potting.

Base case estimates indicated that B_0 was about 62,000 t for this stock and that B_{2023} was about 55%B_0 (Table 13 and Figure 32).

Table 13 LIN 7WC Bayesian median and 95% credible intervals (in parentheses) of B_0 and B_{2023} (in tonnes and as a percentage of B_0), and the probability that B_{2023} is above or below 20% of B_0.

Model run	B_0		B_{2023}		B_{2023} (%B_0)		P(>40% B_0)	P(<20% B_0)
Base case	62 168	(55 007–74 122)	34 265	(25 711–47 751)	55.1	(38.2–63.5)	0.953	0.000
No trawl CPUE (R2)	59 725	(53 183–70 139)	30 970	(23 237–42 440)	51.8	(43.2–61.8)	0.996	0.000
h = 0.6 (R3)	66 716	(59 468–78 689)	34 803	(26 105–48 449)	52.1	(43.5–62.1)	0.998	0.000
M = 0.15 (R4)	58 067	(54 568–62 211)	20 776	(17 255–24 804)	35.8	(31.5–40.0)	0.025	0.000
M = 0.21 (R5)	72 175	(59 611–96 155)	47 907	(34 186–72 670)	66.1	(56.0–77.8)	1.000	0.000

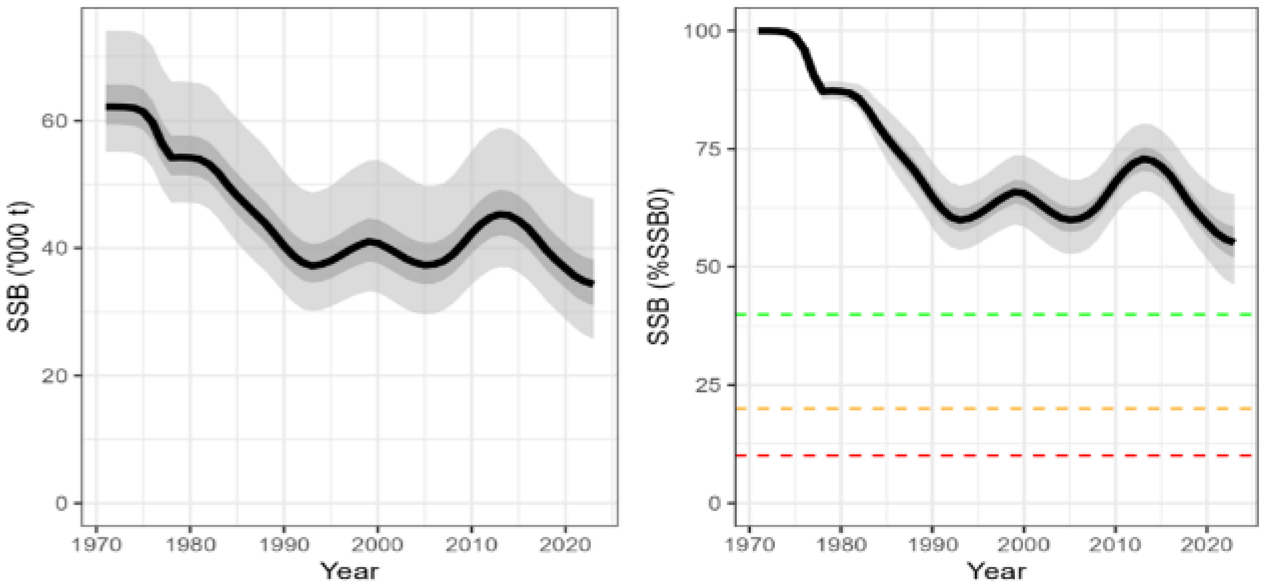


Figure 32: LIN 7WC base case. Estimated posterior distribution of the spawning stock biomass (SSB in tonnes, left) and of the proportion of initial spawning biomass (%SSB$_0$, right) trajectory and estimated virgin spawning stock biomass reference points (40%, 20%, and 10% B$_0$) for the base case model. The solid black lines represent the median values, the dark grey shading interquartile range and light shading 95% credible intervals. (FNZ, 2024).

Projections out to 2028 using the base case model indicated that biomass was likely to reduce slightly, to 52%B0, with future catches equal to the average of catch in 2020-2022 (i.e. 3 269 t), which includes Statistical Area 032 and excludes Cook Strait, and YCS resampled over the entire range of the model (Table 14).

Table 14: LIN 7WC, Bayesian median and 95% credible intervals (in parentheses) of projected B_{2028}, B_{2028} and a percentage of B_0, and B_{2028}/B_{2023} (%) for the base case model run. The probability of B_{2028} being above B_0 (p40) and below 20%B_0 (p20) are also reported.

YCS range	Catch range	Future catch (t) Trawl	Future catch (t) Line/Pot	B_{2028} (t)		B_{2028} (%B_0)		B_{2028} (%B_{2023})		p_{40}	p_{20}
All	2020–2022	1 511	1 758	32 550	(22 128–48 238)	52	(39–69)	94	(78–117)	0.97	0.00

The historical stock status trajectory and current status are illustrated below (Figure 33).

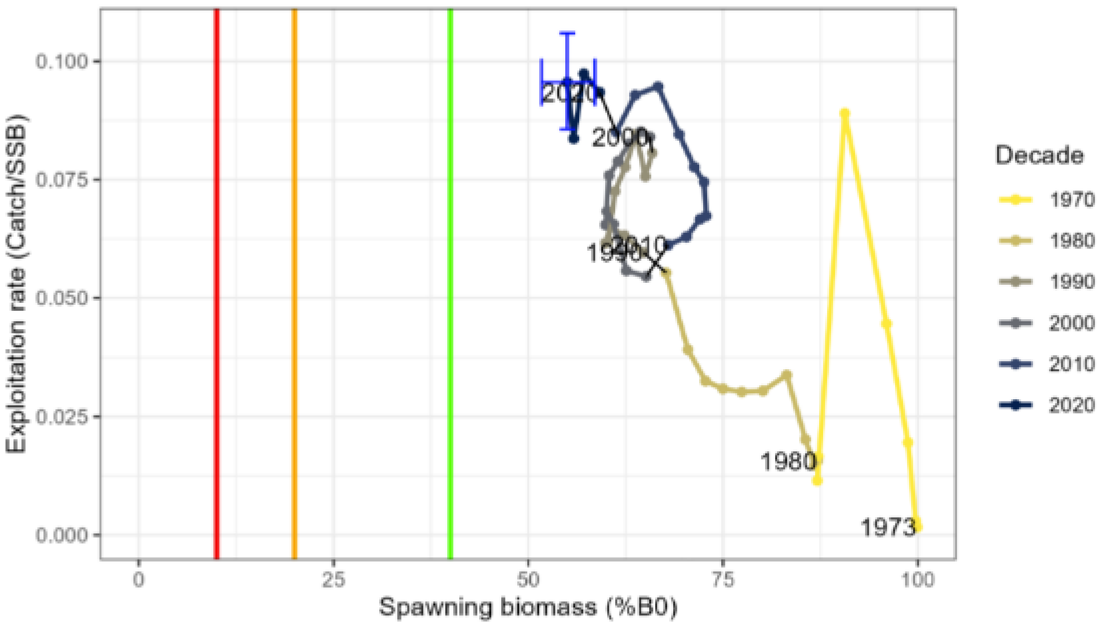


Figure 33: Trajectory over time of exploitation rate (U) and spawning biomass (% B0), for the LIN 7 base model from the start of the assessment period in 1972 to 2023. The red vertical line at 10% B0 represents the hard limit, the orange line at 20% B0 is the soft limit, and green line is the % B0 target (40% B0). Biomass and exploitation rate estimates are medians from MCMC results. The blue cross represents the limits of the 95% confidence intervals of estimated the ratio of the SSB to B0 and exploitation rate in 2023.

Development of an MSE for LIN 7 is underway/has been completed (Mormede, 2024).

Cook Strait, LIN 7CK (sub-components of LIN 7 and LIN 2)

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 appeared evident from CPUE values. The 2010 model, the last accepted stock assessment, estimated the stock to be 54% B0 and Likely (> 60%) to be at or above the target. 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 (Table 15).

Table 15: LIN 7CK. Probabilities that current (B2010) and projected (B2015) biomass will be less than 40%, 20%, or 10% of B0. Projected biomass probabilities are presented for two scenarios of future annual catch (i.e., 220 t and 420 t).

	Management reference points		
Biomass	**40% B_0**	**20% B_0**	**10% B_0**
B_{2010}	0.248	0.006	0.000
B_{2015}, 220 t catch	0.179	0.010	0.000
B_{2015}, 420 t catch	0.328	0.094	0.019

Key P1 references

Ballara, S.L. (2019). A descriptive analysis of all ling (*Genypterus blacodes*) fisheries, and CPUE for ling fisheries in LIN 5&6, from 1990 to 2017. New Zealand Fisheries Assessment Report 2019/49. 88 p. https://deepwatergroup.org/wp-content/uploads/2022/06/Ballara-S.L.-2019.-A-descriptive-analysis-of-all-ling-Genypterus-blacodes-fisheries-and-CPUE-for-ling-fisheries-in-LIN-56.pdf

Bull, B; Francis, R I C C; Dunn, A; McKenzie, A; Gilbert, D J; Smith, M H; Bian, R; Fu, D (2012) CASAL (C++ algorithmic stock assessment laboratory): CASAL user manual v2.30-2012/03/21. NIWA Technical Report 135. 280 p. https://niwa.co.nz/sites/niwa.co.nz/files/sites/default/files/casalv230-2012-03-21.pdf

Dunn, M.R. & Langley, A. (2018). A review of the hoki stock assessment in 2018. New Zealand Fisheries Assessment Report 2018/42. 55 p. https://fs.fish.govt.nz/Doc/24640/FAR-2018-42-Hoki-stock-assessment-review.pdf.ashx

Dunn, A; Horn, P L; Cordue, P L; Kendrick, T H (2000) Stock assessment of hake (*Merluccius australis*) for the 1999–2000 fishing year. New Zealand Fisheries Assessment Report 2000/50. 50 p. https://fs.fish.govt.nz/Doc/17520/2000%20FARs/00_50_FARD%20%20%20%20%20%20%20%20%20%20%20%20%20.pdf.ashx

Dunn, A; Mormede, S; Webber, D N (2021a) Descriptive analysis and stock assessment model inputs of hake (*Merluccius australis*) in the Sub-Antarctic (HAK 1) for the 2020–21 fishing year. New Zealand Fisheries Assessment Report 2021/74. 52 p. https://www.mpi.govt.nz/dmsdocument/48691/direct

Dunn, A; Mormede, S; Webber, D N (2021b) Stock assessment of hake (*Merluccius australis*) in the Sub-Antarctic (HAK 1) for the 2020–21 fishing year. New Zealand Fisheries Assessment Report 2021/75. 37 p. https://fs.fish.govt.nz/Doc/24998/FAR-2021-75-Hake-Stock-Assessment-HAK1-For-2020-21-4225.pdf.ashx

Dunn, A., Mormede, S. & Webber, D. N. (2023) Stock assessment of hake (*Merluccius australis*) off the west coast South Island (HAK 7) for the 2021–22 fishing year. *New Zealand Fisheries Assessment Report* 2023/48. 45 p. https://fs.fish.govt.nz/Doc/25566/FAR-2023-48-The-2022-Hake-Stock-Assessment-HAK7-4389.pdf.ashx

Dunn, A. (in prep) Stock assessment of hake (*Merluccius australis*) off the west coast South Island (HAK 7) for the 2022–23 fishing year. Draft New Zealand Fisheries Assessment Report.

DWG (2022). DWG Operational Procedures for 2022-23. Update for Operational Managers and Vessels. 2 p. https://deepwatergroup.org/wp-content/uploads/2023/07/Memo-DWG-OPs-Fleet-Update-October-2022.pdf

FNZ (2021). Review of Sustainability Measures for the 2021-22 October Round. Fisheries New Zealand Decision Paper. 275 p. https://www.mpi.govt.nz/dmsdocument/47617-Review-of-Sustainability-Measures-for-the-2021-October-round-Decision-paper

FNZ (2022) Changes to sustainability measures for the 2022 October Round. https://www.mpi.govt.nz/dmsdocument/53391-The-ministers-decision-letter-changes-to-fisheries-sustainability-measures-for-the-2022-October-round

FNZ (2023). Review of sustainability measures for the 2023 October round. Fisheries New Zealand Decision Paper No: 2023/21. 253 p. https://www.mpi.govt.nz/dmsdocument/59104-Review-of-sustainability-measures-for-the-2023-October-round-Fisheries-New-Zealand-decision-paper

FNZ (2023a). Minister’s decision letter. Changes to fisheries sustainability measures for the 2023 October Round. 8 p. https://www.mpi.govt.nz/dmsdocument/59101-Changes-to-fisheries-sustainability-measures-for-the-2023-October-Round-Decision-letter

FNZ (2023b). Fisheries Assessment Plenary May 2023: Stock Assessments and Stock Status, Vol. 1 Introductory Sections and Alfonsino to Hoki (Hake pp. 553-588; Hoki pp.589-633). https://www.mpi.govt.nz/dmsdocument/51730-Fisheries-Assessment-Plenary-May-2022-Stock-Assessments-and-Stock-Status-Volume-1-Introductory-sections-and-Alfonsino-to-Hoki#page=567

FNZ (2023c). Fisheries Assessment Plenary May 2023: Stock Assessments and Stock Status, Vol. 2 Horse mussel to Red crab (Ling pp.795-849). https://www.mpi.govt.nz/dmsdocument/57253-Fisheries-Assessment-Plenary-May-2023-Stock-Assessments-and-Stock-Status-Volume-2-Horse-mussel-to-Red-crab#page=155

FNZ (2024). Fisheries Assessment Plenary May 2024: Stock Assessments and Stock Status, Vol. 1 Introductory Sections and Alfonsino to Hoki (Hake pp. 567-603). https://fs.fish.govt.nz/Doc/25741/May-Plenary-2024-Volume-1.pdf.ashx

Holmes, S.J. (2021) Stock assessment of hake (*Merluccius australis*) on Chatham Rise (HAK 4) for the 2019–20 fishing year. New Zealand Fisheries Assessment Report 2021/22. 55 p. https://www.mpi.govt.nz/dmsdocument/44959/direct

Kienzle, M (2021) Stock assessment for ling off the west coast South Island (LIN 7WC) to the 2018–19 fishing year. New Zealand Fisheries Assessment Report 2021/18. 22 p. https://fs.fish.govt.nz/Doc/24879/FAR-2021-18-Ling-Stock-Assessment-For-LIN7WC-To-2018-19-4160.pdf.ashx

Langley, A.D. (2020). Review of the 2019 hoki stock assessment. New Zealand Fisheries Assessment Report 2020/28. 52 p. https://www.mpi.govt.nz/dmsdocument/42282-FAR-202028-Review-of-the-2019-hoki-stock-assessment

Langley, A.D. (2023). The 2023 Management Strategy Evaluation for Hoki (*Macruronus novaezelandiae*). New Zealand Fisheries Assessment Report 2023/49. https://www.mcguinnessinstitute.org/wp-content/uploads/2023/12/The-2023-Management-Strategy-Evaluation-for-hoki-Macruronus-novaezelandiae-.pdf

MacGibbon, D.J., Ballara, S.L., Schimel, A.C.G. and O'Driscoll, R.L. (2019). Trawl survey of hoki and middle-depth species in the Southland and Sub-Antarctic areas, November–December 2018 (TAN1811). New Zealand Fisheries Assessment Report 2019/71. 96 p. https://www.mpi.govt.nz/dmsdocument/38828-FAR-201971-Trawl-survey-of-hoki-and-middle-depth-species-in-the-Southland-and-Sub-Antarctic-NovemberDecember-2018-TAN1811

Mormede, S.; Dunn, A.; Webber, D.N. (2023). Spatial-temporal standardisation of commercial longline and trawl survey catches of ling on the Chatham Rise (LIN 3&4) up to 2020–21. New Zealand Fisheries Assessment Report 2023/13. 10 p. https://www.mpi.govt.nz/dmsdocument/55858/direct

Mormede, S; Dunn, A; Webber, D N (2023) Descriptive analysis of ling (*Genypterus blacodes*) off the west coast South Island (LIN 7WC) up to 2021–22 and inputs for the 2023 stock assessment. New Zealand Fisheries Assessment Report 2023/51. 91p. https://docs.niwa.co.nz/library/public/FAR2023-51.pdf

Mormede, S.; Dunn, A.; Webber, D.N. (2023). Stock assessment of ling (*Genypterus blacodes*) on the Chatham Rise (LIN3&4) for the 2021–22 fishing year. New Zealand Fisheries Assessment Report 2023/14. 39 p. https://www.mpi.govt.nz/dmsdocument/55876/direct

Mormede, S; Dunn, A; Webber, D N (2024) The 2023 stock assessment of ling off the west coast South Island (LIN 7WC). New Zealand Fisheries Assessment Report 2024/02. 23p. https://www.mpi.govt.nz/dmsdocument/60778/direct

Mormede, S. (2024 draft). Developing a Management Strategy Evaluation for ling. Initial results. DWWG presentation, 3 April 2024. Presentation to Deep Water Working Group. https://deepwatergroup.org/wp-content/uploads/2024/09/Mormede-2024-Draft-LIN-MSE-Report-v1.pdf

Mormede, S; Dunn, A; Webber, D N (in prep a) Descriptive analysis of ling in the Sub-Antarctic (LIN 5&6 and LIN 6B) up to 2023 and inputs for the 2024 stock assessment. Draft New Zealand Fisheries Assessment Report.

Mormede, S; Dunn, A; Webber, D N (in prep b) Stock hypothesis for ling in the Sub-Antarctic (LIN 5&6 and LIN 6B). Draft New Zealand Fisheries Assessment Report.

Mormede, S; Dunn, A; Webber, D N (in prep c) The 2024 stock assessment of ling (*Genypterus blacodes*) in the Sub-Antarctic (LIN 5&6 and LIN 6B). Draft New Zealand Fisheries Assessment Report.

O'Driscoll, R.L. and Ballara, S.L. (2019). Trawl and acoustic survey of hoki and middle depth fish abundance on the west coast South Island, July–August 2018 (TAN1807). New Zealand Fisheries Assessment Report 2019/19. 120 p. https://www.mpi.govt.nz/dmsdocument/35526-FAR-201919-Trawl-and-acoustic-survey-of-hoki-and-middle-depth-fish-abundance-on-the-west-coast-South-Island-JulyAugust-2018-TAN1807

O'Driscoll, R.L. & Escobar-Flores, P. (2020). Acoustic survey of spawning hoki in Cook Strait and off the east coast South Island during winter 2019. New Zealand Fisheries Assessment Report 2020/21. 39 p. https://fs.fish.govt.nz/Doc/24810/FAR2020-21-Acoustic-Survey-Hoki-Cook-Strait-ECSI-Winter-2019-4060.pdf.ashx

Stevens, D.W.; Ballara, S.L.; Escobar-Flores, P.C.; O'Driscoll, R.L. (2023). Trawl survey of hoki and middle depth species on the Chatham Rise, January 2022 (TAN2201). New Zealand Fisheries Assessment Report 2023/24. 122 p. https://fs.fish.govt.nz/Doc/25391/FAR-2023-24-Chatham-Rise-Middle-Depths-Trawl-Survey-January-2022-TAN2201-4353.pdf.ashx

Saunders, R.J.; Ballara, S.; Hart, A.; Sutton, C.P. (2022). Catch-at-age for hake (*Merluccius australis*) and ling (*Genypterus blacodes*) for the 2019–20 fishing year and from a research trawl survey in 2020, and a summary of the available data sets from the New Zealand EEZ. New Zealand Fisheries Assessment Report 2022/09. 95 p. https://fs.fish.govt.nz/Doc/25134/FAR-2022-09-Hake-And-Ling-Catch-At-Age-2019-2020-4269.pdf.ashx

P2 - OVERVIEW OF ENVIRONMENTAL INFORMATION

Observer Coverage

The Ministry for Primary Industries (MPI) fishery observer deployment covers a range of objectives, including monitoring of ETP species interactions, recording of biological data from fish catches for use in stock assessment, monitoring catch composition and discards, and providing 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 it is considered there may be a high-risk of ETP species capture (e.g., squid and southern blue whiting trawl fisheries where operations overlap with sea lions[1]).

The level of coverage may vary depending on the nature of the fishery and the areas of operation. Fishery 'complexes' that have a coverage target of less than 30% are the Cook Strait and West Coast South Island "inside the line" hoki fisheries and the small vessel ling bottom longline fishery. Biological data requirements for the two hoki fisheries is supported by onshore factory sampling (FNZ, 2023).

The level of observer coverage is also designed to enable collection of sufficient biological data (i.e. length-frequency measurements and otolith samples) for use in stock assessments (Table 16). The required number of observer days per fish stock is then based on the number of days required to collect the target number of biological samples. The rationale applied is provided in Table 17.

Table 16: Fishery Observer Programme biological sampling requirements for the hoki, hake and ling fisheries by fishery area and month during 2022-23 (FNZ, 2023).

Species	FMA/stock	LF target	Otolith target	Area	Months
Hoki	Sub-Antarctic	400	1600	Sub-Antarctic	Year-round (except July-Aug)
	Chatham Rise	400	1600	Chatham Rise	Year-round (except Jul-Aug)
	WCSI	400	1000	WCSI	May-September
	Cook Strait	200	1000	Cook Strait	Year-round
	Inside the line	200	600	WCSI	May-September
Hake	HAK 1	100	1,000	Sub-Ant	October-February
	HAK 4	100	1,000	Mernoo Bank/CR	September-February
	HAK 7	200	1,000	WCSI	June – September
Ling	LIN 3/4 (trawl)	100	500	Chatham Rise	October-May
	LIN 3/4 (BLL)	100	500	Chatham Rise	Year-round
	LIN 5/6 (trawl)	100	500	Sub-Ant	September-April
	LIN 5/6 (BLL)	100	500	Sub-Ant	Year-round
	LIN 7	200	500	WCSI	June-October

[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.

Table 17: Fishery Observer Programme determination of observer coverage by area (FNZ, 2023).

Fishery complex & stocks covered	Planned days 2022/23	Main objective(s) of observer coverage planning	Rationale and comment
Hoki and middle-depth trawl			
West Coast South Island HOK 1, HAK 7, LIN 7, SWA 1	400	Biological sampling of HOK, HAK, LIN. Protected species monitoring	800 LFs in total (400 HOK, 200 HAK & 200 LIN). Using an estimate of 2 LFs per day, 400 days estimated to be sufficient to collect required number of biological samples. 400 days estimated to provide coverage of approx. 30% of effort (HOK target only).
WCSI (inside the line) HOK 1	105	Biological sampling of HOK. Protected species monitoring	200 LFs required. Using an estimate of 2 LFs per day, 105 days estimated to be sufficient to collect required number of biological samples. 100 days estimated to provide coverage of approx. 20% of effort.
Cook Strait hoki HOK 1	200	Biological sampling of HOK. Protected species monitoring	200 LFs required. Using an estimate of 2 LFs per day, 200 days estimated to be sufficient to collect required number of biological samples. 200 days estimated to provide coverage of approx. 20% of effort.
Chatham Rise middle-depth HOK 1, HAK 1, HAK 4, LIN 3, LIN 4, SWA 3, SWA 4, JMA 3, BAR 1, BAR 4	555	Biological sampling of HOK, HAK, LIN Protected species monitoring	400 LFs in total. Using an estimate of 2 LFs per day, 555 days estimated to be sufficient to collect required number of biological samples, will provide coverage of approx. 30% of effort (HOK target only).
Sub-Antarctic middle-depth HOK 1, HAK 1, LIN 5, LIN 6, SWA 4, WWA 5B, BAR 5, JMA 3	325	Biological sampling of HOK, HAK, LIN. Protected species monitoring	400 LFs in total using an estimate of 2 LFs per day, 325 days estimated to be sufficient to collect required number of biological samples and estimated to provide coverage of approx. 30% of effort (HOK, HAK & LIN target only).
Total days	**1585**		

The achieved level of observer coverage for each of hoki, hake and ling-targeted tows over the period 2018-19 to 2022-23 averaged out at 44.3% (Table 18). Data for 2018-19 to 2020-21 were retrieved from the Protected Species website; data for 2021-22 & 2022-23 were retrieved from MPI databases (D. Foster, FNZ, pers. comm.)

Table 18: Total numbers of trawl tows, observed tows and percentage of tows observed by target fishery and fishing year.

Target	2018/19			2019/20			2020/21			2021/22			2022/23		
	Total tows	Obs. tows	Obs. tows (%)	Total tows	Obs. tows	Obs. tows (%)	Total tows	Obs. tows	Obs. tows (%)	Total tows	Obs. tows	Obs. tows (%)	Total tows	Obs. tows	Obs. tows (%)
HOK	9,617	3,202	33.3%	8,124	3,727	45.9%	7,665	3,613	47.1%	8,059	3,663	45.5%	8,816	3,848	43.6%
HAK	77	76	98.7%	205	205	100%	206	165	80.1%	132	132	100%	255	241	94.5%
LIN	775	307	39.6%	691	332	48.0%	767	277	36.1%	700	449	64.1%	790	529	67.0%
Totals	**10,469**	**3,585**	**34.2%**	**9,020**	**4,264**	**47.3%**	**8,638**	**4,055**	**46.9%**	**8,891**	**4,244**	**47.7%**	**9,861**	**4,618**	**46.8%**

Observer costs are funded through levies recovered from quota owners. While the overall Fishery Observer programme is managed by the Ministry for Primary Industries, the administration of observer coverage for ETP species is undertaken by the Department of Conservation (DOC).

In summary, 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.

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 34).

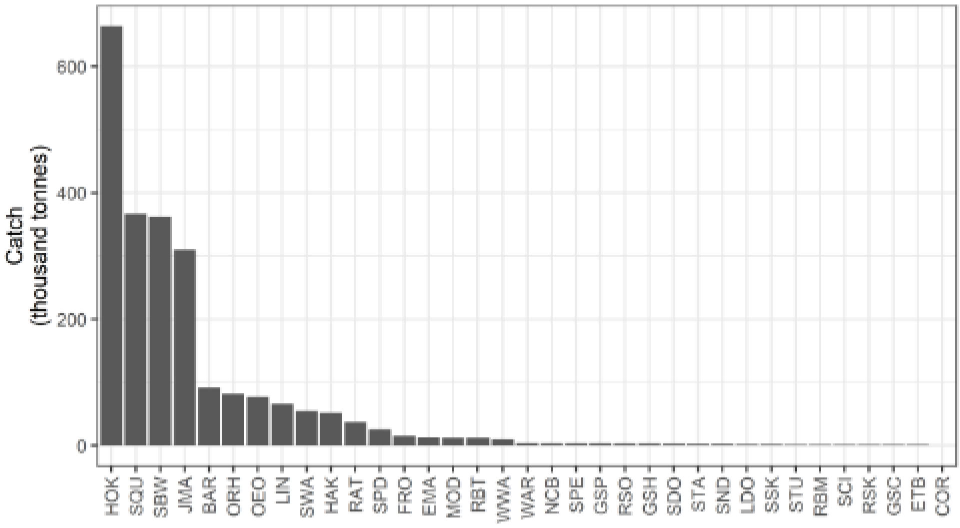


Figure 34: Total observed catch for the top 33 species recorded in the Centralised Observer Database 2000/01 to 2019/20 (Edwards & Mormede, 2023).

The trend in FNZ observer coverage for the relevant stocks of HAK, HOK and LIN target fisheries from 2018-19 to 2021-22, and the planned observer coverage in 2022-23, are shown in Table 19. The planned 2022-23 was based on FNZ's observer coverage plans for middle-depth, mixed species fisheries as provided in the Annual Operational Plan for Deepwater Fisheries 2022/23 (FNZ, 2022). A total of 1,585 observer days were planned for middle-depth trawl (excluding Squid) during 2022-23, an observer coverage rate considered by MPI sufficient given identified threats posed by ETP species captures and the high level of overall compliance by these fisheries.

Table 19: Observer coverage (% of tows) achieved in middle-depth fisheries from 2018-19 to 2021-22 and planned in 2022-23 (FNZ Annual Operational Plan 2022/23).

<table>
<tr><th>QMA & Fishery</th><th>2018-19</th><th>2019-20</th><th>2020-21</th><th>2021-22</th><th>2022-23 (planned)</th></tr>
<tr><td>HAK 1 Chatham Rise</td><td>93%</td><td>100%</td><td rowspan="2">48%</td><td rowspan="2">45%</td><td rowspan="2">30%</td></tr>
<tr><td>HAK 4 Chatham Rise</td><td>100%</td><td>-</td></tr>
<tr><td>HAK 7 West Coast South Island</td><td>32%</td><td>74%</td><td>42%</td><td>77%</td><td>30%</td></tr>
<tr><td>HOK 1 West Coast South Island</td><td rowspan="4">29%</td><td rowspan="4">44%</td><td>42%</td><td>77%</td><td>30%</td></tr>
<tr><td>HOK 1 WCSI 'inside the line'</td><td>22%</td><td>27%</td><td>20%</td></tr>
<tr><td>HOK 1 Cook Strait</td><td>10%</td><td>32%</td><td>20%</td></tr>
<tr><td>HOK 1 Chatham Rise</td><td>46%</td><td>45%</td><td>30%</td></tr>
</table>

HOK 1 Sub-Antarctic			64%	60%	30%
LIN 3 Chatham Rise	8%	9%	48%	45%	30%
LIN 4 Chatham Rise	0%	0%			
LIN 5 Sub-Antarctic	28%	17%	54%	72%	30%
LIN 6 Sub-Antarctic	34%	52%			
LIN 7 West Coast South Island	5%	10%	42%	77%	30%

Observer-reported catch composition (all species) 2018-19 to 2022-23

Catch composition data from the MPI Fishery Observer Services programme from 2018-19 to 2022-23 was used to determine species categories (e.g., in-scope or out-of-scope). While observer data contained ~600 individual species, 17 species comprised 98% of the total catch (Table 20). All chondrichthyan species in the observer data were cross-checked against CITES, CMS, ICUN red list and NZ national legislation to determine their designation.

Table 20: Catch composition (t) from MPI Fishery Observer Services data for targeted tows in the hoki/hake/ling fishery. Species comprising the top 98.5% of the observed catch are represented. Green rows are QMS species, white rows are non-QMS species. Observer coverage: 2018-19 to 2020-21 from Protected Species website; 2021-22 & 2022-23 from FNZ (D. Foster, pers. comm.).

Observer coverage (% of tows observed)		34.2%	47.3%	46.9%	47.7%	46.8%		44.3%	
Species	**Listing**	**2018-19**	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**5-year Average**	**5-year Average (%)**	**MSC Category**
Hoki *Macruronus novaezelandiae*	NA	39,521	46,444	44,279	44,403	47,124	44,354	76.89%	Principle 1
Ling *Genypterus blacodes*	NA	3,451	3,749	3,829	5,024	4,712	4,153	7.20%	Principle 1
Hake *Merluccius australis*	NA	1,380	2,234	2,000	2,015	2,170	1,960	3.40%	Principle 1
Silver warehou *Seriolella punctata*	NA	1,384	927	794	1,336	1,467	1,181	2.05%	In-scope minor
Javelinfish *Lepidorhynchus denticulatus*	NA	877	1,021	1,434	1,201	1,133	1,133	1.96%	In-scope minor
Rattails Macrouridae	NA	827	856	1,069	815	1,140	941	1.63%	In-scope minor
Spiny dogfish *Squalus acanthias*	Chondrichthyes IUCN - VU National legislation - NA CITES II - NA	612	427	595	839	687	632	1.10%	In-scope minor
Gemfish *Rexea solandri*	NA	335	602	378	510	599	485	0.84%	In-scope minor
Frostfish *Lepidopus caudatus*	NA	407	165	195	316	176	252	0.44%	In-scope minor
White warehou *Seriolella caerulia*	NA	214	186	271	249	189	222	0.38%	In-scope minor
Pale ghost shark *Hydrolagus bemisi*	Chondrichthyes IUCN - LC National legislation - NA CITES II - NA	203	225	230	197	191	209	0.36%	In-scope minor
Southern blue whiting *Micromesistius australis*	NA	111	129	170	157	195	152	0.26%	In-scope minor

Lookdown dory *Cyttus traversi*	NA	121	140	153	146	164	145	0.25%	In-scope minor
Black oreo *Allocyttus niger*	NA	72	74	247	185	77	131	0.23%	In-scope minor
Sea perch *Helicolenus spp.*	NA	89	113	112	119	144	115	0.20%	In-scope minor
Shovelnose spiny dogfish *Deania calcea*	Chondrichthyes IUCN - NT National legislation - NA CITES II - NA	91	77	135	177	68	110	0.19%	In-scope minor
Jack mackerel *Trachurus spp.*	NA	134	6	62	90	254	109	0.19%	In-scope minor
Silverside *Argentina elongata*	NA	85	186	73	73	121	108	0.19%	In-scope minor
Arrow squid *Nototodarus gould / N. sloanii*	NA	86	114	101	167	59	105	0.18%	In-scope minor
Ribaldo *Mora moro*	NA	92	98	85	101	142	104	0.18%	In-scope minor
Giant stargazer *Kathetostoma spp.*	NA	64	70	59	106	70	74	0.13%	In-scope minor
Baxters lantern dogfish *Etmopterus baxteri*	Chondrichthyes IUCN - NA National legislation - NA CITES II - NA	79	53	69	51	74	65	0.11%	In-scope minor
Smooth skate *Dipturus innominatus*	Chondrichthyes IUCN - LC National legislation - NA CITES II - NA	46	71	55	58	54	57	0.10%	In-scope minor

In-scope main species

Species are considered 'main' if:

a. Catch of a species by the UoA comprises 5% or more by weight of the total catch of all species by the UoA, or
b. The species is classified as 'less resilient' and the catch of the species by the UoA comprises 2% or more by weight of the total catch of all species by the UoA, with less resilient species classified as species whose productivity indicates that it has intrinsically low resilience, and/or
    - Its intrinsic resilience is high and existing knowledge of the species indicates that its resilience has been lowered because of anthropogenic or natural changes to its life history.
    - The species is a shark and the fishery trades in shark fins (SA3.5.2.1).

Therefore, there are no in-scope 'main' species in the UoA catch.

In-scope minor species

All in-scope species that are not considered 'main' according to the criteria listed above are considered 'minor' species (SA3.5.2.3). In addition, 'minor' species that make up < 2% of total UoA catch are considered 'negligible', except in cases where SA3.5.2.2 applies (i.e. if the total catch by the UoA is exceptionally large, such that even small catch proportions of a P2 species significantly impact the affected stocks/populations).

Silver warehou is the only 'minor' species that comprises >2% of the total UoA catch (Table 21). The remaining species individually comprise <2% of the total catch and are classified as 'negligible'

(SA3.5.2.2), with the vast majority (i.e., ~580 species) individually comprising <0.10% of the total catch of the UoA.

Table 21: HOK/HAK/LIN trawl fishery observed catch composition (t) 2018-19 to 2022-23 combined, for the single P2 species, silver warehou, which contributed >1% of the total catch, by QMA.

Species	SWA1	SWA3	SWA4	Total (kg)	Total (%)
Silver warehou *Seriolella punctata*	844	2,683	2,380	5,907	2.05%

Silver warehou (*Seriolella punctata*)

Silver warehou is a QMS species and is common around the South Island and on the Chatham Rise in depths of 200–800m. It grows rapidly and available information suggests maturity is reached at four years. Maximum age is estimated to be 23 years for females and 19 years for males. The majority of the commercial catch is taken from the Chatham Rise (SWA 4), in the Canterbury Bight and southeast of Stewart Island (SWA 4), and off the west coast of the South Island (SWA 1). The stock structure is not well known although four distinct spawning areas have been suggested (Fisheries New Zealand, 2023c).

WCSI (part of SWA 1)

- Generic reference points: target: 40% B_0, soft limit: 20% B_0, hard limit: 10% B_0
- There is currently no reliable way of tracking abundance due to the characteristics and behaviour of the fish and the fishing fleet.
- Status in relation to reference points is unknown.

Chatham Rise and Southland (SWA 3 and SWA 4)

- Generic reference points: target: 40% B_0, soft limit: 20% B_0, hard limit: 10% B_0
- CPUE and biomass indices have been variable but relatively stable since 2000.
- Fishing intensity is likely to have been stable, because the CPUE series and catches have been relatively stable since 2000.

In-scope species management

The Fisheries Act 1996 provides the legal basis for managing fisheries in New Zealand, including the Minister's responsibilities for setting and varying sustainability measures such as TACCs. The management of New Zealand's deepwater fisheries is a collaborative arrangement between Fisheries New Zealand and the commercial fishing industry, represented by Seafood New Zealand's Deepwater Council (DWC).

The management of deepwater fisheries encompasses all target and bycatch stocks and the environmental effects of fishing. All 28 deepwater species/species groups in the quota management system (QMS), have been categorised into two tiers according to their commercial value and volume of catch. Tier 1 fisheries are high volume and/or high value fisheries and are the targets of dedicated fisheries. Tier 2 fisheries are typically less commercially valuable, may comprise the bycatch component of Tier 1 fisheries, or are only targeted periodically throughout the year (Fisheries New Zealand, 2019b). Tier 3 species are non-QMS and are generally of little or no commercial value (Table 22).

Table 22: Categorisation of commercial deepwater fish stocks by tier.

	Stocks [2]	
Tier 1	Hake: all Hoki : all Jack mackerel: JMA3, JMA7 Ling: LIN3 - LIN7 Orange roughy: all	Oreos: all Scampi: all Southern blue whiting: all Squid: all
Tier 2	Alfonsino: all Barracouta: BAR4, BAR5, BAR7 Black cardinalfish: all Deepwater crabs (CHC/GSC/KIC); all English mackerel: EMA3, EMA7 Frostfish: FRO3-FRO9 Gemfish: SKI3, SKI7 Ghost shark, dark: GSH4-GSH6 Ghost shark, pale: all Lookdown dory: all	Patagonian toothfish: all Prawn killer: all Redbait: all Ribaldo: RIB3-RIB8 Rubyfish: all Sea perch: SPE3-SPE7 Silver warehou: all Spiny dogfish: SPD4, SPD5 White warehou: all
Tier 3	Non-QMS species	

Observer-reported chondrichthyan catch composition

Around 59 chondrichthyan species/species groups have been observed in catches over the most recent five-year period. Spiny dogfish (*Squalus acanthias*) is the most abundant species caught and comprises ~1.1% of the overall total catch. Pale ghost chark (*Hydrolagus bemisi*) is the second-most abundant chondrichthyan at 0.4% of the overall catch. Both these species are managed under the Quota Management System. These, together with shovelnose spiny dogfish (*Deania Calcea*) (0.2%), Baxter's lantern dogfish (*Etmopterus baxteri*) (0.1%) and smooth skate (*Dipturus innominatus*) (0.1%) make up the top five species caught (Table 23).

Table 23: Observed chondrichthyan catch composition (t) by hake/hoki/ling targeted tows. Percentages based on total catch of all species. Green rows are QMS species, white rows are non-QMS species.

Species	2018/19	2019/20	2020/21	2021/22	2022/23	5-yr average (t)	5-yr average (%)
Spiny dogfish *Squalus acanthias*	612	427	595	839	687	632	1.10%
Pale ghost shark *Hydrolagus bemisi*	203	225	230	197	191	209	0.36%
Shovelnose spiny dogfish *Deania calcea*	91	77	135	177	68	110	0.19%
Baxters lantern dogfish *Etmopterus baxteri*	79	53	69	51	74	65	0.11%
Smooth skate *Dipturus innominatus*	46	71	55	58	54	57	0.10%
Ghost shark *Hydrolagus spp.*	70	40	50	35	47	48	0.08%
Leafscale gulper shark *Centrophorus squamosus*	42	35	47	40	37	40	0.07%

Long-nosed chimaera *Rhinochimaera pacifica*	23	26	41	27	26	28	0.05%
School shark *Galeorhinus galeus*	15	14	18	18	23	18	0.03%
Northern spiny dogfish *Squalus griffini*	7	18	10	17	30	16	0.03%
Other sharks and dogs	20	9	14	8	19	14	0.02%
Rough skate *Dipturus nasutus*	15	15	11	16	12	14	0.02%
Longnose velvet dogfish *Centroselachus crepidater*	9	12	12	27	4	13	0.02%
Lucifer dogfish *Etmopterus lucifer*	13	10	11	15	14	12	0.02%
Seal shark *Dalatias licha*	7	15	5	10	6	8	0.01%
Plunket's shark *Scymnodon plunketi*	9	10	5	7	4	7	0.01%
Porbeagle shark *Lamna nasus*	5	1	4	5	9	5	0.01%
Slender smooth-hound *Gollum attenuatus*	3	6	2	6	5	4	0.01%
Deepwater dogfish *Etmopterus spp.*	3	7	1	0	9	4	0.01%
Smooth skin dogfish *Centroscymnus owstoni*	1	3	7	2	3	3	0.01%
Other (x39 spp.)	21	14	10	17	12	15	0.03%

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. However, an exception to the fins attached requirement is provided for seven QMS species to allow at-sea processing to continue (Table 24). In contrast the MSC standard requires a fins naturally attached (FNA) policy to be in place for all retained sharks (GSA2.4.3-2.4.4) with no exceptions. The fishery can partially cut the fins, for the purpose of storage, freezing and draining carcasses, and fold them around the carcasses. However, fins should be attached to a substantial part of the shark, not just some vertebrae, allowing the shark to be easily identified to the species level. If fins are removed and then artificially attached to the carcass via ropes or wire or placed into a bag that contains that carcass and fins, this would not constitute FNA (GSA2.4.3-2.4.4). The MSC standard v3.0 specifies that a FNA must apply to all Chondrichthyan species within the Selachimorpha and Rhinopristiphormes (SA2.4.3.1). However, SA2.4.3.1a states if the UoA is part of a management agency whose definition of “shark” includes additional species, the management agency’s definition shall apply. In New Zealand, under Fisheries (commercial) fishing regulations 2001, shark is defined as a fish of the class Chondrichthyes but excludes Batoidea which is much broader than MSC definition (i.e. it includes Chimaerids).

Table 24: New Zealand conditions for landing shark fins (FNZ AOP, 2022).

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

All QMS shark species must be landed if taken. However, Schedule 6 provides for exceptions to this rule by listing QMS species which may be returned to the sea (FNZ, 2022), as follows:

- Rig (SPO) and School shark (SCH) – may be returned alive only
- Blue shark (BWS), mako shark (MAK) and porbeagle shark (POS) – may be returned alive or dead and if dead, balanced against ACE
- Spiny dogfish (SPD) – may be returned alive or dead and must always be balanced against ACE regardless of life status.

FNA – TBC!

Shark fins naturally attached (FNA) policy

MSC Fisheries Standard v3.0 MSC specifies that retained sharks should have their fins naturally attached, as per SA2.4.3.1.

The Standard defines sharks as selachimorpha (true sharks) and rhinopristiformes (e.g. shovel nose rays, guitar fishes). However, if the fishery operates within a jurisdiction that defines additional species such as skates or chimaeras, the assessment must consider those additional species.

In New Zealand two shark definitions are used:

1) The Fisheries (Commercial Fishing) Regulations 2001 defines sharks as 'a fish of the class *Chondrichthyes*, but excludes *Batoidea'*.
2) New Zealand's NPOA Sharks uses the term 'sharks' generally to include all species in the class Chondrichthyes (sharks, rays, skates and chimaeras).

SA2.4.3.1(a) identifies MSC is happy to use management agency definitions. Recognising the difference in shark definitions within New Zealand for different purposes it is expected that the definition to be used is the regulatory definition.

DWC is in consultation with MSC to amend the requirement to use management agency definitions, thereby removing the requirement to land chimaeras with fins naturally attached (FNA).

The MSC Standard outlines that:

‘Where reference is made to the requirement for FNA, in order to facilitate freezing and storage, the fishery could partially cut the fins, including for the purposes of draining blood to avoid ammonisation, and fold them around the carcasses. However, fins should be attached to a substantial part of the shark, not just some vertebrae, allowing the shark to be easily identified to the species level. If fins are removed and then artificially attached to the carcass via ropes or wire or placed into a bag that contains that carcass and fins, this would not constitute FNA’

The Evidence Requirements Framework is used to support the scoring of the shark finning Scoring Issues. The following information is provided to demonstrate the implementation of FNA or non-retention policy.

1. DWC Sharks Fins Naturally Attached Operational Procedures - operational changes around shark finning for the southern blue whiting UoAs (DWC, 2024).
2. A fleet-wide code-of conduct for deepwater vessels.

Additionally, to ensure the FNA policy is adhered to by vessels:

1. FNZ’s observer protocols have been updated to specifically require observers to look for any instances of shark finning, including for sharks that go into the meal plant.

- Where a shark is landed, observers record the species and determine its disposal code. The disposal code is cross-checked against DWC’s Sharks Operational Procedures to check they are landed in accordance with DWC’s operational documentation.

2. FNZ’s observer reports include a section reporting on any observation of shark finning.

DWC Sharks Fins Naturally Attached Operational Procedures for MSC certified fisheries

Purpose of these procedures

These operational procedures have been established to ensure vessels targeting MSC certified fisheries (hoki, hake, ling and southern blue whiting) meet the Fins Naturally Attached (FNA) policy in the new MSC standard and enable verification of shark processing.

Background

The new FNA policy has been developed by MSC as a way to address shark finning globally and ensure it does not occur in MSC certified fisheries. New Zealand has strict regulations to prohibit shark finning in national waters. (**https://legislation.govt.nz/regulation/public/2001/0253/latest/DLM6279825.html**). Despite this, MSC does not accept artificially attached fins or ratio approach which is allowable under regulations. The result of this is that some processed shark states will no longer be acceptable when targeting hoki, hake, ling and southern blue whiting. Operators will need to land sharks with their fins naturally attached or return to the sea non-QMS or QMS species in alignment with regulations.

Responsibilities of vessel owners, operators and managers:

All vessel owners, operators and managers must:

- Ensure key crew (including captain and factory manager) of vessels targeting hoki, hake, ling and southern blue whiting know what processing states of sharks are allowable under the FNA Policy, and which cuts are not permitted.
- Be responsible for corrective action if requirements are not met.

Responsibility of captain

All captains and senior crew must:

- Be aware of the requirements

- Ensure factory managers comply with the FNA policy.

Sharks FNA Policy

All sharks landed from hoki, hake, ling and southern blue whiting target fishing events must have their fins naturally attached to the body. Processed states which remove the fins from the body will not be allowed. Mealed sharks are acceptable so long as the species is identified, quantified and reported accurately (if there is an observer on board, this will be verified).

Species included in the FNA policy

For the purpose of these requirements “shark” is defined as all *Chondrichthyes* except *rays, skates (Batoidea) or chimaera*.

The following QMS and non-QMS species are the most frequently caught in deepwater fisheries. **Note, this does not include all sharks.**

Species included in FNA Policy

- School shark
- Spiny dogfish
- Rig
- Shovelnose dogfish
- Baxter's lantern dogfish
- Leafscale gulper shark
- Lucifer dogfish
- Seal shark
- Longnose velvet dogfish

Species excluded from FNA policy (process as normal)

- Elephantfish
- Pale ghost shark
- Dark ghost shark
- Long-nosed chimaera
- Smooth skates
- Rough skates

Processing of sharks

QMS and non-QMS shark species are permitted to be:

1. landed GRE
2. landed mealed
3. landed in another official process state which meets FNA policy
4. returned to the sea as discards (if non-QMS) or returned to the sea under landings and discard exemption notice or by observer authorized discards (if QMS species)

Partial cuts

In order to facilitate freezing and storage, vessels are able to partially cut the fins, including for the purposes of draining blood to avoid ammonisation, and fold them around the carcasses.

However, fins should remain attached to a substantial part of the shark, allowing the shark to be easily identified to the species level.

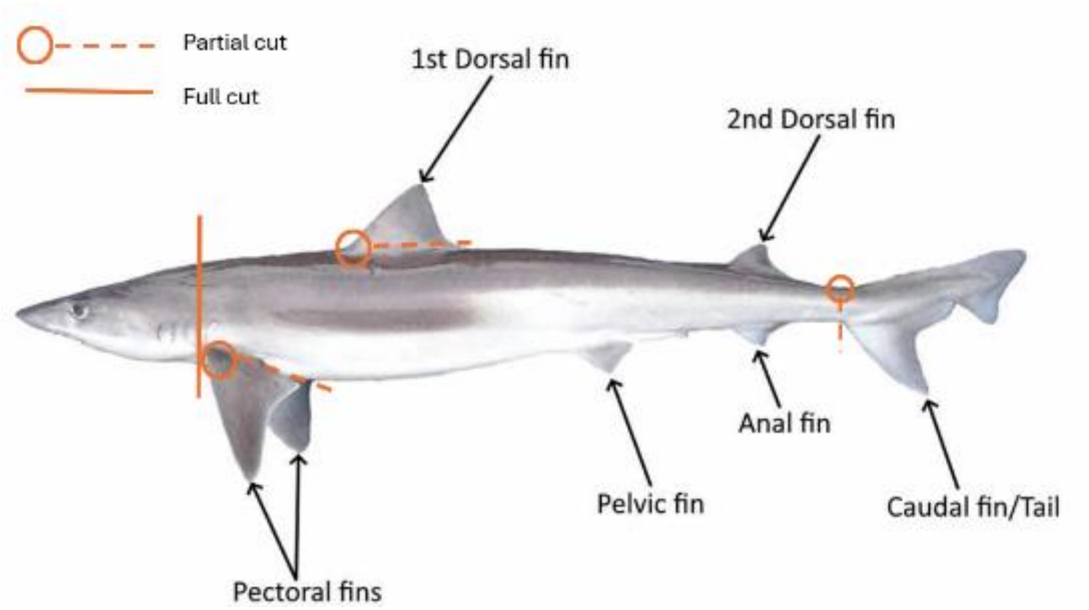


Figure 1: Locations of permitted cuts (this is an indicative guide of permitted cuts under FNA policy, this does not supersede regulatory cuts)

Reporting and verification

There are no changes to vessel reporting requirements under the FNA policy. FNZ observers may be required to verify that sharks being put to meal are not having fins removed before mealing occurs.

Contact

If you have any questions about these procedures, please get in contact with Ben Steele-Mortimer at DWC (bensm@southswell.co.nz or admin@deepwatergroup.org).

Trends in retained & bycatch species (In-scope species)

Over 800 bycatch species or species groups have been identified by observers in the hoki/hake/ling target trawl fishery, most being non-commercial species, including invertebrate species, caught in low numbers (Anderson et al., 2019). Estimates of the level of individual, non-target fish and invertebrate species catch by fishing year from 1990–91 to 2016–17 concluded the following:

- 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), (Finucci et al., 2019).

The most recent available information on catch composition of non-target catches and discards by the hoki/hake/ling fishery is from Anderson et al. (2019. This work represents the first time that the calculation of non-target catches and discards has been undertaken using observer data in a statistical model (Figure 35).

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%), 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. As a valuable quota species, they were mostly retained. Other squids and octopuses, sponges, echinoderms, and crabs were the other main invertebrate bycatch groups caught, all at less than 0.05% of the total catch, and most of these were discarded.

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 (*Deania calcea*), Baxters dogfish (*Etmopterus baxteri*), redbait (*Emmelichthys nitidus*), silverside (*Argentina elongata*), leafscale gulper shark (*Centrophorus squamosus*), and silver dory (*Cyttus novaezealandiae*).

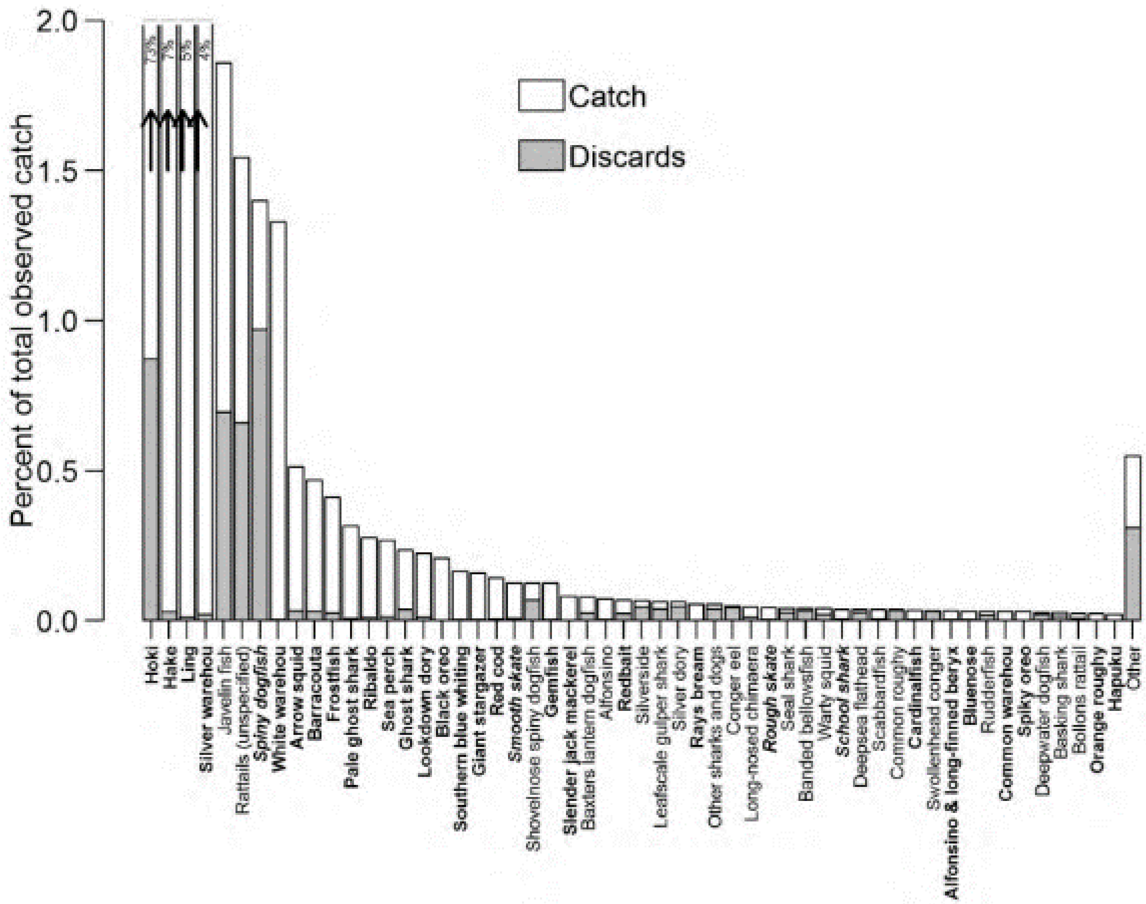


Figure 35: Percentage of the total catch contributed by the main bycatch species (those representing 0.02% or more of the total catch) in the observed portion of the HOK, HAK, LIN, SWA and WWA target trawl fishery for fishing years 2002–03 to 2016–17, and the percentage discarded. The Other category 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).

The total annual bycatch estimated by the observer-based model was 17,500–49,000 t between 1990–91 and 2016–17, varying over time approximately in proportion to total fishing effort throughout the period. Annual bycatch of QMS species (5,000–25,000 t) and non-QMS fish species (8,000–36,000 t), was approximately even although QMS species catch increased over time while non-QMS fish species catch decreased. Annual bycatch of non-QMS invertebrates increased significantly over time, from 400–700 t in the early 1990s to over 1,100 t after 2014–15 (Figure 36).

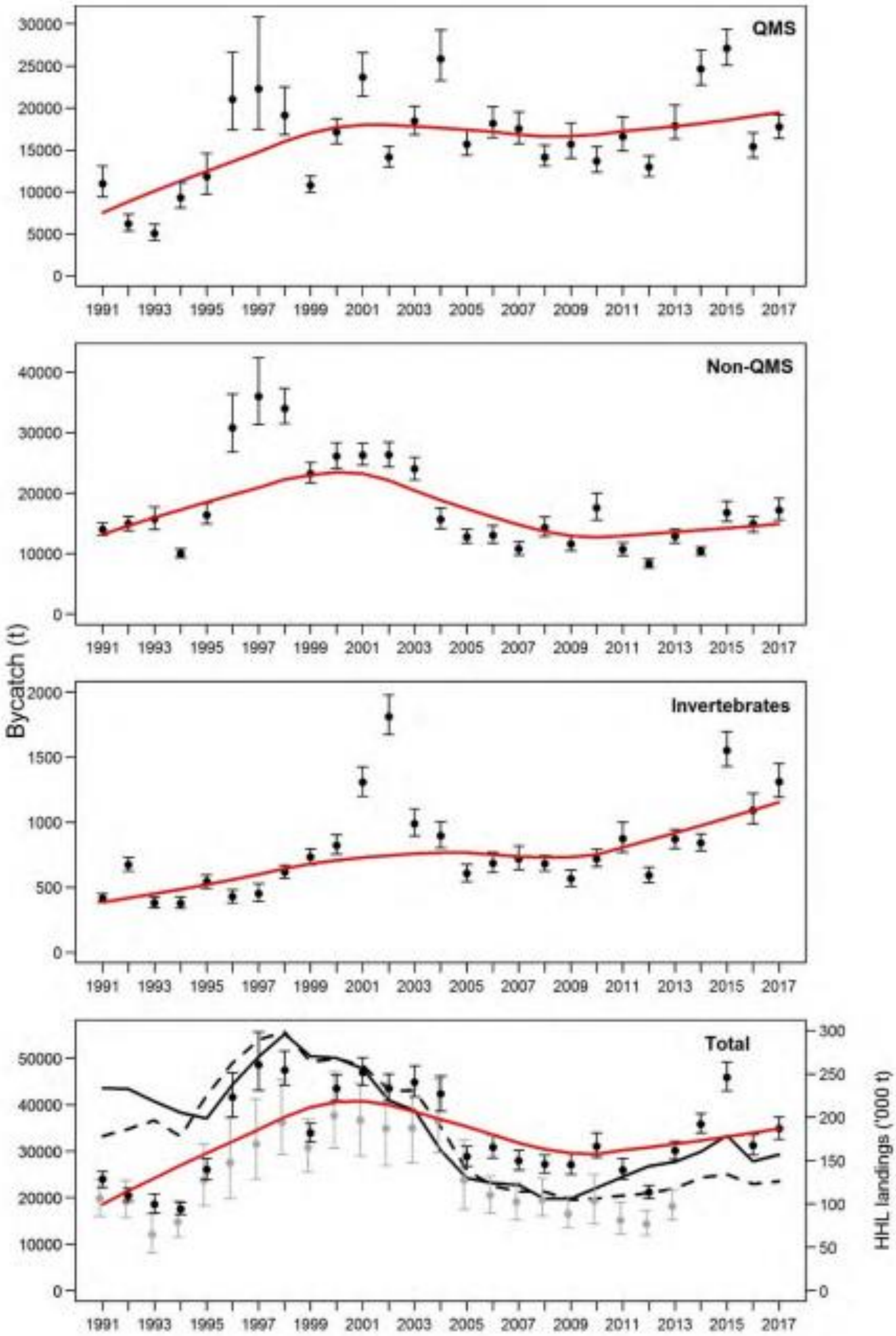


Figure 36: Annual estimates of bycatch in the target hoki, hake, ling, silver warehou or white warehou trawl fishery, by species category, for 1990–91 to 2016–17 (black dots). Error bars indicate 95% confidence intervals. The red lines show the fit of a locally-weighted polynomial regression to annual 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).

Discard estimates were calculated only for the period 2002–03 to 2016–17 for the primary target species (hoki, hake, ling) and were low, but highly variable, 76–2,300 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– 3,500 t) and a significant decline in non-QMS fish discards (2,000–19,000 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 processing species previously discarded. Total discards were 5,000–25,000 t per year and decreased significantly between 2002–03 and 2016–17 (Figure 37).

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 with 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 has been pronounced, with the highest discard rates associated with foreign-owned or chartered vessels, and the lowest with BATM vessels, which all have meal plants. Median discard rates were low for the small amount of fishing effort in area EAST, and lower also in areas COOK and AUCK, and for midwater trawls in area WCSI than in other areas. Discard rates were highest for bottom trawling in area WCSI.

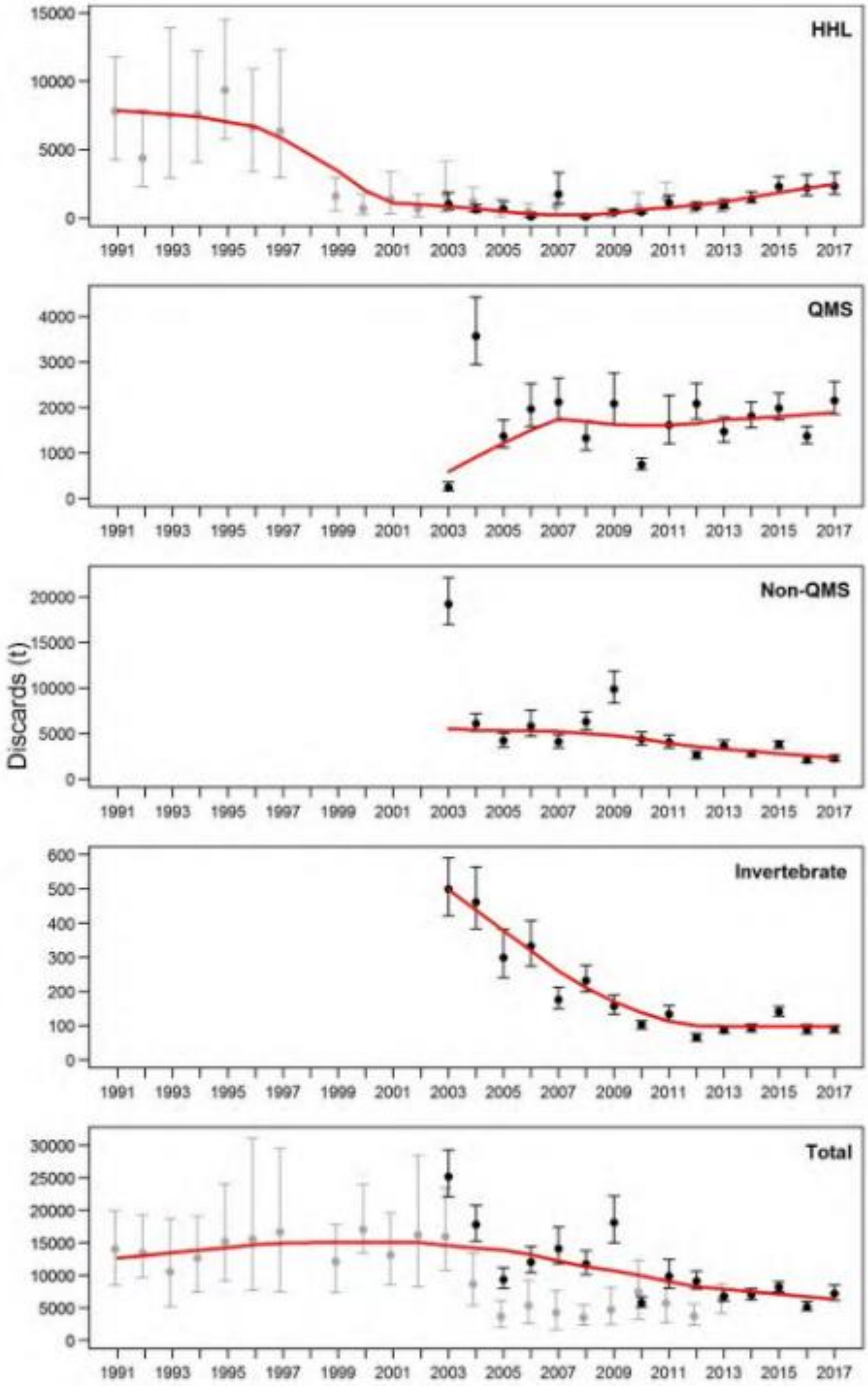


Figure 37: Annual estimates of discards in the target hoki, hake, ling, silver warehou or white warehou trawl fishery, by species category, for 2002–03 to 2016–17 (black dots). Error bars indicate 95% confidence intervals. The red lines show the fit of a locally-weighted polynomial regression to annual 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).

Ghost gear

MSC Fisheries Standard Version 3.0 requires fisheries to have effective measures in place to minimise gear loss and to mitigate the impact of any losses. Fisheries must implement management strategies to minimise gear loss and manage any impacts of lost gear. This could include measures to monitor lost gear, marking and retrieval programs and gear modifications, such as biodegradable locks on pots.

Regulatory framework related to ghost fishing gear

New Zealand maintains stringent regulations to ensure garbage lost at sea from vessels is minimised. The regulations primarily fall under the Maritime Protection Rules[2] but there are also components of the Fisheries Act (1996) which reduces risk of gear being lost.

Vessels are also required by law to report lost gear to authorities as shown in the extracts below.

Maritime Protection Rules

170.3 General prohibition on discharge of garbage into the sea:

1. Garbage is a harmful substance for the purposes of section 225 of the Act.
2. The discharge of garbage [including fishing gear] into the sea from a ship is prohibited, except as provided in this Part or the Act.

170.4 General exceptions to prohibition:

Nothing in this Part prohibits or restricts any person from discharging garbage from a ship if –

c) the discharge is an accidental loss of fishing gear from a ship and all reasonable precautions have been taken to prevent such loss; or
d) the discharge is a discharge of fishing gear from a ship for the protection of the marine environment or for the safety of that ship or its crew.

170.21 Reporting accidental loss or discharge of fishing gear:

In the event of an accidental loss or discharge of fishing gear referred to in 170.4(c) or (d) that poses a significant threat to the marine environment or navigation, the owner and the master of a ship to which this rule applies must report the accidental loss or discharge:

a) to the Director; and
b) if the accidental loss or discharge occurs within waters subject to the jurisdiction of a coastal State, to the appropriate authority in that coastal State.

DWC Management Strategy for lost gear

All vessels are required by law to report lost gear. This is done via Electronic Reporting System (ERS), (Figure 38).

Is net lost?	Enter *Yes* if the trawl net or any key component of trawl any additional details in the Notes field. In this case, rec and position in the *start location* and leave the *finish loc*

[2] Part 170 - Consolidated - Marine Protection Rules Part 199 Prevention of Air Pollution from Ships Various Amendments 2022 (maritimenz.govt.nz)

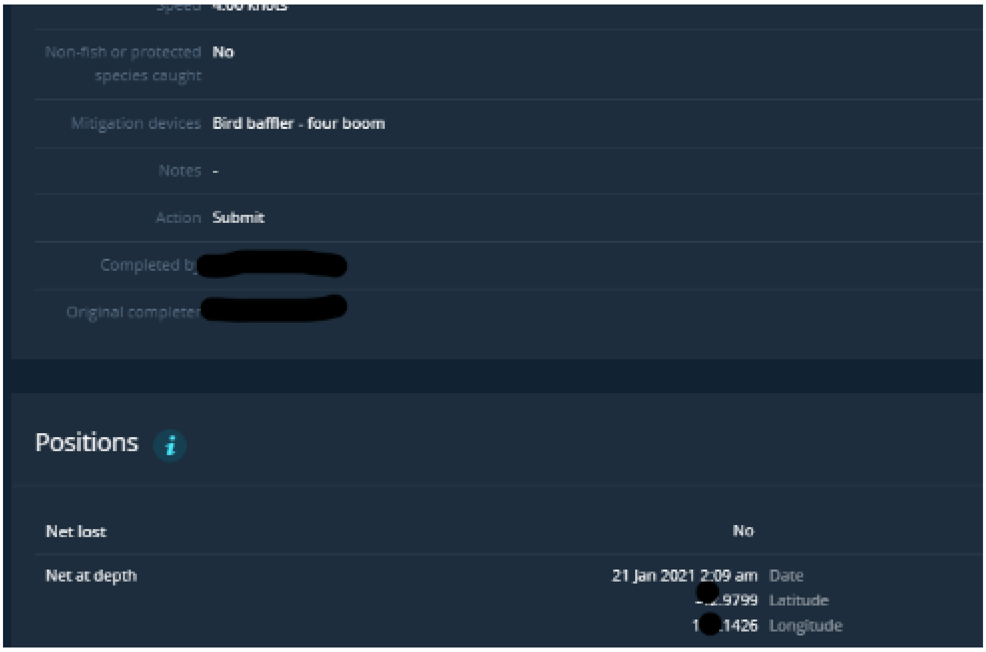


Figure 38: Screenshots from the ERS of the relevant reporting components for the statutory system.

In addition to their statutory requirements vessel operators in the HOK/HAK/LIN trawl fisheries have management strategies in place to prevent, mitigate and remediate gear lost or abandoned at sea (Table 25). Discarding gear at sea is prohibited unless under the circumstances noted above.

Table 25: Ghost Fishing Gear Management Strategy for HOK/HAK/LIN trawl fisheries

Prevention	• There is inherently very low risk of losing trawl fishing gear in the HOK/HAK/LIN fisheries. The gear is firmly attached to the vessel throughout fishing operations. Losing this type of gear is incredibly costly to the operator and so all precautions are taken to ensure gear is not lost.
	• Vessel managers and skippers ensure that gear is well maintained before, during and after use. E.g.
	  ○ nets are covered when not in use to avoid UV damage
	  ○ warps are kept appropriately greased to prevent abrasion
	  ○ gear maintenance is conducted when the gear is on board the vessel
	  ○ old or damaged gear is replaced.
	• In the Coastal Hoki Operational Procedures, vessels are required to have ‘windows’ in trawl net panels as a safety precaution if a high volume of fish in the net is a risk to crew and gear failure.
	• Most components of fishing gear are marked for identification

Mitigation	• The nature of trawl fishing requires waterflow through the net to herd and funnel fish into the codend of the net. A trawl net without drag and lift will collapse and won’t have the ability to catch fish. If a whole trawl were to be lost, the heavy ground gear and doors would pull the gear to the seafloor. If meshing alone were to be lost as sea, it may remain in the water column and move depending on current flows. However, due to the configuration of trawl nets, losing a single piece of meshing is highly unlikely.

	• Trawl doors, ground ropes or floats lost at sea do not have the characteristics that would result in ghost fishing. E.g. trawl doors would remain on the seabed, and while they may attract marine communities, they would not be classed as 'ghost fishing'.
Remediation	• Trawl gear in these fisheries cost hundreds of thousands of dollars with expensive sensors and other electronics attached. There is significant economic incentive to retrieve gear if lost. • If in the unlikely event a trawl is lost or abandoned at sea, the catch sensors in the codend and net sonde on the headline will emit a signal for up to a week after it is lost. Vessel acoustic systems can pick up the signal and locate the lost gear. • The skipper is also required to record lost fishing gear in ERS, including the specific location of where it was lost. Some vessel operators also maintain a register of garbage (fishing gear) lost at sea. Some do not as it is such an infrequent occurrence. • Sophisticated geo-position sensors on gear during fishing also helps with locating gear. • Once the gear is located, vessels have grapnels onboard to retrieve the gear. • Garbage, including other fishing gear is occasionally trawled up by vessels. Operators will always return this rubbish to shore instead of putting back overboard.

Available data sources

- FishServe has all events where gear was reported 'lost'
- Observers record events where gear has been lost
- Some operators have a register of lost gear.

There have been three lost gear events recorded through ERS between 2019-20 to 2021-22 for the HOK/HAK/LIN and southern blue whiting trawl fisheries combined. For one of these events the trawl was retrieved using grapnels. It is not clear what the situation was for the other two events i.e. what the specific gear was and whether it was retrieved or not.

DWC is of the view that effects of ghost fishing gear are demonstrably absent or negligible in these fisheries.

ETP and OOS species observer programme

The Conservation Services Programme (CSP), administered by the Department of Conservation, has as its aim to avoid, remedy or mitigate the adverse effects of commercial fisheries on protected species. The CSP Annual Plan outlines the conservation services projects required to be delivered each year and forms the basis for levying the commercial fishing industry to cover these costs under the Fisheries Act 1996. The CSP objectives are as follows (DOC, 2023):

- Objective A: Proven mitigation strategies are in place to avoid or minimise the adverse effects of commercial fishing on protected species across the range of fisheries with known interactions
- Objective B: The nature of direct adverse effects of commercial fishing on protected species is described
- Objective C: The extent of known direct adverse effects of commercial fishing on protected species is adequately understood

- Objective D: The nature and extent of indirect adverse effects of commercial fishing are identified and described for protected species that are at particular risk to such effects
- Objective E: Adequate information on population level and susceptibility to fisheries effects exists for protected species populations identified as at medium or higher risk from fisheries.

The CSP planning for middle-depth and deepwater fisheries considers and works in parallel with other relevant planning and management processes such as those prescribed in the following:

- National Plan of Action (NPOA) for seabirds
- National Plan of Action for sharks
- Threat Management Plan (TMP) for the New Zealand sea lion

The planning process is iterative and inclusive and ensures that gaps are identified and research synergies are maximised. Observer coverage is planned and prioritised based on specific monitoring objectives for protected species interactions with fisheries and achieving adequate coverage levels for high-risk fisheries to allow detection of changes in bycatch over time. Coverage is aimed at reducing uncertainly around the risks to protected species and assessing mitigation options for identified interactions. The allocation of observer coverage across fisheries is guided by factors including data needs for protected species and fisheries management, compliance, and international obligations, with particular consideration of:

- Independently verifying protected species captures
- Fishing effort
- Past observer coverage
- Monitoring of high value stocks or fisheries where there may be a sustainability risk
- Current level of information, especially for recently protected species
- The status of threatened protected species
- Historic mortality of protected species and risk assessment work which has been undertaken
- Requirements under the NPOAs and any relevant TMPs or Strategies
- Planned and ongoing research priorities/projects for DOC and FNZ
- Ministerial directives.

The CSP concedes that observer placements and coverage rates typically have high spatial and temporal variation, as well as multiple competing priorities for information collection, which can result in inconsistent data collection and may hamper efforts to interpret and extrapolate bycatch rates by fishery, location, or other variables. Data accuracy and reliability can be affected by inter-observer variability and weather conditions, while precision is affected by the observer sampling design. In addition, as it is not always possible to place observers on vessels randomly or representatively, data quality may also be biased by the opportunistic allocation of observers to vessels. Nevertheless, it is considered that the use of fisheries observers is currently the most reliable and flexible means of acquiring data on protected species interactions (DOC, 2023).

Observers working in the offshore deepwater and middle-depth trawl fisheries have multiple priorities including stock assessment data collection, compliance monitoring, protected species research and benthic interaction monitoring. As these fisheries have had historically high and consistent levels of observer coverage over the last ten years, they are well characterised. CSP-focused observer days in these fisheries is therefore less than that allocated to monitoring of commercial fishing and recording of associated biological data, but still deemed sufficient for monitoring of ETP species interactions and compliance with mitigation requirements.

CSP observer focus in 2023-24 was prioritised in specific fishery areas as follows:

3. Cook Strait hoki spawn fishery (HOK 1) – increased observer coverage due to high fur seal interactions.

4. Chatham Rise (HOK 1, HAK1&4, LIN 3&4) - observer focus is on:

- ETP coral capture
- Monitoring and recording of interactions with, and behaviours of, seabirds
- Recording information on mitigation techniques used, including:
    - bird scaring devices
    - offal and discard management
    - trawling known tracks to avoid catching deep sea invertebrates.

5. Sub-Antarctic (HOK 1, HAK 1, LIN 5&6) – observer focus is on:

- Monitoring and recording of interactions with, and behaviours of fur seals and sea lions
- Seabird interactions and behaviour, due to the close location to many seabird breeding islands
- Monitoring of ETP coral captures.

6. West Coast South Island (HOK 1, HAK 7, LIN 7) – observer coverage will target the hoki spawning season during July and August. The fleet has high levels of interactions with fur seals and a wide range of seabirds. The fleet is broadly divided between larger vessels which operate outside the 25 nm line and smaller vessels which operate within 25 nm of the coast. Observer coverage levels are specified specifically for each of these two fleets due to their different fleet dynamics and their associated bycatch profiles (Doc, 2023).

ETP and OOS 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.

DWC Liaison Programme for ETP Species Risk Management

During 2018-19, DWC'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, 2022, 2023).

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 DWC 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 DWC, 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, 2022, 2023).

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 DWC 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 DWC 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).

Protected Species Website

Information and data on incidental captures of ETP species reported by the MPI Observer Programme is published on Fisheries New Zealand's Protected Species Bycatch website, which enables captures of protected seabirds, marine mammals, sharks and turtles by the commercial fisheries to be interrogated by species, fishery type, vessel type, area and fishing year.

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 FNZ)
- 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.

Seabird capture rate reduction targets were established under the NPOA Seabirds for use in comparing them to baseline capture rates. The latter were defined as the average estimated capture rates across the three-year block leading up to the implementation of the NPOA Seabirds 2013 (i.e. the 2010/11 to 2012/13 fishing years), with at least 10% observer coverage and an estimated seabird capture rate coefficient of variation (CV) of less than 0.30. For vessels >28 m length in the middle depth trawl fisheries, the agreed capture rate reduction target was 2.3 estimated captures per 100 tows (i.e. a 15% reduction compared to the baseline of 2.7 estimated captures per 100 tow).

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 (i.e. middle depth) trawlers, illustrating that small albatross species (i.e. mollymawks), petrels & shearwaters are the most abundant groups caught (FNZ, 2020a; FNZ, 2021b; FNZ, 2022a). Historical capture rates for the squid and middle depth trawl fisheries show that for the middle depth trawl fishery the capture rate has remained reasonably stable but with a slight downward trend towards the baseline level in 2020/21 of 2.36 captures per 100 tows (Figure 39), (FNZ, 2023). The substantial decrease in capture rate in the squid trawl fishery is mainly due to a decrease in warp strikes/captures, brought about by implementation of warp-scaring/excluder devices and the practice of batch-discarding of offal (Reid et al., 2023).

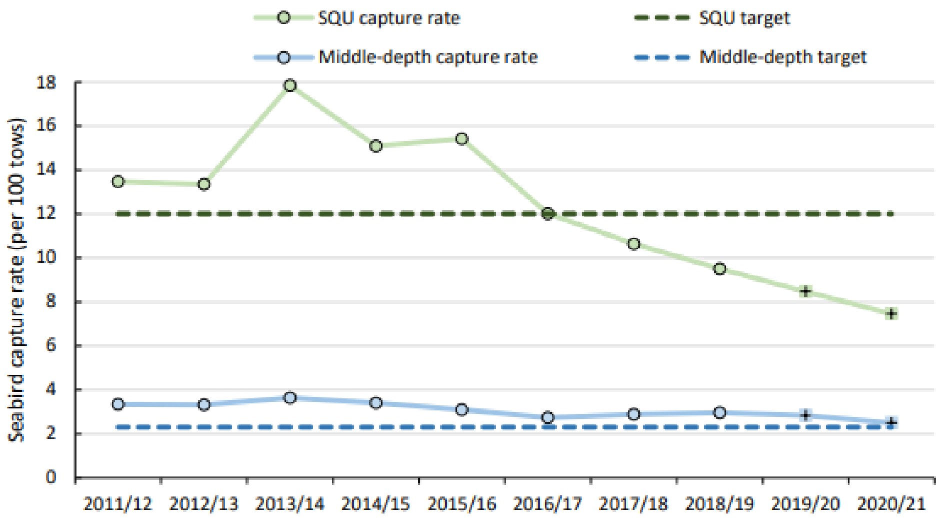


Figure 39: Estimated seabird capture rates (captures per 100 tows) relative to agreed reduction targets, for the >28 m squid and middle-depth trawl fisheries between the 2011/12 and 2020/21 fishing years. As seabird capture rates are expressed as three-year rolling averages, data for 2020/21 represents the average for the 2018/19, 2019/20 and 2020/21 years. Data taken from the Protected Species Bycatch webpage.

Developments in seabird mitigation

It is noteworthy that while seabed mitigation methods and practices (i.e. as per agreed Operational Procedures) by the middle depth and squid fisheries are identical, the squid fleet has shown a substantial catch rate reduction to well below the baseline target in recent years, while the mid water fleet catch rate has more-or-less flat-lined. Much of the squid fishing effort occurs in southern areas where it overlaps with seabird breeding areas and where seabirds are more abundant. Clearly, mitigation methods here over the last decade have proven effective in substantially reducing capture rates. However, net captures have remained stubbornly persistent, a phenomenon common to squid and middle depth trawl fisheries, indicating that these mitigation methods have limitations in that they have been unable to completely eliminate fatal interactions with trawl gear.

As most captures now involve interactions with trawl nets, a Net Capture Programme was initiated in 2019 to explore additional ways of reducing these interactions and is on-going. The trials have focused on three mitigation approaches to date:

1. Attraction – minimising seabird attendance by reducing cues such as sound and scent.
2. Deterrence – keeping attendant seabirds away from the danger area by distraction, scaring.
3. Prevention – creating physical and/or visual barriers to seabird-net interaction.

In addition, an analysis was conducted to quantify the risks of net captures associated with different gear configurations and operational factors associated with trawl fisheries operating in the southern areas of the EEZ where seabird interactions are highest. The model estimated relative risk as a probability of seabird capture for multiple capture types, and by species group, and identified the following risks associated with fishing practices (Edwards & Dunn, 2021):

- Time of day and season (i.e. higher risk at night and during breeding season)
- The duration of time that a net remained on the surface (i.e. food source availability)
- The magnitude of other commercial fishing effort in the local vicinity at the time of the haul (i.e. a dilution effect when large numbers of vessels were present)
- The type of mesh in the codend (with rotated mesh yielding the lowest probability of capture)
- The type of mesh in the lengthener (with hexagonal mesh presenting the lowest risk)
- Weather conditions (i.e. lower risk in rough sea conditions)

However, despite significant funds and resources being invested into research, desktop studies, sea trials and other work, no ‘silver bullet’ solution has emerged to bring about further significant reductions to the risk of seabirds getting entangled in trawl nets (Wells et al., 2021; Steele-Mortimer & Wells, 2023).

Efforts to improve seabird capture mitigation are ongoing and are challenging.

Seabird Risk Assessments

A Spatially Explicit Fisheries Risk Assessment (SEFRA) method, as developed for non-target species in trawl fisheries, estimates the encounter rate between such species and fishing effort as a function of the overlap (in space and time) between mapped species distributions and mapped fishing effort distributions (Sharp et al., 2009). The SEFRA framework for seabirds in the New Zealand Exclusive Economic Zone, covering captures by all trawl, longline and setnet fisheries, attempts to quantify the impact of commercial fisheries on New Zealand populations of 71 seabird species (Sharp et al., 2011; Edwards et al., 2023). The 2023 SEFRA has made significant structural changes in order to improve seasonal resolution and improve the transparency diagnosis of the capture predictions and some of the species risk ratios produced by this update are noticeably different from those of the 2017 and 2020 seabird risk assessments (Richard et al., 2017; Richard et al., 2020), reported to be a result of the structural changes to the model.

The results from the 2023 SEFRA show that only southern Buller's albatross (code XBM) was estimated to have a risk metric of greater than one, indicating that current captures are higher than can be sustained by the population over the long term (Table 26), noting that the SEFRA considered captures by all trawl, longline and setnet fisheries in the EEZ and did not specifically include a category for hoki, hake and ling targeted tows. It is assumed that the bulk of captures by the UoA would have been accounted for within the category 'Large Freezer', which accounted for only 27% of all southern Buller's captures over the period 2006-07 to 2019-20 (Edwards et al., 2023a).

Table 26: Annual observable captures, deaths and risk per species, ranked from highest to lowest median risk for the top 14 species. Red: risk ratio with a median over 1 or upper 95% credible limit (u.c.l.) over 2; dark orange: median over 0.3 or u.c.l. over 1; light orange: median over 0.1 or u.c.l. over 0.3; yellow: u.c.l. over 0.1.

	C_s		D_s		Risk	
Code	Mean	95% CI	Mean	95% CI	Median	95% CI
XBM	242.2	[208.0-280.7]	728.5	[554.5-938.7]	1.19	[0.71-2.65]
XSA	299.5	[256.0-349.0]	1706.3	[1291.0-2258.5]	0.69	[0.35-1.69]
XWM	570.0	[506.3-638.3]	2634.8	[2071.1-3334.1]	0.50	[0.29-1.07]
XBP	221.8	[180.3-279.0]	256.1	[177.6-352.2]	0.49	[0.30-0.82]
XWP	89.9	[65.7-121.3]	143.3	[91.2-220.5]	0.38	[0.17-0.88]
XCI	26.9	[14.7-43.0]	61.5	[33.5-98.7]	0.27	[0.13-0.68]
XFS	253.0	[211.7-296.7]	368.1	[264.3-493.5]	0.22	[0.12-0.44]
XNB	63.2	[43.3-88.7]	173.8	[109.3-262.9]	0.19	[0.10-0.43]
XAU	33.0	[20.7-48.0]	41.9	[22.9-68.4]	0.16	[0.08-0.37]
XAN	31.8	[21.0-44.0]	38.3	[21.8-60.3]	0.16	[0.08-0.35]
XWC	895.8	[820.0-975.0]	1694.3	[1295.3-2319.9]	0.09	[0.06-0.18]
XRA	22.5	[12.7-36.3]	49.6	[25.9-84.6]	0.08	[0.04-0.17]
XNP	6.2	[1.7-14.3]	16.0	[4.1-35.0]	0.08	[0.02-0.22]
XCM	30.9	[18.7-46.7]	68.5	[37.8-117.6]	0.05	[0.03-0.14]

Species codes:

XBM southern Buller's albatross; XSA Salvin's albatross; XWM New Zealand white-capped albatross; XBP black petrel; XWP Westland petrel; XCI Chatham Island albatross; XFS flesh-footed shearwater; XNB northern Buller's albatross; XAU Gibson's albatross; XAN Antipodean albatross; XWC white-chinned petrel; XRA southern royal albatross; XNP northern giant petrel; XCM Campbell black-browed albatross.

Reviewing the 2017, 2020 and 2023 risk assessment results indicates, overall, a continued reduction in risk, indicating that ongoing operational mitigation is resulting in beneficial outcomes.

DOC's conservation status classifications (Robertson et al., 2012; 2016; 2021), and putative 2023 classifications, are provided below (Table 27) for the main species incidentally captured by New Zealand fisheries.

Table 27. Change in DOC threat classifications for the most prevalent incidental seabird captures in all trawl fisheries.

Species	DOC Threat Classification 2012[1]	DOC Threat Classification 2016[2]	DOC Threat Classification 2021[3]	DOC Threat Classification 2023	Status change
Southern Buller's albatross	Naturally Uncommon	Naturally Uncommon	At Risk - Declining	Nationally Critical	Worse
Salvin's albatross	Nationally Critical	Nationally Critical	Nationally Critical	At Risk - Declining	Better
White-capped albatross	At Risk - Declining	At Risk - Declining	At Risk - Declining	At Risk - Declining	No change
Black (Parkinson's) petrel	Nationally Vulnerable	Nationally Vulnerable	Nationally Vulnerable	Nationally Vulnerable	No change
Westland petrel	Naturally Uncommon	Naturally Uncommon	Naturally Uncommon	Naturally Uncommon	No change

The median risk ratios of the top 5 most at risk seabird species from the 2015, 2017, 2020 and the 2023 Spatially Explicit Fisheries Risk Assessment (SEFRA) are provided below (Table 28). Species with a median risk ratio <1 are not expected to hinder the achievement of population management (Richard et al., 2020). While the risk ratio for southern Buller's albatross is currently assessed to be >1, it is clear that estimates for this species have been highly variable over the last four risk assessments, and it is important to note that these risk assessments consider impacts by all fisheries in New Zealand waters, not just the UoA fisheries

The 2020 risk assessment (FNZ, 2020), noted an overall decline in seabird interactions consistent with the declining effort in all trawl fisheries over the study period. The risk ratios post-2015 have for the most part shown very great improvements (Table 28).

Table 28: Median risk ratios (and 95% CIs) and SEFRA risk classifications for captures of the top 5 seabird species across all trawl, longline and setnet fisheries in New Zealand waters.

Species	2015 risk ratio (data to 2012-13)	2017 risk ratio (data to 2014-15)	2020 risk ratio (data to 2016-17)	2023 risk ratio (data to 2019-20)	2023 SEFRA Risk Classification (all fisheries combined)	Risk Ratio Trend
Southern Buller's albatross	1.82 (0.97-3.67)	0.4 (0.22-0.69)	0.37 (0.21-0.6)	1.19 (0.71-2.65)	Very high	Variable
Salvin's albatross	3.44 (1.82-6.50)	0.79 (0.52-1.12)	0.65 (0.42-0.94)	0.69 (0.35-1.69)	High	Steady
White-capped albatross	1.10 (0.59-1.97)	0.38 (0.22-0.62)	0.29 (0.18-0.46)	0.50 (0.29-1.07)	High	Variable
Black petrel	11.34 (6.85-19.81)	1.15 (0.51-2.03)	1.23 (0.55-2.11)	0.49 (0.30-0.82)	High	Decreasing

Westland petrel	0.53 (0.21-1.38)	0.55 (0.21-1.28)	0.54 (0.26-1.12)	0.38 (0.17-0.88)	High	Steady

In 2020-21, hoki-targeted trawl tows resulted in 99 observed captures of all seabirds, of which 20 (20%) were released alive. The catch was dominated by white-chinned petrel (37), Salvin's albatross (17), sooty shearwater (12), New Zealand white-capped albatross (11), and southern Buller's albatross (9). Live-releases were dominated by white-capped albatross.

The total estimated number of birds caught was 176 (95% c.i. 148 – 210), (FNZ, 2021). The estimated number of all seabird mortalities by hoki-targeted tows from 2017-18 to 2020-21 shows a declining trend (Figure 40).

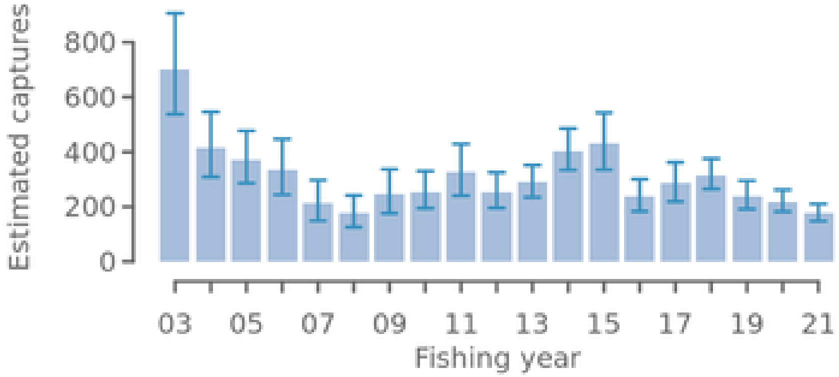


Figure 40: Hoki trawl fishery estimated total incidental seabird captures (dead and live released) 2002-03 to 2020-21.

Hake-targeted trawl tows have produced very few seabird captures in recent years, estimated at less than 1 per annum over the most recent five-year period (Figure 41) (FNZ, 2021).

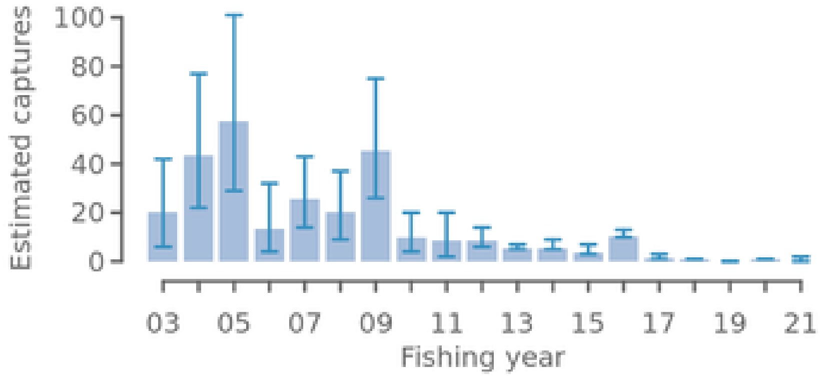


Figure 41: Hake trawl fishery estimated incidental seabird captures 2002-03 to 2020-21.

Ling-targeted trawl tows resulted in 5 observed captures of all seabirds in 2020-21, of which one was released alive. The captures comprised southern Buller's albatross (2), New Zealand white-capped albatross (2), and common diving petrel (1). Around 22 seabirds were estimated captured in 2020-21 and there has been a decreasing trend in captures since 2014-15 (Figure 42), (FNZ, 2021).

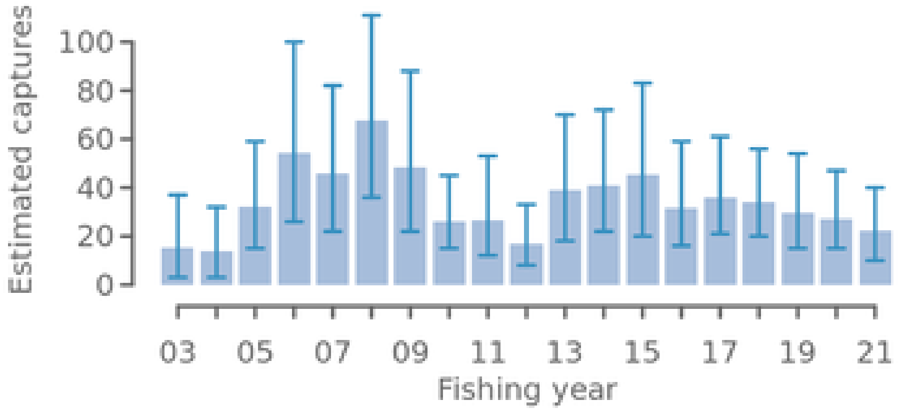


Figure 42: Ling trawl fishery estimated incidental seabird captures 2002-03 to 2020-21.

In 2020-21, 67% of observed seabird captures by hoki and ling targeted trawls were classed as ‘net captures’, of which 21% were released alive. The smaller species (e.g. petrels or shearwaters) generally get trapped inside the net when they dive into its mouth, while larger species (e.g. albatrosses) tend to get tangled in the meshes when they try to seize fish from the outside. Deck captures accounted for 12% of captures of which 88% were released alive (FNZ, 2021).

Seabird species most at risk

The following species-specific information has been provided for the most prevalent incidental seabird captures by the UoA 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, 2023).

Southern Buller’s albatross

Southern Buller’s albatross, endemic to New Zealand, breeds in four separate island locations with the estimated annual breeding population of approximately 15,000 pairs being spread between the Snares Islands (8,704 pairs), the Solander Islands (5,280 pairs), (Edwards et al., 2023).

The most recent counts of breeding pairs in 2024 showed decreases for Mollymawk Bay, Upper Punui Bay and Lower Punui Bay (Sagar et al., 2024). Counts in 2022 were at an all-time high for the 32-year duration of the study (Thompson & Sagar, 2022). The cause of the recent decline is unknown (Figure 43). Prior to the 2024 report, it had been estimated that the Snares Islands population had almost doubled since 1969 (BirdLife International, 2024). The rate of increase slowed in the 1990s and then became stable between 2002 and 2014 (Sagar *et al.* 1999b, Sagar and Stahl 2005, Sagar 2014). The second-largest breeding population, on the Solander Islands, remained relatively stable during the period 1985 - 1996 and increased by around 1.36% per annum from 1996 - 2016 (Sagar and Stahl, 2005; Thompson *et al.* 2016). No counts were made here in 2024.

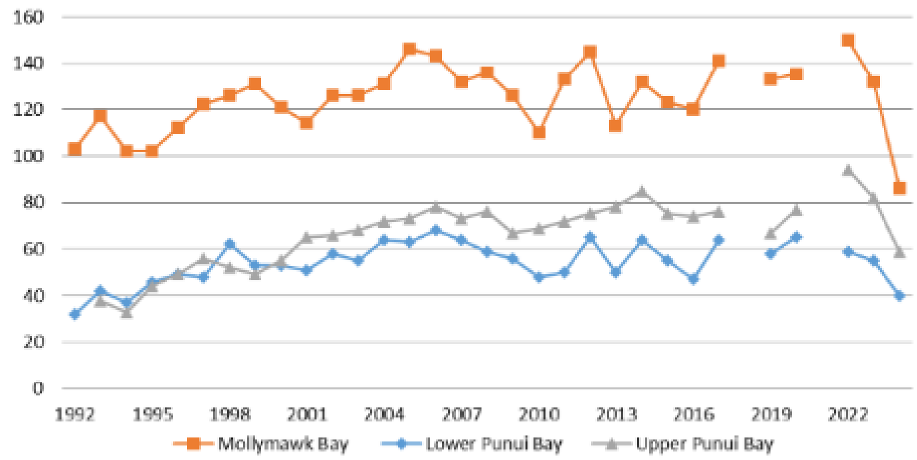


Figure 43: Count of southern Buller's albatross breeding pairs (nests) at three study colonies on Northeast Island, The Snares 1992-2024.

The diet of southern Buller's has been examined through food delivered to chicks at the Snares and Solander Islands (James & Stahl, 2000). Fish (mostly fishery discards comprising hoki *Macruronus novaezelandiae* and jack mackerel *Trachurus* sp.) dominated the diet, occurring in 92% of samples and forming 65% by weight of solid food. Cephalopod remains (mostly *Notodarus* spp. and *Histioteuthis atlantica*) occurred in 53% of samples, but salps (*Pyrosoma* sp. and *Iasis zonaria*) were the most abundant prey items (44% by number and 24% by weight of all prey). The authors concluded that the high proportion of fish in the diet strongly suggested that discards from fishing operations had a beneficial effect on the population of southern Buller's albatrosses breeding on the Snares Islands. It is therefore ironic is that efforts by the fishing industry to reduce interactions with seabirds, commencing around 2004, involving a significant reduction in bycatch and offal discarding (now largely rendered to fishmeal aboard vessels), may have negatively affected the survival of chicks in recent years.

Observed captures of southern Buller's albatross by hoki-targeted trawl tows over the most recent 5-year period 2016-17 to 2020-21 have ranged between 5 and 22, with an average of 12 birds per annum. Captures by hake-targeted tows are negligible, while 3 captures have been recorded for ling-targeted tows during the recent 5-year period (Figure 44), (FNZ, 2021).

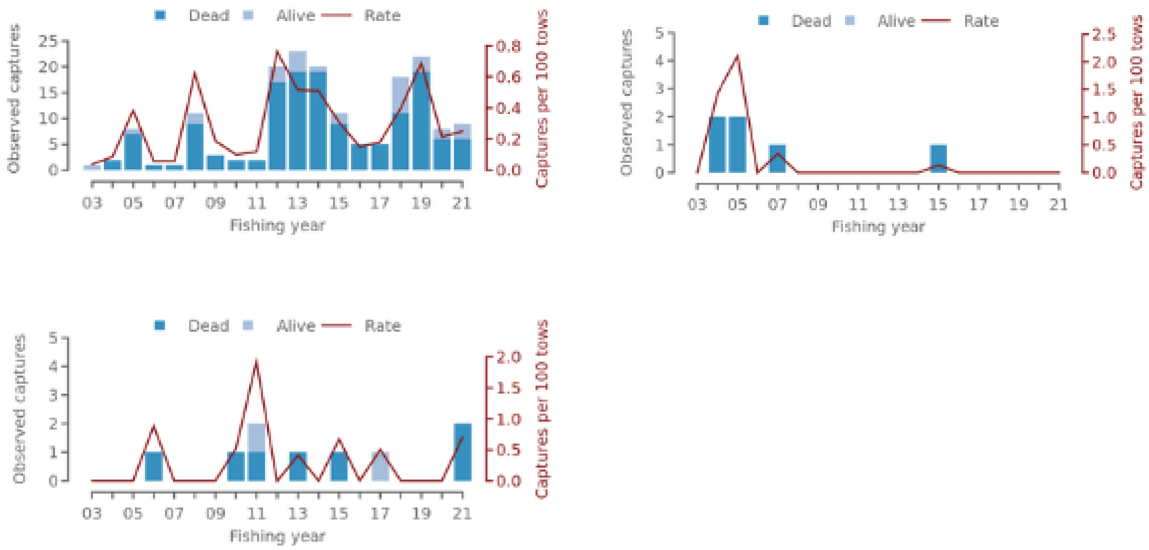


Figure 44: Observed captures and capture rates of southern Buller's albatross by hoki (top left), hake (top right) and ling (bottom) trawl fisheries 2002-03 to 2020-21.

The 2023 SEFRA risk ratio for southern Buller's albatross, of 1.19 (95% CI 0.71 – 2.65), suggests that current deaths exceed the sustainable death rate. The SEFRA analysis encompassed captures by all fisheries (i.e. trawl, longline & setnet). Captures by UoA vessels are most likely to have been accounted for within the trawl category 'Large Freezer', which was responsible for 27% of southern Buller's captures over the period 2006-07 to 2019-20 (Edwards et al., 2023a).

It should also be noted that during egg incubation (Jan-Mar) birds range along the shelf slope off the east and west coasts of the South Island, New Zealand, and into the Tasman Sea, where the encounter international surface longline fleets targeting southern bluefin tuna. After breeding, southern Buller's of all ages range widely, foraging off the coasts of Chile and Peru (Figure 45), (ACAP, 2009). It is clear that risks to southern Buller's extend well beyond New Zealand's waters and fleets.

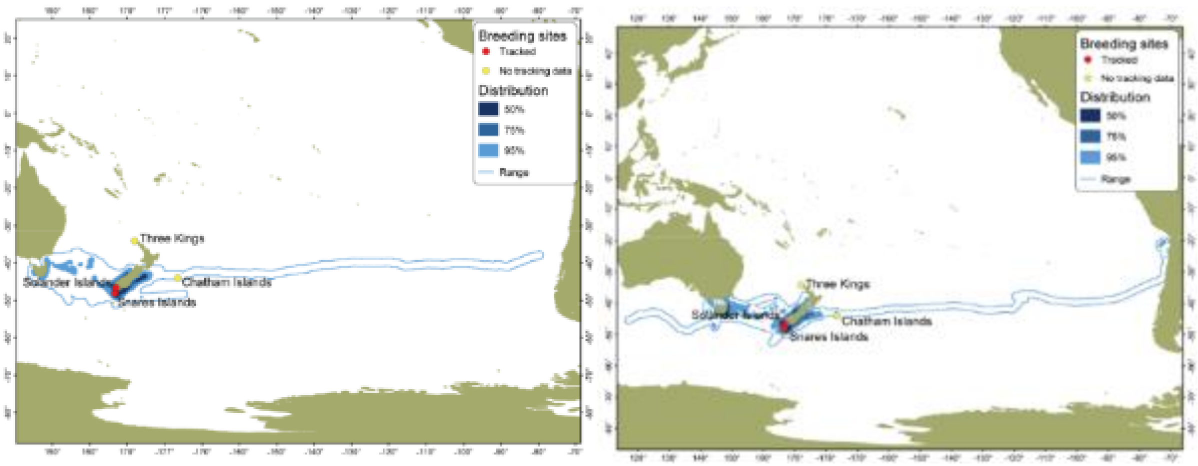


Figure 45: Satellite tracking data of breeding adult (Left) and juvenile and non-breeding (Right) southern Buller's from the Snares and Solander Islands (ACAP, 2009).

Note that, in contrast to DOC's 'Nationally Critical' threat classification for southern Buller's, BirdLife International lists southern Buller's as 'Near Threatened' (BirdLife International, 2024). They do so on the basis that "*although it is restricted to a small area when breeding, the population is stable and the islands on which it breeds are moderately widely spread so it is unlikely to become highly threatened in a short time owing to human activities or stochastic events*".

As fisheries observers are unlikely to be able to reliably differentiate Northern Buller's (*Thalassarche bulleri*) and Southern Buller's (T. *bulleri bulleri*), due to their very similar appearance (Figure 46), observer sightings-based data were informative only of the distributions of the two species combined.

Figure 46: Northern Buller's albatross (Left), (photo © Nature Quest) and southern Buller's albatross (Right), (photo © Peter Shearer).

Confirmed species identifications from necropsies of fishery-captured birds enabled modelled predicted spatial distributions (Roberts et al., 2022), for the two Buller's species combined in the New Zealand EEZ, to be spatially disaggregate, thereby producing predicted distributions separately for the two species (i.e. Northern and Southern Buller's), (Figure 47).

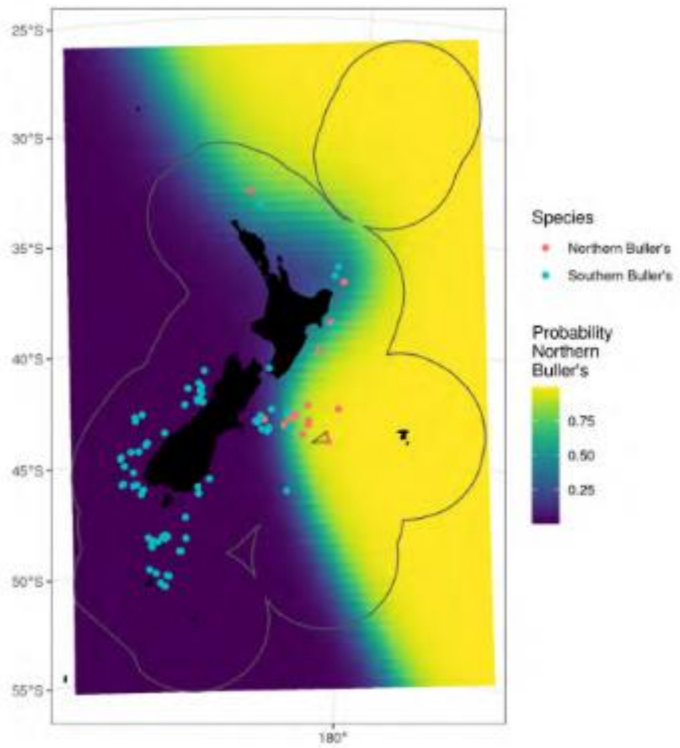


Figure 47: Spatial probability of Northern Buller's albatross and spatially explicit necropsy data for confirmed Southern and Northern Buller's (points) used to inform the model (Roberts et al., 2022).

The model predicted that Southern Buller's albatross are the dominant subspecies around all of the South Island and off the west coast of the North Island, whereas Northern Buller's albatross were predicted to be dominant around the Chatham Islands, where their largest breeding colony is located and in offshore regions to the north and east of the North Island (Figure 48).

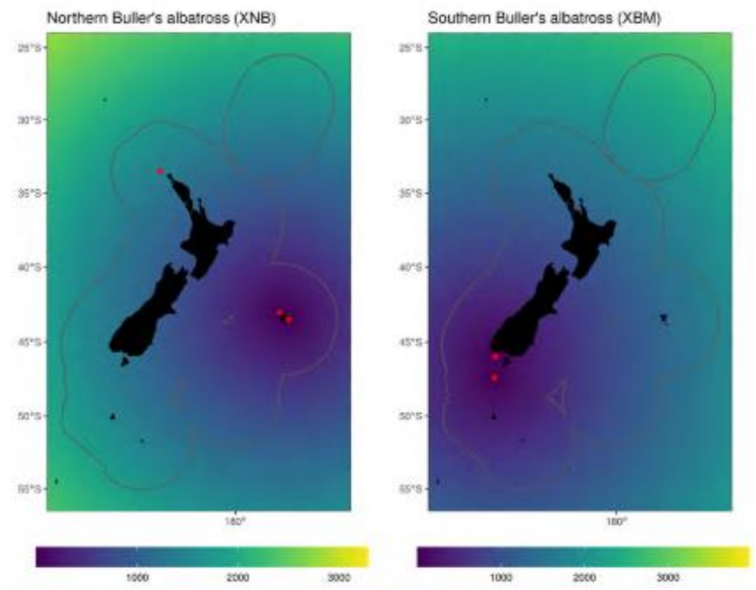


Figure 48: Modelled distance from colony (km) for Northern and Southern Buller's albatross. Red points indicate colonies comprising ≥ 1% of the total breeding population (Roberts et al., 2022).

The distributions of the two Buller's species overlap on the Chatham Rise, more strongly in the western part, but given that Northern Buller's has two breeding colonies on the eastern Chatham Rise, with a large breeding population of ~14,699 pairs (Bell, 2022), it is surprising that only a single Northern Buller's has been recorded captured by trawl fisheries here over the 19-year period 2002-03 to 2020-21, while 35 Southern Buller's have been recorded captured here (Protected Species Database).

As the two species of Buller's are very similar in appearance, it is conceivable that unless all mortalities are identified by experts, some of the captures identified by observers as southern Buller's may in fact have been northern Buller's albatrosses, thereby artificially inflating capture numbers of the former, potentially escalating the Risk Ratio as estimated by the recent spatial risk assessment for Southern Buller's.

Salvin's albatross

Aerial censuses 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 steadily increased from around 43,000 in 2010 to around 60,000 in 2018 (Table 29), (Baker & Jensz, 2019).

DOC has been reviewing the methodology used to survey Salvin's albatross on the Bounty Islands. Recent ground-based surveys have produced varying results due to differences and inherent uncertainties in the methods applied. This in turn has resulted in difficulties in the assessment of population status (Taylor 2000; Baker et al. 2014; Sagar et al. 2015; Baker & Jensz, 2018; Parker & Rexer-Huber 2020).

Table 29: 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 2016-17 to 2020-21 have ranged between 12 and 42, with an average of 20 birds per annum. The rate of capture in hoki-targeted tows spiked in 2019-20 for reasons unknown but reverted to average in 2020-21. Captures by hake- and ling-targeted tows are negligible (Figure 49), (FNZ, 2021).

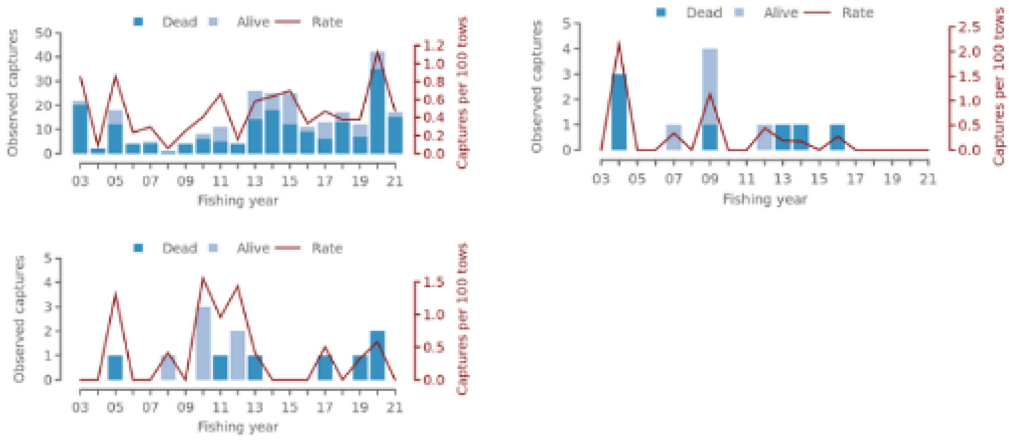


Figure 49: Observed captures and capture rates of Salvin's albatross by hoki (top left), hake (top right) and ling trawl (bottom) fisheries 2002-03 to 2020-21.

The estimated Salvin's albatross captures by hoki-targeted tows has ranged between approximately 40 to 80 per annum over the recent 5-year period. Estimated captures by ling-targeted tows have ranged from 2 – 5 per annum (Figure 50), (FNZ, 2021a).

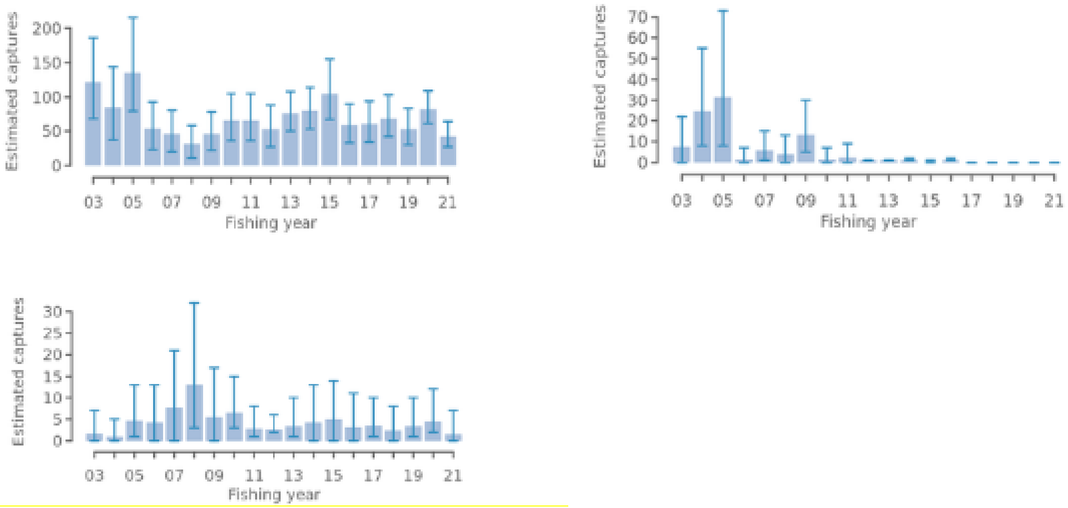


Figure 50: Estimated incidental captures of Salvin's albatross by hoki, hake and ling trawl fisheries 2002-03 to 2020-21.

White-capped albatross

Annual population censuses of white-capped albatross at the Auckland Islands over 12 years between 2006 and 2017 produced an estimated mean of 89,846 breeding pairs over this period. A slight negative linear trend was evident but due to high inter-annual variability in counts, was not statistically significant. A reasonable interpretation is that, although impacted by fisheries bycatch, the population of white-capped albatross is stable (Baker er al., 2015; Baker et al., 2023). Current research is focussed on estimating adult survival, documenting a study set up to quantify productivity, and trials to assess the suitability of drones for quantifying the breeding population size.

Observed captures of white-capped albatross by hoki-targeted trawl tows over the most recent 5-year period 2016-17 to 2020-21 have ranged between 6 and 23, with an average of 12 birds per annum but noting that a high proportion are released alive. Captures by hake-targeted tows are negligible, while captures by ling-targeted tows have ranged between 2 and 9 (Figure 51), (FNZ, 2021).

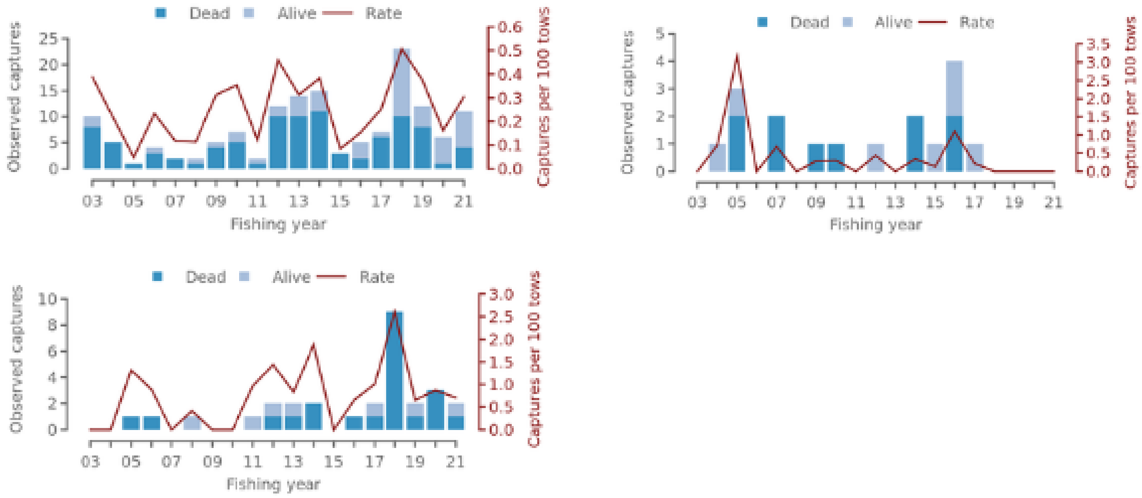


Figure 51: Observed captures and capture rates of White-capped albatross by hoki (top left), hake (top right) and ling (bottom) trawl fisheries 2002-03 to 2020-21.

Estimated captures of white-capped albatross by hoki-targeted trawl tows over the most recent 5-year period 2016-17 to 2020-21 have ranged between 13 and 39, with an average of 25 birds per annum. The estimated 18 captures in 2020-21 is lower than the 5-year average. Captures by hake-targeted tows are negligible, while ling-targeted tows are estimated to have taken between 6 and 13 per annum (Figure 52), (FNZ, 2021).

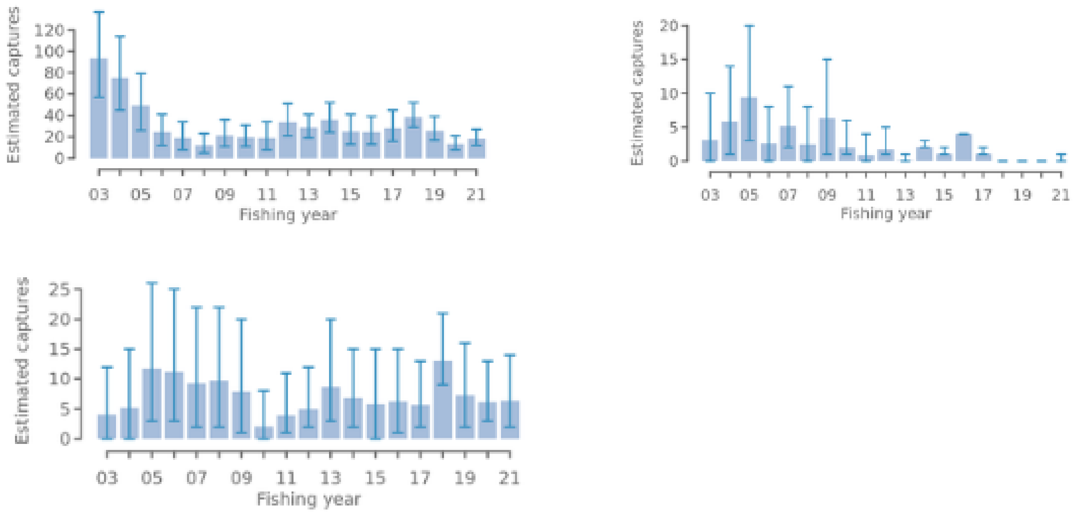


Figure 52: Estimated incidental captures of white-capped albatross by hoki, hake and ling trawl fisheries 2002-03 to 2020-21.

Black petrel

There are two known breeding colonies of black petrel, the main one is on Great Barrier Island and a secondary one on Little Barrier Island, both of which occur in the Hauraki Gulf off the east coast of North Island. The population comprises an estimated 15,000 birds of which approximately 5,100 are breeding pairs (Zhang et al., 2020). Field studies have shown there has been a steady increase in burrow occupancy during the breeding season between 1999 and 2023 (Figure 53), (Bell et al., 2023).

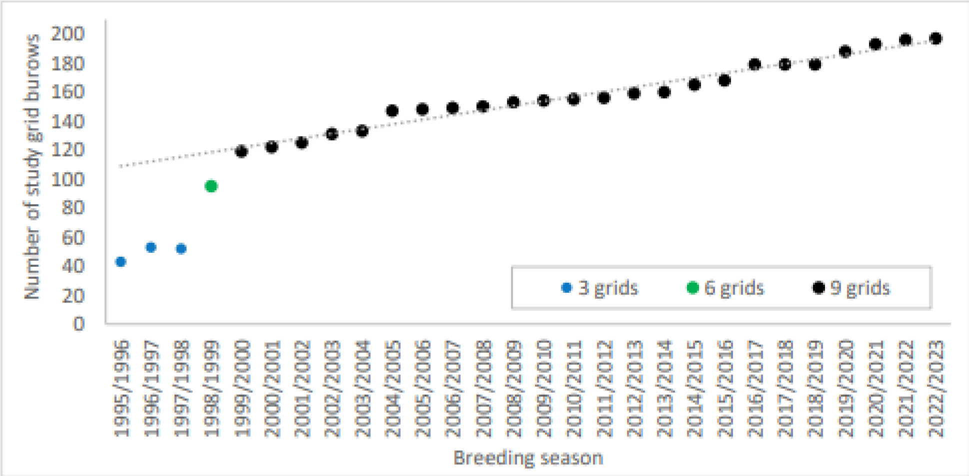


Figure 53: Black petrel burrow occupancy rates monitored during each breeding season on Great Barrier Island/Aotea between 1995 to 2023 (Bell et al., 2023).

There have been no observed captures of black petrel by hoki-, hake- or ling-targeted trawl tows over the 19-year period 2002-03 to 2020-21 (Figure 54), (FNZ, 2021).

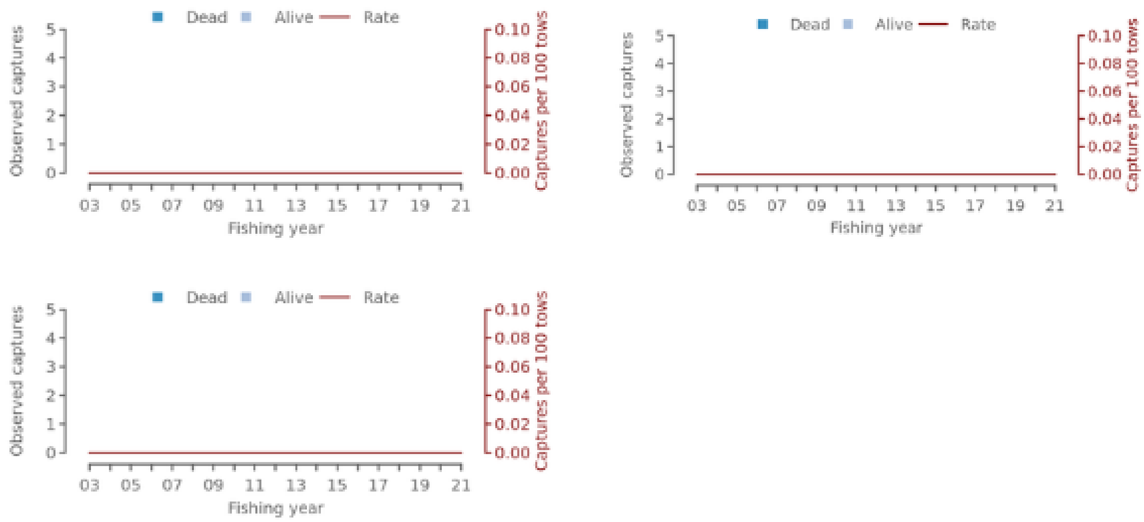


Figure 54: Observed captures and capture rates of black petrel by hoki, hake and ling trawl fisheries 2002-03 to 2020-21.

Estimated captures of black petrel by hoki-, hake- and ling-targeted trawl tows over the 19-year period 2002-03 to 2020-21 are zero (Figure 55), (FNZ, 2021).

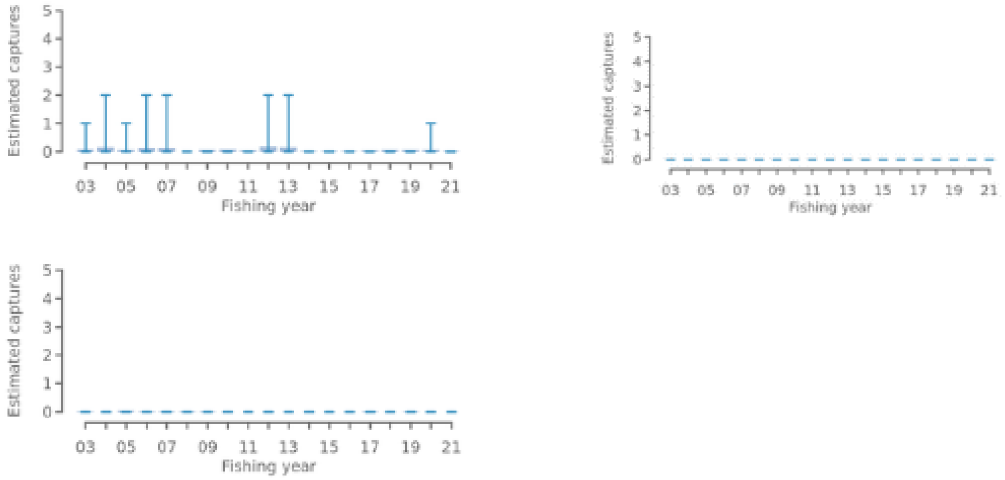


Figure 55: Estimated incidental captures of black petrel by hoki, hake and ling trawl fisheries 2002-03 to 2020-21.

Westland petrel

Assessment of the number of Westland petrel burrows over a 12-year period provided a baseline population estimate of 6,200 breeding pairs. Burrow density was assessed to have increased by approximately 1% per annum over this period and the population is considered to be stable, although the single nesting area is vulnerable to climate effects (e.g. treefall and landslips), (Waugh et al., 2020).

Observed captures of Westland petrel by hoki-targeted trawl tows over the most recent 5-year period 2016-17 to 2020-21 have ranged between 1 and 5, with an average of 3 birds per annum. No captures by hake- or ling-targeted tows have been recorded during the recent 5-year period (Figure 56), (FNZ, 2021).

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).

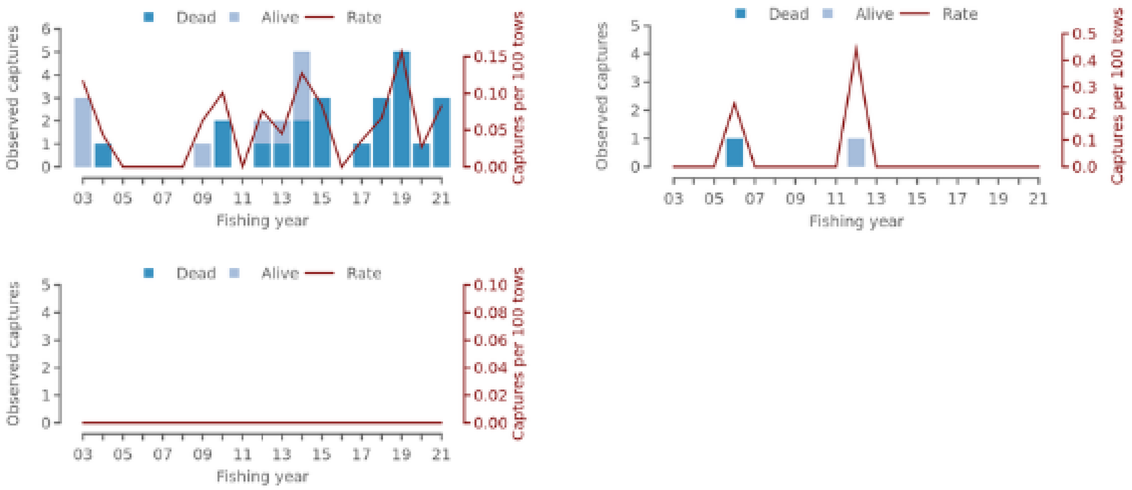


Figure 56: Observed incidental captures of Westland petrel by hoki (top left), hake (top right) and ling (bottom) targeted tows from 2002-03 to 2020-21.

All seabird and marine mammal species in New Zealand are protected and all interactions/mortalities are required to be reported. A summary of observed interactions of hoki, hake and ling-targeted tows with ETP seabirds over the 5-year period 2016-17 to 2020-21 is provided below (Table 30). Data were sourced from the New Zealand Protected Species Database.

Table 30: Summary of observer-recorded interactions of the hoki/hake/ling UoAs with ETP/OOS seabirds from 2016-17 to 2020-21. Data sourced from FNZ Protected Species Database. Observer coverage averaged 33%, 93% and 41% of tows for hoki, hake and ling respectively. Rows in orange did not meet the criteria for 'negligible'. Population information was from Error! Hyperlink reference not valid. **Risk ratings are from [1] Edwards, et al., (2023), [2] Richard, et al., (2020), [3] Abraham, et al., (2017).**

				2016/17		2017/18		2018/19		2019/20		2020/21		
Common name	**ETP Listing**	**Risk (+ 95% CI)**	**No. individuals in population**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Desig-nation**
Albatrosses (unid.)	Seabird									1		1		OOS-negligible Meets SA3.8.2.5
black-bellied storm petrel (XFT) *Fregetta tropica*	Seabird IUCN-LC	0.00 (0.00-0.01)[1]	500,000 individuals				1							OOS-negligible Meets SA3.8.2.5
Southern black-browed albatross *Thalassarche melanophris*	Seabird IUCN-LC		1,4 million mature individuals							1			1	OOS-negligible Meets SA3.8.2.5
black petrel (XBP) *Procellaria parkinsoni*	Seabird IUCN - VU	0.49 (0.30-0.82)[1]	5500 mature individuals					1						OOS-negligible Meets SA3.8.2.5
Buller's albatross (XNB) *Thalassarche bulleri*	Seabird IUCN-NT	0.19 (0.10-0.43)[1]	50,000-100,000								1			OOS-negligible Meets SA3.8.2.5
Buller's shearwater *Ardenna bulleri*	Seabird IUCN-VU	0.00 (0.00–0.00)[2]	2.5 million individuals					1						OOS-negligible Meets SA3.8.2.5
Campbell black-browed albatross (XCM) *Thalassarche impavida*	Seabird IUCN-VU	0.05 (0.03-0.14)[1]	43,296 mature individuals			1	2							OOS-negligible Meets SA3.8.2.5
Chatham Island albatross (XCI) *Thalassarche eremita*	Seabird IUCN-VU	0.27 (0.13-0.68)[1]	11,000 mature individuals						1					ETP-negligible Meets SA3.8.2.5
common diving petrel (XDP) *Pelecanoides urinatrix*	Seabird IUCN-LC	0.00 (0.00-0.01)[1]	16 million individuals			6							2	ETP-negligible Meets SA3.8.2.5
fairy prion (XFP) *Pachyptila turtur*	Seabird IUCN-LC	0.00 (0.00-0.00)[1]	5 million individuals	2		2	1	1		2			1	ETP-negligible Meets SA3.8.2.5
flesh-footed shearwater (XFS) *Ardenna carneipes*	Seabird IUCN-NT	0.22 (0.12-0.44)[1]	10,000-15,000 breeding pairs (NZ)			1								ETP-negligible Meets SA3.8.2.5
gadfly petrels	Seabird					1								ETP-negligible

Pterodroma spp.														Meets SA3.8.2.5
great albatrosses *Diomedea spp.*	Seabird						1	1		1				ETP-negligible Meets SA3.8.2.5
grey-backed storm petrel *Garrodia nereis*	Seabird IUCN-LC		>200,000 individuals			1				1				ETP-negligible Meets SA3.8.2.5
grey-faced petrel (XGF) *Pterodroma macroptera gouldi*	Seabird IUCN-LC	0.00 (0.00-0.00)[1]	400,000-600,000 mature individuals			1								ETP-negligible Meets SA3.8.2.5
mottled petrel (XMP) *Pterodroma inexpectata*	Seabird IUCN-NT	0.00 (0.00-0.02)[1]	1.5 million individuals			1					1			ETP-negligible Meets SA3.8.2.5
New Zealand white-capped albatross (XWM) *Thalassarche cauta steadi*	Seabird IUCN-NT	0.50 (0.29-1.07)[1]	>200,000 mature individuals	2	9	15	19	5	9	7	7	7	5	ETP-Assessed Does not meet SA3.8.2.5
New Zealand white-faced storm petrel (XWF) *Pelagodroma marina*	Seabird IUCN-LC	0.00 (0.00-0.00)[1]	4 million individuals			3								ETP-negligible Meets SA3.8.2.5
northern giant petrel (XNP) *Macronectes halli*	Seabird IUCN-LC	0.08 (0.02-0.22)[1]	11,800 breeding pairs						1				1	ETP-negligible Meets SA3.8.2.5
northern royal albatross (XNR) *Diomedea sanfordi*	Seabird IUCN-EN	0.04 (0.01-0.15)[1]	17,000 mature individuals							1				ETP-negligible Meets SA3.8.2.5
petrels, prions, and shearwaters (unid.)	Seabird							1				1		ETP-negligible Meets SA3.8.2.5
prions (unid.)	Seabird							1	1		1			ETP-negligible Meets SA3.8.2.5
Salvin's albatross (XSA) *Thalassarche salvini*	Seabird IUCN-VU	0.69 (0.35-1.69)[1]	79,990 mature individuals	10	6	9	13	5	8	12	35	2	15	ETP-Assessed Does not meet SA3.8.2.5
seabirds (unid)	Seabird									1				ETP-negligible Meets SA3.8.2.5
Snares Cape petrel (XCA) *Daption capense*	Seabird IUCN-LC	0.02 (0.00-0.13)[1]	2 million individuals (global Cape petrel)		1	1		2		1			1	ETP-negligible Meets SA3.8.2.5
sooty shearwater (XSH) *Ardenna grisea*	Seabird IUCN-NT	0.00 (0.00-0.01)[1]	4.4. million pairs	10	7	4	15		7	2	22	2	9	ETP-Assessed Does not meet SA3.8.2.5
southern Buller's albatross (XBM)*	Seabird		50,000-99,999		6	9	11	3	19	2	6	3	8	ETP-Assessed

Thalassarche bulleri	IUCN-NT	1.19 (0.71-2.65)[1]	mature individuals											Does not meet SA3.8.2.5
Southern giant petrel *Macronectes giganteus*	Seabird IUCN-LC		47,800-54,000 pairs						2			1		ETP-negligible Meets SA3.8.2.5
southern royal albatross (XRA) *Diomedea epomophora*	Seabird IUCN-VU	0.08 (0.04-0.17)[1]	27,200 mature individuals			2			1	1		2		ETP-negligible Meets SA3.8.2.5
storm petrels	Seabird			1										ETP-negligible Meets SA3.8.2.5
Westland Petrel (XWP) *Procellaria westlandica*	Seabird IUCN-LC	0.38 (0.17-0.88)[1]	7,900-13,700 mature individuals	1	1	1	3	1	5		1		3	ETP-negligible Meets SA3.8.2.5
white-chinned petrel (XWC) *Procellaria aequinoctialis*	Seabird IUCN-VU	0.09 (0.06-0.18)[1]	3 million mature individuals	7	20	24	35	1	14	4	27	1	36	ETP-Assessed Does not meet SA3.8.2.5

As FNZ observers are not present on all fishing events, the Protected Species Bycatch in New Zealand Fisheries database (https://protectedspeciescaptures.nz/) also provides mean estimated captures of seabirds based on the total number of tows, the number of observed tows, observer coverage (the percentage of tows that were observed), the number of observed captures (both dead and alive), the capture rate (captures per hundred tows) per fishing year to provide the mean number of estimated total captures (with 95% confidence interval), and the percentage of tows included in the estimate. While estimated captures are not available by species, the estimates for all seabird species combined for each of the hoki, hake and ling-targeted tows (Table 31; Table 32; Table 33) provide support for the designation of negligible for some bird species (see Table 30) based on ratios provided.

Table 31: Observed and estimated seabird interactions by the hoki fishery. Data sourced from the Protected Species Bycatch database (https://protectedspeciescaptures.nz/)

Year	% Tows observed	No. observed captures	Observed capture rate	Mean estimated captures	95% CI
2016/17	24.1	59	2.1	284	219-362
2017/18	37.8	139	3.1	314	265-375
2018/19	33.3	79	2.5	238	191-295
2019/20	45.9	113	3.0	218	182-262
2020/21	47.1	99	2.7	176	148-210

Table 32: Observed and estimated seabird interactions by the hake fishery. Data sourced from the Protected Species Bycatch database (https://protectedspeciescaptures.nz/)

Year	% Tows observed	No. observed captures	Observed capture rate	Mean estimated captures	95% CI
2016/17	95.0	1	0.2	1	1-3
2017/18	99.3	1	0.7	1	1-1

2018/19	98.7	0	0.0	0	0-0
2019/20	-	1	0.5	1	1-1
2020/21	80.1	0	0.0	0	0-2

Table 33: Observed and estimated seabird interactions by the ling trawl fishery. Data sourced from the Protected Species Bycatch database (https://protectedspeciescaptures.nz/)

Year	% Tows observed	No. observed captures	Observed capture rate	Mean estimated captures	95% CI
2016/17	31.5	15	7.5	36	21-61
2017/18	47.0	14	4.1	34	20-56
2018/19	39.4	6	2.0	30	15-54
2019/20	48.9	11	3.2	27	15-47
2020/21	36.0	5	1.8	22	10-40

ETP seabird research

On-going and proposed new seabird population research projects include the following (DOC, 2024):

- POP2022-01 Black petrel population monitoring
- POP2022-08 Auckland Islands seabird research: Gibson's and white-capped albatross
- POP2022-10 Antipodes Island seabird research: Antipodean albatross and white chinned petrel
- POP2023-02 Southern Buller's population study
- POP2023-04 Campbell Island seabird research
- POP 2024-01 Flesh-footed shearwater population monitoring.

On-going and proposed seabird mitigation projects include the following (DOC, 2024):

- MIT2023-06 Underwater line setting devices for bottom longline vessels
- MIT2024-01 Protected species liaison project
- MIT2024-06 Efficacy of seabird mitigation in large vessel trawl.

Post-release survival assessment of seabirds

- INT2019-06 Investigation of options for assessing the post-release survival of seabirds that interact with commercial fisheries in New Zealand.

Sharks

A total of eight fish species, all of them chondrichthyans, are designated as OOS, based on the decision tree for species categorisation (Figure SA3). All have 'negligible' status. One species, basking shark, is protected under New Zealand legislation (Table 34).

Table 34: Fish species designated as Out Of Scope based on the decision tree for species categorisation. Observed catches in tonnes; catch percentages based on overall observed catch composition. Data from MPI observed catch composition. Data source: FNZ Rep Log 15659.

Species	ETP/OOS Designation	2018/19	2019/20	2020/21	2021/22	2022/23	5-yr average (t)	5-yr average (%)	Designation
Porbeagle	Chondrichthyan	5	1	4	5	9	5	0.01	ETP/OOS-negligible

Lamna nasus	CITES Appendix II IUCN - VU Does not meet modification criteria								Meets SA3.8.2.5
Leafscale gulper shark *Centrophorus squamosus*	Chondrichthyan IUCN – EN	42	35	47	40	37	40	0.07	ETP/OOS-negligible Meets SA3.8.2.5
School shark *Galeorhinus galeus*	Chondricthyan IUCN - CR	15	14	18	18	23	18	0.03	ETP/OOS-negligible Meets SA3.8.2.5
Short finned mako *Isurus oxyrinchus*	Chondrichthyan IUCN – EN	1	0	1	1	0	1	0.001	ETP/OOS-negligible Meets SA3.8.2.5
Thresher shark *Alopias vulpinus*	Chondrichthyan CITES-CMS IUCN-VU Does not meet modification criteria	1	2	3	3	2	2	0.004	OOS- negligible Meets SA3.8.2.5
Big eye thresher shark *Alopias superciliosus*	Chondrichthyan CITES-CMS IUCN-VU Does not meet modification criteria	0	0.1	0	0	0	0.02	<0.001	OOS- negligible Meets SA3.8.2.5
Blue shark *Prionace glauca*	Chondrichthyan CITES-CMS IUCN-NT Does not meet modification criteria	0	0	0	0.2	0.2	0	<0.001	OOS- negligible Meets SA3.8.2.5
Basking shark *Cetorhinus maximus*	ETP – National legislation CITES-CMS IUCN -EN NZ Wildlife Act 1953	6	0	0	0	0	0.2	0.002	ETP-negligible Meets SA3.8.2.5

Application of Modification Criteria

Porbeagle

Productivity

Productivity		
Scoring element (species)	Porbeagle Biological characteristics from fish base	
Attribute	Justification	Score
Average age at maturity	8-11 years males 15-18 years females	2
Average maximum age	65	3
Fecundity	4 pups per year	3

Average maximum size Not scored for invertebrates	200cm	2
Average size at maturity Not scored for invertebrates	186.5cm	3
Reproductive strategy	viviparous	3
Trophic level	4.6	3
Productivity score from RBF	2.71	

Management status

The porbeagle is managed as part of the QMS, there are some specific provisions for the species, regarding the removal of fins and returning individuals to the water (i.e., Schedule 6). However, there are no other management measures in place and the species is not managed using LRP or TRP (or equivalent) therefore the species does not meet the modification criteria for management status (SA3.1.4.3b).

Stock status

The stock structure of porbeagle sharks in the Southern Hemisphere is unknown (Fisheries New Zealand, 2019c) however, it seems likely that sharks in the south-west Pacific comprise a single stock. The stock status of porbeagle sharks from the entire Southern Hemisphere range of the species was assessed in 2017 (Hoyle, et al, 2017). The assessment noted that although the stock status of the species is currently unknown the results of the assessment show that fishing mortality on the Southern Hemisphere stock is very low, and that it decreases eastward from the waters off South Africa to the waters off New Zealand. although the stock status of the species is currently unknown there is a very low risk that the Southern Hemisphere porbeagle shark is subject to overfishing anywhere within its range. A qualitative risk assessment was completed on all chondrichthyans (sharks, skates, rays and chimaeras) at the New Zealand scale in 2017 (Ford et al, 2018). Porbeagle sharks had a risk score of 15 and were ranked second equal lowest risk of the eleven QMS chondrichthyan species.

Porbeagle does not meet any of the three modification criteria and therefore is classified as ETP/OOS in accordance with SA3.1.4.3.

Thresher shark

Productivity

Productivity		
Scoring element (species)	Thresher shark Biological characteristics from fish base	
Attribute	Justification	Score
Average age at maturity	5-13 years	2
Average maximum age	25 years	2
Fecundity	2 to 4 young in a litter	3

Average maximum size Not scored for invertebrates	573 cm TL male, 549.0 cm TL female	3
Average size at maturity Not scored for invertebrates	250-375cm	3
Reproductive strategy	Ovoviviparous,	3
Trophic level	4.5 ±0.0 se; based on diet studies	3
Productivity score from RBF	2.90	

Management status

There are no other management measures in place and the species is not managed using LRP or TRP (or equivalent) therefore the species does not meet the modification criteria for management status (SA3.1.4.3b)

Stock status

There are no data for population size of the Common Thresher. Genetic results indicate one global population, however there is some genetic structuring between the Northwest Atlantic and the Pacific Oceans (www.iuncnredlist.org). The Common Thresher is estimated to be declining in the North Atlantic and increasing in the Eastern North Pacific. However, the increasing trend in the Eastern North Pacific is from a managed fishery and may not be representative of trends in the wider Pacific. Trends are uncertain and there is a lack of data from other regions of the world accept North Pacific (www.iuncnredlist.org). Therefore, the species does not meet the modification criteria for management status (SA3.1.4.3b)

Thresher shark does not meet any of the three modification criteria and therefore is classified as ETP/OOS in accordance with SA3.1.4.3.

Bigeye Thresher Shark
Productivity

Productivity		
Scoring element (species)	Bigeye Thresher shark Biological characteristics from fish base	
Attribute	Justification	Score
Average age at maturity	7- 14 years	2
Average maximum age	20 years	2
Fecundity	2 to 4 young in a litter	3
Average maximum size Not scored for invertebrates	488 cm male	3
Average size at maturity	138-270cm	3

Not scored for invertebrates		
Reproductive strategy	Ovoviviparous,	3
Trophic level	4.5 ±0.0 se; based on diet studies	3
Productivity score from RBF	2.90	

Management Status

There are no other management measures in place and the species is not managed using LRP or TRP (or equivalent) therefore the species does not meet the modification criteria for management status (SA3.1.4.3b)

Stock Status

No Pacific Ocean stock assessment of bigeye thresher shark have been conducted. Information gaps and changes in reporting and observer coverage over time and space, make traditional approaches to stock assessment impractical (Fu, et al., 2016). Fu, et al., (2016) conducted a spatially explicit and quantitative sustainability risk assessment on available data. However, impact was uncertain in the southwest Pacific. Therefore, the species does not meet the modification criteria for management status (SA3.1.4.3b).

Bigeye thresher shark does not meet any of the three modification criteria and therefore is classified as ETP/OOS in accordance with SA3.1.4.3.

Blue shark

Productivity

Productivity		
Scoring element (species)	Blue shark Biological characteristics from fish base	
Attribute	Justification	Score
Average age at maturity	4 years	1
Average maximum age	20 years	2
Fecundity	4-63 young in a litter, gestation 9-12 months	3
Average maximum size Not scored for invertebrates	400cm	3
Average size at maturity Not scored for invertebrates	199 (range 170 – 221)	3
Reproductive strategy	viviparous	3
Trophic level	4.4 ±0.2 se; based on diet studies	3

Productivity score from RBF	2.57	

Management Status

Blue shark is a QMS, Schedule 6 species and be returned to the water alive or dead and if dead, balanced against ACE. Blue shark was introduced into the QMS on 1 October 2004 under a single QMA, BWS 1, with allowances, TACC (1 860t), and TAC (2 080t) however, it is unclear what information these metrics were based on. There are no other management measures in place and the species is not managed using LRP or TRP (or equivalent) therefore the species does not meet the modification criteria for management status (SA3.1.4.3b)

Stock status

Blue shark in the southwest Pacific is considered a single stock (Neubauer et al., 2021). A recent stock assessment found that 90% of model runs indicated that fishing mortality at the end of the assessment period was below F_{MSY} and 96% of model runs show that the biomass is above SB_{MSY} (Neubauer et al., 2021). Fishing mortality had declined over the last decade and is currently relatively low, as blue sharks are not retained by most longline fleets. Neubauer, et al., (2021) concluded that the stock on average does not appear to be overfished and overfishing is not occurring. Therefore, the stock assessment criteria are met in accordance with SA3.1.4.3c.

Blue shark does not meet at least two of the modification criteria and is therefore assessed as ETP/OOS in accordance with SA3.1.4.3.

Shark ETP reporting

Very few protected sharks have been reported captured by the hoki/hake/ling trawl fishery. Over the 5-year period 2016-17 to 2020-21, 2 basking sharks (*Cetorhinus maximus*) [NZ Threat Classification: threatened; IUCN classification: endangered], and one small-tooth sand tiger shark (*Odontaspis ferox*) [NZ Threat Classification: naturally uncommon; IUCN classification: vulnerable] were taken by hoki-targeted tows. Three basking sharks were taken by hake-targeted tows and one by ling-targeted tows (Figure 57).

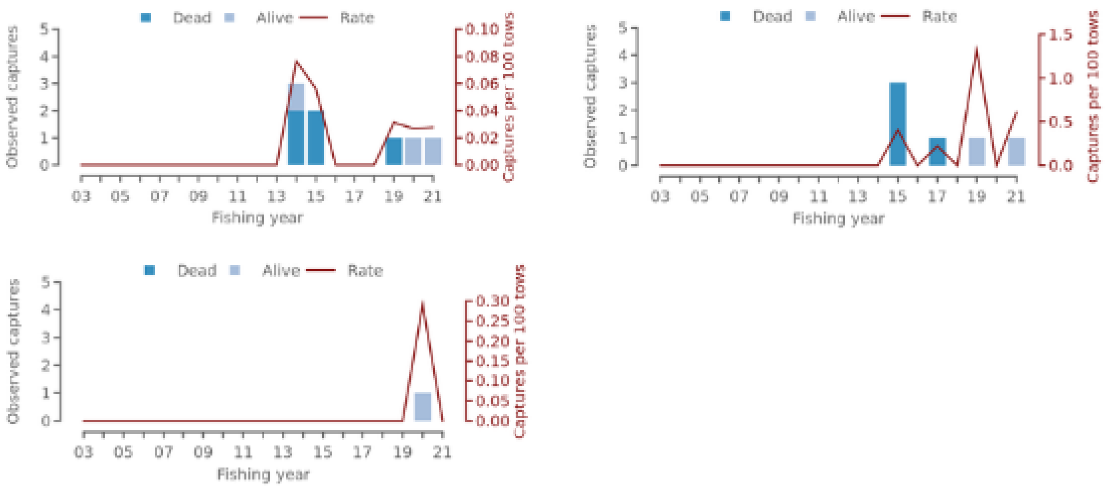


Figure 57: New Zealand protected shark captures by hoki (top left), hake (top right) and ling-targeted tows (bottom) from 2002-03 to 2020-21.

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).

DWC's Sharks Operational Procedures (OP) provide guidelines for returning protected sharks to the sea unharmed wherever possible (DWG, 2022).

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 Table 35 below.

Table 35: 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

Post-release survival of sharks

Post-release survival rates for the pelagic mako and blue sharks caught by longline fisheries are thought to be medium-to-high, and medium-low post-release survival probability. There is very little information on post-release survival rates from trawl fisheries, but they are thought to be low (Moore & Finucci, 2024). This is likely to be particularly the case on factory trawlers where the catch may be transported below-decks prior to release and where it may not be possible to release large sized sharks timeously via the discharge chute.

Marine mammals

New Zealand fur seal

The New Zealand fur seal is found in both New Zealand and Australia. It is abundant and classified as 'least concern' by DOC, while their threat classification status is 'Not Threatened'. The New Zealand population is estimated to be around 127,000 and numbers are increasing (Baker et al., 2019). A 2017 marine mammal risk assessment estimated a Population Sustainability Threshold (PST) of 3,400 animals and a median risk ratio of 0.2 for New Zealand fur seals (**Figure 58**), (Abraham et al., 2017).

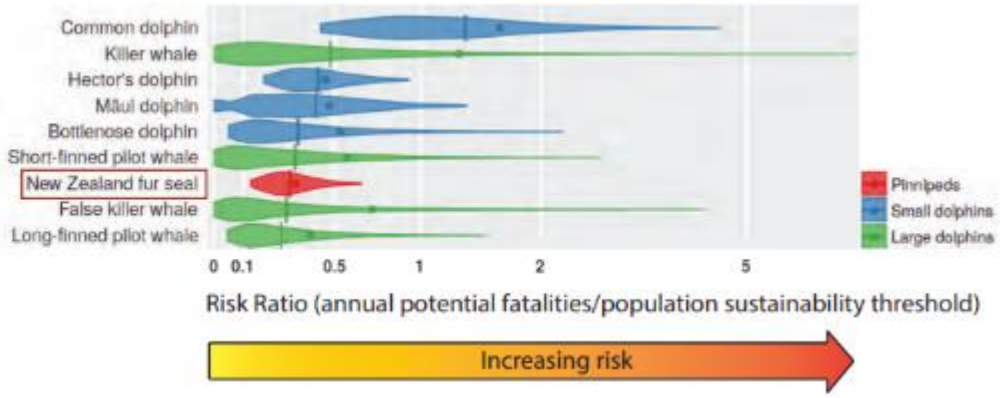


Figure 58: New Zealand fur seal risk ratio as calculated by the 2017 Assessment of the risk to New Zealand marine mammals from commercial fisheries (Abraham et al, 2017).

Over the last five years, there have been on average around 18 observed and 97 estimated captures of New Zealand fur seals per year by hoki-targeted tows, with a small fraction being released alive. Observed captures by hake- and ling-targeted tows combined have averaged around 2 per year (Figure 59). Increasing observer rates have led to improved levels of confidence in the results (Figure 60). This level of this risk from captures by the fishery is unlikely to pose a threat to population sustainability.

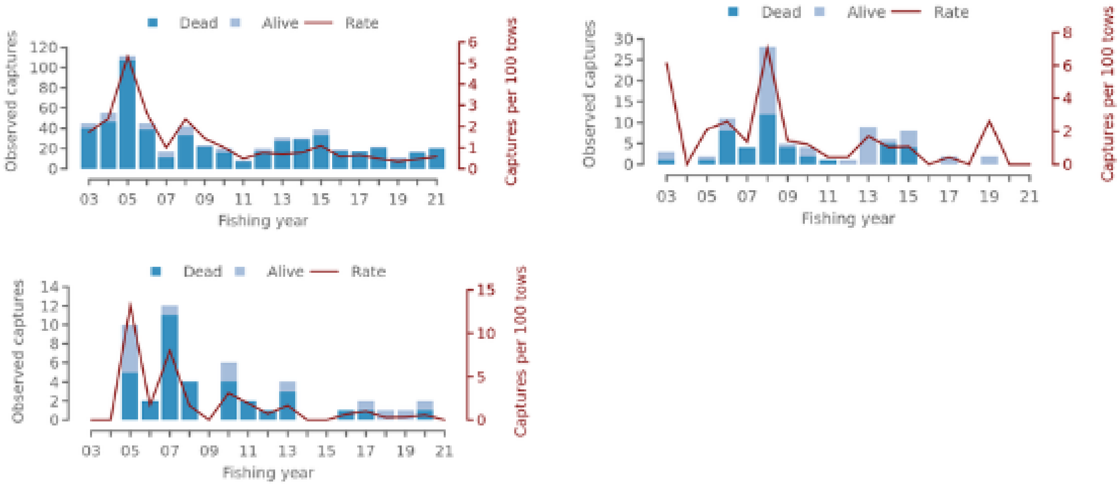
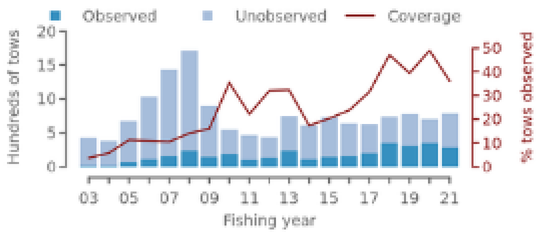


Figure 59: New Zealand observed fur seal captures by the hoki, hake and ling trawl fisheries from 2002-03 to 2020-21.



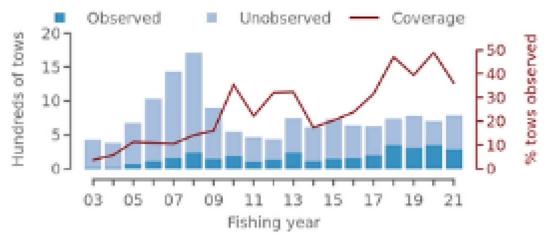


Figure 60: Fishing effort and observations of the hoki-, hake- and ling-targeted trawls 2002-03 to 2020-21.

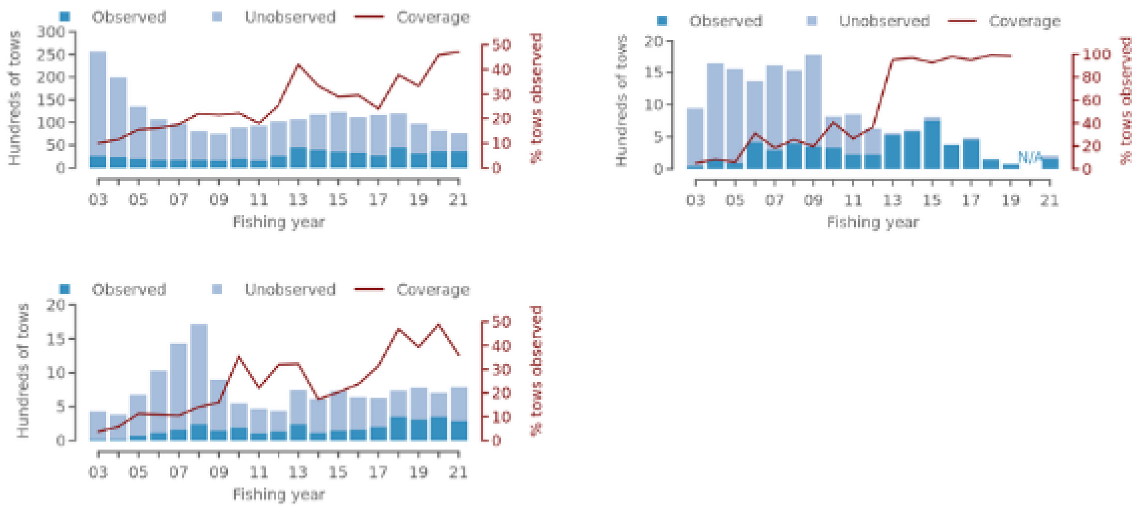


Figure 60: Fishing effort and observations of the hoki-, hake- and ling-targeted trawls 2002-03 to 2020-21.

Fur seal bycatch research

Recent research on NZ fur seal bycatch has focused on:

- The distribution of fur seal haul-outs and colonies in relation to bycatch in the core hoki spawn fishery in Cook Strait (Pavanato et al., 2023)
- The utility of using drones for aerial surveys to quantify fur seals populations sizes at the Bounty Islands, to investigate the effects of bycatch by the southern blue whiting trawl fishery (Rexer-Huber & Carter, 2020)
- Analysis of marine mammal bycatch rates by New Zealand's commercial fisheries as a basis for evaluating the efficacy and effectiveness of the different mitigation measures employed (Tremblay-Boyer & Berkenbusch, 2022)

New Zealand sea lion

The indigenous New Zealand sea lion (*Phocarctos hookeri*) has a population size of approximately 12,000 and has four known breeding sites, the largest being at the Auckland Islands. Other sites are Campbell Island, Stewart Island and the southern tip of South Island (**Figure 61**).

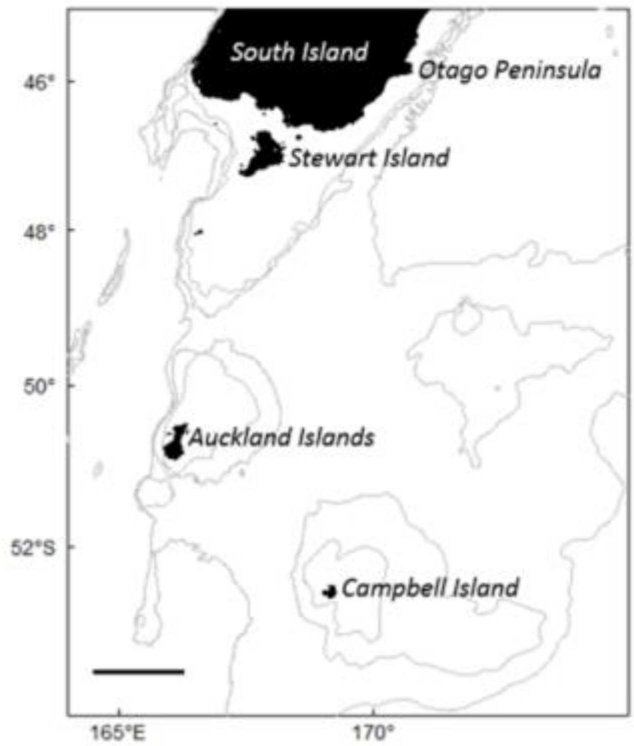


Figure 61: Location of New Zealand sea lion breeding populations on Auckland Islands, Campbell Island, Stewart Island and the southern tip of South Island (after Roberts & Doonan, 2016).

Annual pup counts at the Auckland Islands are used to index trends in the sea lion population. Pup counts halved between 1998 and 2009, prompting a risk assessment to be undertaken (Roberts et al., 2016) and the development and implementation of a New Zealand Sea Lion/rāpoka Threat Management Plan in 2017 (DOC, 2017) with a vision to "promote recovery and ensure the long-term viability of New Zealand sea lions".

While their conservation threat status is 'Nationally Vulnerable' (Baker et al., 2019; FNZ, 2022), the mandatory use of Sea Lion Exclusion Devices (SLEDs) under the squid fishery and southern blue whiting Operational Plans and agreed Operational Procedures followed by vessels, has arrested captures. The estimated number of annual fishing-related deaths has declined from around 160 in the mid-1990s to an average of three over the last decade. Annual pup production has been relatively stable over the 13-year period 2008-09 to 2021-22, although large, unexplained inter-annual fluctuations continue to feature (Young & Manno, 2022). Pup production declined by 24% in 2022-23 (**Figure 62**), which has triggering a review of the New Zealand sea lion Threat Management Plan (DOC & MPI 2017) and the Squid 6T Operational Plan (FNZ, 2019). No estimate of pup production was obtained in 2020-21 due to Covid-19-related cancellation of the field season.

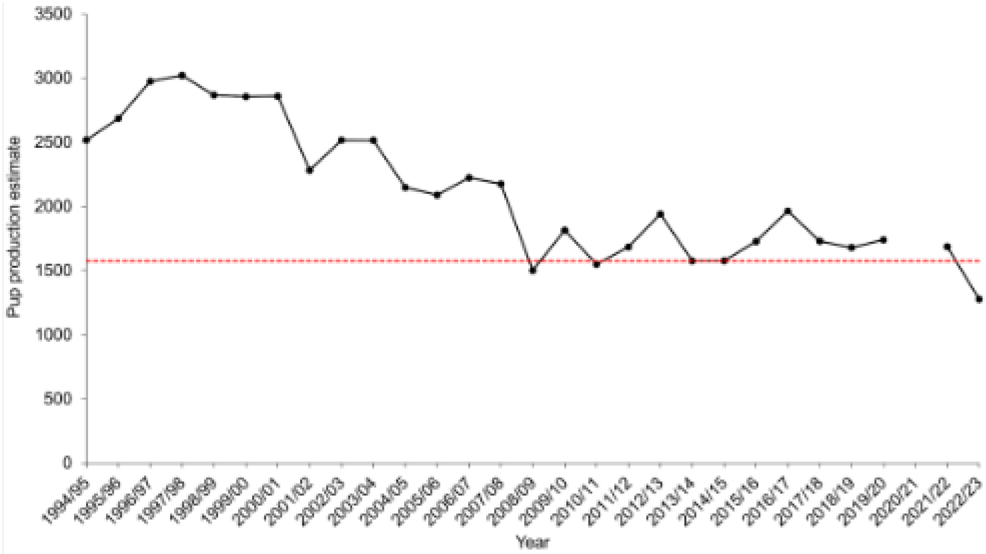


Figure 62: Total estimated sea lion pup production at the Auckland Islands colonies 1994-95 to 2022-23. The dashed line represents the minimum count of 1575 pups set to trigger reviews of the New Zealand sea lion Threat Management Plan (DOC & MPI, 2017) and Squid 6T Operational Plan (FNZ, 2019).

The risk of sea lion captures is highest in the Squid 6T trawl fishery, which is prosecuted in New Zealand's sub-Antarctic waters (i.e. areas within the EEZ south of 49°S), and which has a very high level of observer coverage, approximating 100%. Under the SQU6T Operational Plan the annual Fishing-Related Mortality Limit (FRML) is 52, estimated by adjusting the observed number of captures by a cryptic multiplier of 1.3 (FNZ, 2019). The observed number of captures by squid trawl fisheries over the 5-year period 2016-17 to 2020-21 has averaged 4 per annum, well below the FRML. Due to the ongoing low capture rate, the FRML was rescinded in April 2024.

No observed captures of New Zealand (NZ) sea lion have been reported for hoki- and hake-targeted tows since 2013-14 and there have been no captures by hake-targeted tows over the period 2002-03 to 2020-21. A single sea lion was caught by ling-targeted tows in each of 2017-18 and 2018-19 (Figure 63).

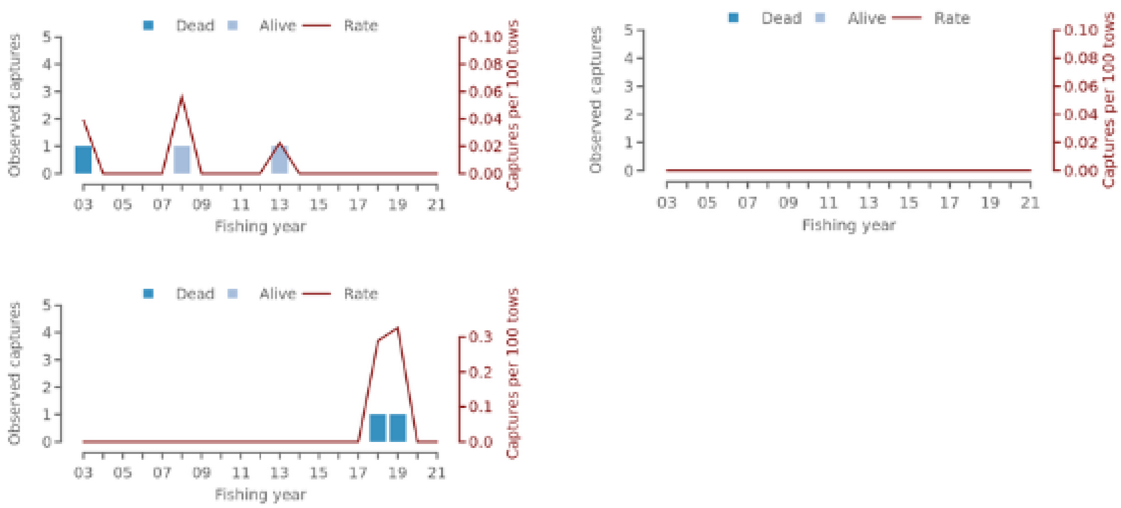


Figure 63: New Zealand observed sea lion captures by the hoki (top left), hake (top right) and ling trawl fisheries from 2002-03 to 2020-21.

Dolphins & whales

There were two reported incidental captures of dusky dolphin (*Lagenorhynchus obscurus*), and two of a long-finned pilot whale (*Glopicephala melas*) in the hoki mixed species trawl fishery in the five-year period 2016-17 to 2020-21 (Figure 64), (FNZ, 2021).

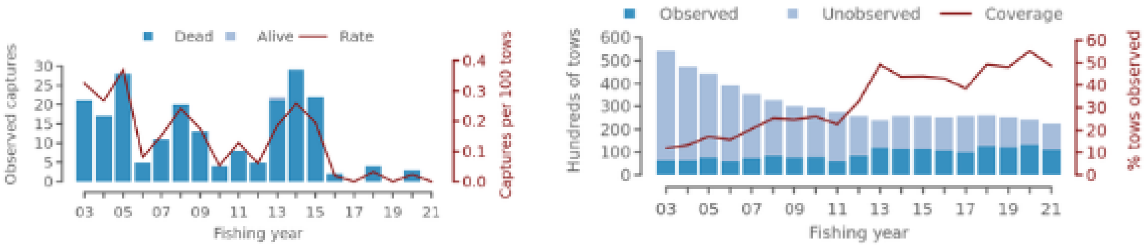


Figure 64: Observed captures of whales and dolphins (left). Fishing effort and observer coverage (right) by trawlers larger than 28 m in length, 2002-03 to 2020-21.

All marine mammal species in New Zealand are protected and all interactions/mortalities are required to be reported. A summary of observed interactions of hoki, hake and ling-targeted tows with ETP marine mammals over the 5-year period 2016-17 to 2020-21 is provided below (Table 36). Data were sourced from the New Zealand Protected Species Database.

Table 36: Summary of observer-recorded interactions of the hoki/hake/ling UoAs with ETP/OOS marine mammals from 2016-17 to 2020-21. Data sourced from FNZ Protected Species Database. Observer coverage averaged 33% of tows. Rows in orange did not meet the criteria for 'negligible'. Population information sourced from Error! Hyperlink reference not valid. **ratings are from [1] Edwards, et al., (2023), [2] Richard, et al., (2020), [3] Abraham, et al., (2017).**

			No. individuals in population	2016/17		2017/18		2018/19		2019/20		2020/21		Desig-nation
Common name	**ETP Listing**	**Risk (+ 95%CI)**		**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	**Alive**	**Dead**	
New Zealand sea lion *Phocarctos hookeri*	Mammal IUCN-EN	0.10 (0.05-0.19)[3]	11,650 individuals				1		1					ETP-negligible Meets SA3.8.2.5
dusky dolphin *Lagenorhynchus obscurus*	Mammal IUCN-LC	0.15 (0.04–0.38)[3]	15,700-17,500 individuals				1				1			ETP-negligible Meets SA3.8.2.5
New Zealand fur seal *Arctocephalus forster*	Mammal IUCN-LC	0.31 (0.13–0.64)[3]	100,000 mature individuals	7	34	9	33	5	19	2	21	1	20	ETP-Assessed Does not meet SA3.8.2.5
pilot whale long-finned *Globicephala melas*	Mammal IUCN-LC	0.38 (0.04–1.48)[3]	>200,000 individuals				1				1			ETP-negligible Meets SA3.8.2.5

Turtles

There have been no observed captures of turtles in the hoki mixed species trawl fishery over the period 2002-03 to 2020-21 (Figure 65).

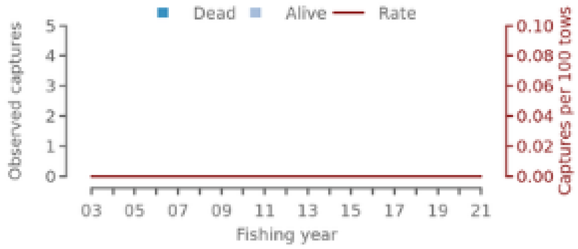


Figure 65: Observed turtle captures by large trawlers, 2002-03 to 2020-21.

ETP coral catches

Landings of corals are reported in the Annual Review Report for Deepwater Fisheries (Fisheries New Zealand, 2022a). All landings of protected corals must be returned to the water immediately, and commercial fishers must report their capture on NFPS catch returns. Although not protected, FNZ observers also record landing of other benthic bycatch such as anemones, bryozoans, sea pens and sponges.

Protected corals are rarely encountered by hoki, hake and ling trawlers, which operate primarily over sandy, muddy and gravelly seabed. The observed coral bycatch by these fisheries averaged ~73 kg/year over the 5-year period 2018-19 to 2022-23 (Table 37). The estimated coral catch, raised in proportion to the average observed rate (i.e. ~ 44% of tows), amounts to around 166 Kg per annum. In contrast, the incidental capture of ETP corals reported by vessels on Non-Fish Protected Species catch forms, averaged 85 kg per annum, suggestive of a less vigorous reporting regime by vessels (Table 38). However, it is clear that the impact of the hoki, hake, ling UoA fisheries on ETP corals may be considered to be negligible.

Table 37: Observed incidental capture of ETP corals (kg) by hoki, hake and ling target tows, 2018-19 to 2022-23. Percentages calculated against total observed fish and invertebrate catch.

Species	Species Code	2018/19	2019/20	2020/21	2021/22	2022/23	5-Year Avg. (kg)	5-Year Avg. (%)
Flabellum cup corals	COF	25.8	23.3	38.8	28.8	18.9	27.1	0.00005%
Crested cup coral	DDI	10.1					10.1	0.00002%
Stony corals	SIA				20.0	0.2	10.1	0.00002%
Coral (Unidentified)	COU	4.3	2.0	10.6	2.5	3.4	4.6	0.00001%
Bushy hard coral	GDU	6.2		0.2	3.0		3.1	0.00001%
Metallic coral	MTL				2.9		2.9	0.00001%
Feathery hydroids	HDF	1.0	1.0		1.9	4.2	2.0	0.00000%
Black corals	COB				1.7		1.7	0.00000%
Hydroids	HDR	0.1		1.0	4.0		1.7	0.00000%
Bottlebrush coral	THO			0.2	3.0		1.6	0.00000%
Stony branching corals	CBR		0.8		-	4.0	1.6	0.00000%
Coral rubble	CBB	2.0			1.0		1.5	0.00000%
Soft coral	SOC		1.0		1.1		1.1	0.00000%
Hydrocorals	COR			1.0			1.0	0.00000%
Long polyp soft corals	TLO		1.0				1.0	0.00000%
Golden corals	CHR	1.0			0.4	1.0	0.8	0.00000%
Gorgonian coral	GOC	0.1		0.6	0.1	1.0	0.5	0.00000%
Stony cup corals	CUP			0.6	0.1		0.4	0.00000%
Deepwater branching coral	ERO				0.3		0.3	0.00000%

Solitary bowl coral	STP					0.2	0.2	0.00000%
Bamboo coral	BOO					0.1	0.1	0.00000%
Totals		**50.6**	**29.1**	**53.0**	**70.8**	**33.0**	**73.3**	**0.00013%**

Table 38: Vessel-reported incidental catches of ETP corals (generic reporting code COU) by hoki, hake and ling UoA trawl fisheries (data source: FNZ Non-Fish Protected Species catch forms).

Species Group	Reporting Code	2018-19	2019-20	2020-21	2021-22	2022-23	5-Year Avg. (kg)	5-Year Avg. (%)
Corals	COU	16	3	69	128	210	85	0.00007%

New Zealand's deep-sea corals are diverse and wide-spread assemblage and are often found in association with hard-bottom regions, including seamounts, ridges and continental shelf edges (Tracey & Hjorvarsdottir, 2019), who reported coral landings from a wide range of depths, with most landings from depths between 800–1000 m, deeper than most hoki/hake/ling-targeted tows for which the median tow depth is ~530 m.

The study found that the fishery areas of highest risk to protected corals, were the deepwater fisheries focussed on underwater topographic features (UTFs) e.g., an orange roughy fishery on the northern and southern slopes of the Chatham Rise and southeast on the Wanganella Bank in northeast waters of the EEZ, and oreo fisheries east of the Pukaki Rise and on the Macquarie Ridge (Tracey, et al., 2011). Fishing for hoki/hake/ling focuses on areas of flat terrain and does not target UTFs. Trawl nets used are winged and with ground ropes that lack the rockhopper gear required for fishing on UTFs.

Anderson, et al., (2019) updated previous coral habitat suitability modelling studies using updated modelling techniques, additional coral presence records, and with the addition of regional environmental predictor layers based on the New Zealand Earth System Model (NZESM). While predicted taxa distributions largely agreed with previous studies, the additional presence records extended the predicted distributions of some taxa into new areas. The risk to corals from fishing was assessed by comparing predicted coral distributions with the aggregated swept area from historical bottom fishing for inshore and deepwater fisheries combined. Overlaying the regions of greatest habitat suitability with the most highly fished regions revealed considerable variability in vulnerability among taxa, both in degree and location (Anderson, et al., 2020). The greatest overlaps were seen for hydrocorals and the shallower scleractinian species, whereas the deeper scleractinians, gorgonians, and black corals were less vulnerable.

Bilewitch & Tracey, (2020) examined archived specimens collected by observers to determine the genetic diversity of corals and accuracy and precision of observer and taxonomist identifications, and to re-examine the effects of bottom trawling on protected coral diversity. The study found approximately 8% of corals in bycatch, identified by traditional methods (i.e., observer and specialist taxonomist identification), were undiscovered, which is also consistent with previous studies of New Zealand bycatch diversity.

Non-ETP sessile benthic species

The most commonly captured non-protected sessile benthic species group is sponges, which are encountered mainly on the western Chatham Rise. Deepsea anemones and sea pens are occasionally encountered in small quantities. Observer-reported and vessel-reported catches are provided in Table 39 and Table 40 respectively.

Table 39: Observed incidental capture of non-ETP sessile benthic invertebrates (kg) by hoki, hake and ling target tows, 2018-19 to 2022-23. Percentages calculated against total observed catch of all fish and invertebrate species (data source: FNZ COD database).

Common name	Species Code	2018/19	2019/20	2020/21	2021/22	2022/23	5-Year Avg. (kg)	5-Year Avg. (%)
Floppy tubular sponge	HYA	4,377	18,825	3,137	4,978	4,429	7,149	0.01239%
Sponges	ONG	8,504	5,410	6,219	5,510	6,270	6,383	0.01106%
Fibrous massive sponge	PHB	3,108	3,205	19,753	1,775	1,775	5,923	0.01027%
Glass sponges	GLS	2,600		900		22	1,174	0.00204%
Warty deepsea anemones	HMT	411	378	517	356	404	413	0.00072%
Anemones	ANT	90	280	344	74	887	335	0.00058%
Smooth deepsea anemones	ACS	524	156	276	200	333	298	0.00052%
Purple sea pen	PNN	22	49	40	77	6	39	0.00007%
Airy finger sponge	CRM	86	34	14	48	4	37	0.00006%
Common anemone	ACB	50	3				27	0.00005%
Sponge	RAS				25		25	0.00004%
Sea pens	PTU	1		14	61	19	24	0.00004%
Sea pen	SPN	2	11	32	10		14	0.00002%
Rocky dumpling sponge	PAZ		13	3	33	3	13	0.00002%
Orange frond sponge	CIC	17		1			9	0.00002%
Fleshy club sponge	SUA	28	0	6	3	3	8	0.00001%
Demosponges	DSO				7		7	0.00001%
Sea anemones	ATR			8		5	7	0.00001%
Sponge	LAA				5		5	0.00001%
Curling stone sponge	GRE	1	11	2	3	2	4	0.00001%
Bryozoan	COZ				3		3	0.00001%
Siboga sea pen	GYS	5		2	3		3	0.00001%
Deepsea anemones	LIP	3					3	0.00001%
Deepsea anemones	BOC	4	1	1	5	1	2	0.00000%
Pink ice egg sponge	RHA	1	3		1	2	2	0.00000%
Rubber sponge	PHW				2		2	0.00000%
Coral-like anemones	CLM	1	1	1	2	4	2	0.00000%
Sea lily, Stalked crinoid	CRN					1	1	0.00000%
Fibreglass cup sponge	PLN		1				1	0.00000%
Bristle ball sponge	TTL					1	1	0.00000%
Knobbly sandpaper sponge	ANZ	1					1	0.00000%
Ostrich egg sponge	GVE				0		0	0.00000%
Smooth white cup sponge	CFU			0			0	0.00000%
Corals, Sponges, Bryozoans	CSB				0		0	0.00000%
Yoyo sponge	THN	0					0	0.00000%
Furry oval sponge	TLD			0			0	0.00000%
Totals		**19,834**	**28,381**	**31,268**	**13,180**	**14,171**	**21,913**	0.03799%

Incidental catches of non-protected anemones, bryozoans and sponges are reported by vessels on Non-Fish Protected Species (NFPS) forms, along with catches of protected seabirds and marine mammals (Table 40). Note: code CSB is sometimes used when mixed catches of unidentified sessile benthics occur.

Table 40: Vessel-reported incidental catches of non-protected sessile benthic species by hoki, hake and ling UoA trawl fisheries. (data source: FNZ Non-Fish Protected Species catch forms and ER reports).

Species Group	Reporting Code	2018-19	2019-20	2020-21	2021-22	2022-23	5-Year Avg. (kg)	5-Year Avg. (%)
Anemones	ANT	10	-	-	81	105	65	0.00005%
Bryozoans	COZ	-	-	-	236	390	125	0.00010%
Coral/Sponge/Bryozoan	CSB	-	-	-	-	4	1	0.00000%
Sponges	ONG	69,209	51,649	38,380	26,904	45,526	46,333	0.03557%

Fishery interaction with sessile benthic taxa

Analysis incidental catches of sessile benthic invertebrate taxa during the period 1989-90 to 2022-23 and in 2022-23, showed that corals, bryozoans and anemones were encountered by a very minor percentage of tows and in minor quantities. Sponges were similarly encountered by a small proportion of tows but involved greater quantities (noting that catch weights were likely over-estimated due to water retention), (Table 41).

Table 41: Incidental capture of sessile benthic invertebrate taxa by hoki/hak/ling-targeted tows during the period 1989-90 to 2022-23 and in 2022-23.

	1989-90 to 2022-23				2022-23			
Benthic Taxa	**No. tows**	**No. tows with captures**	**% tows with captures**	**Capture weight (kg)**	**No. tows**	**No. tows with captures**	**% tows with captures**	**Capture weight (kg)**
Corals	89,833	373	0.4%	529	18,410	116	0.6%	205
Bryozoans	89,833	317	0.4%	581	18,410	179	1.0%	389
Sponges	89,833	3,573	4.0%	245,837	18,410	1,105	6.0%	45,799
Anemones	89,833	1,034	1.2%	3,107	18,410	232	1.3%	587

Encounters with sponges occurred mainly in discrete areas on the southern and south-western flanks of Chatham Rise (Figure 66). Anemones were similarly encountered on south and south-western Chatham Rise and also on the Snares shelf south-east of South Island (Figure 67).

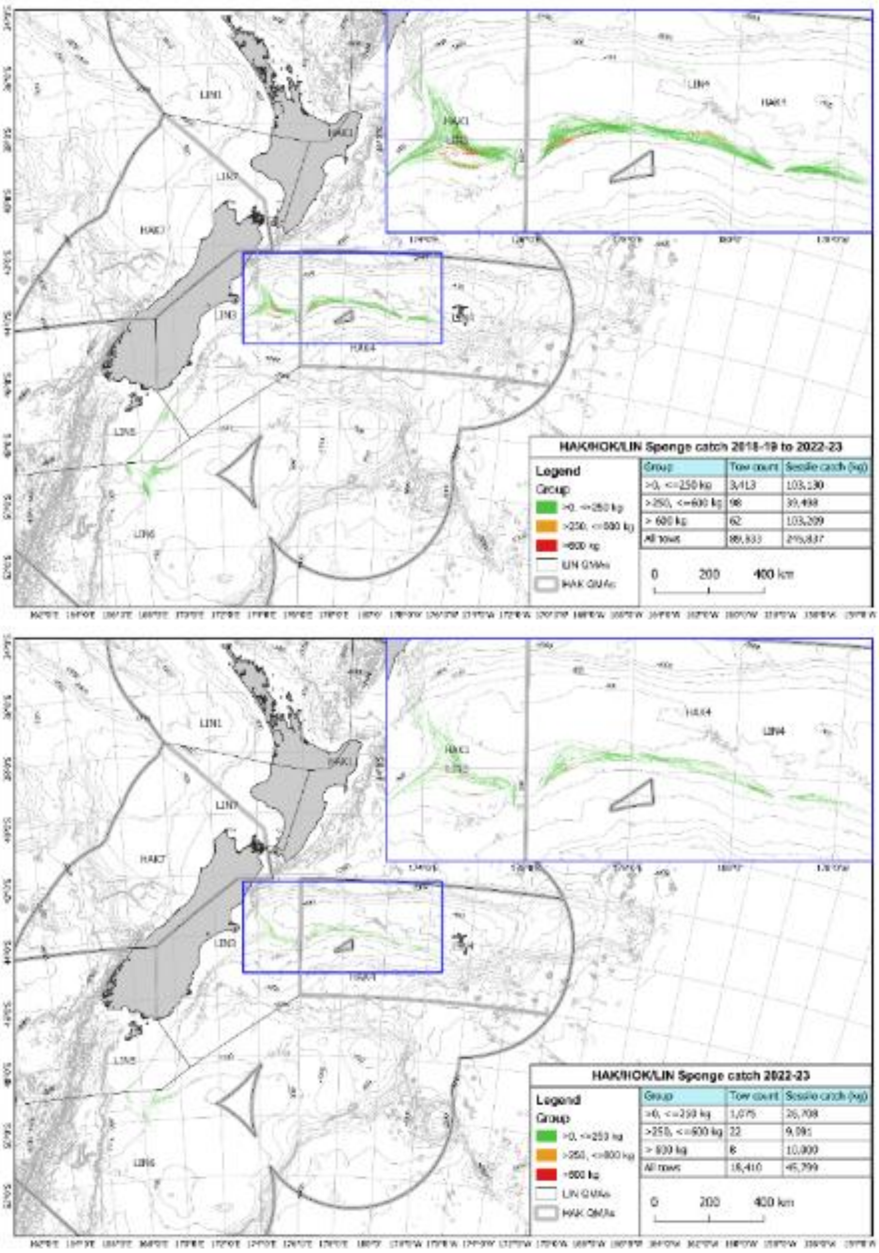


Figure 66: Incidental catches of sponges by the hoki/hake/ling-targeted tows for the period 1989-90 to 2022-23 (Top) and during 2022-23 (Bottom). Data source: FNZ. (L. Easterbrook-Clarke, GNS Science, pers. Comm.)

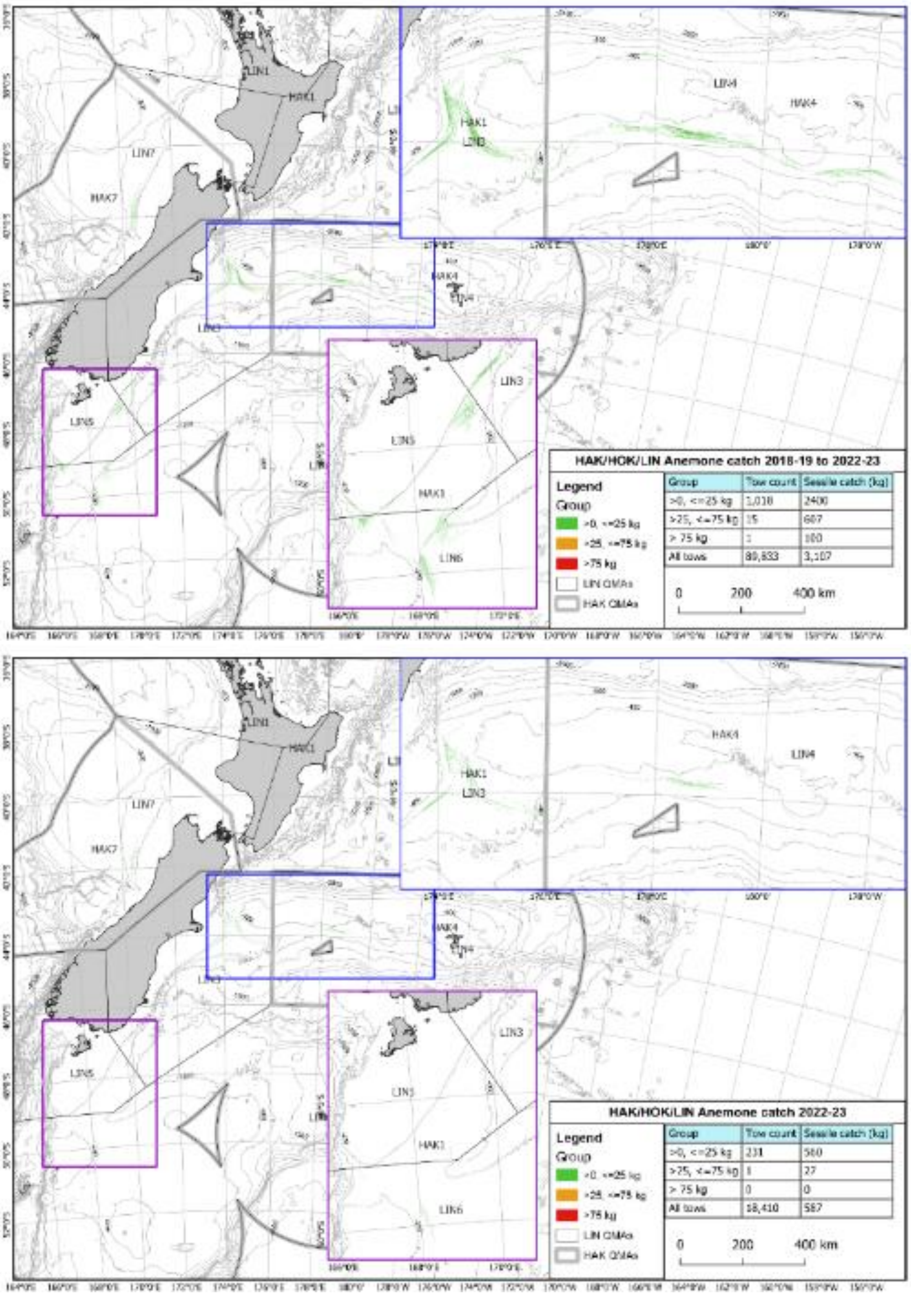


Figure 67: Incidental catches of anemones by the hoki/hake/ling-targeted tows for the period 1989-90 to 2022-23 (Top) and during 2022-23 (Bottom). Data source: FNZ. (L. Easterbrook-Clarke, GNS Science, pers. Comm.)

Information trueness

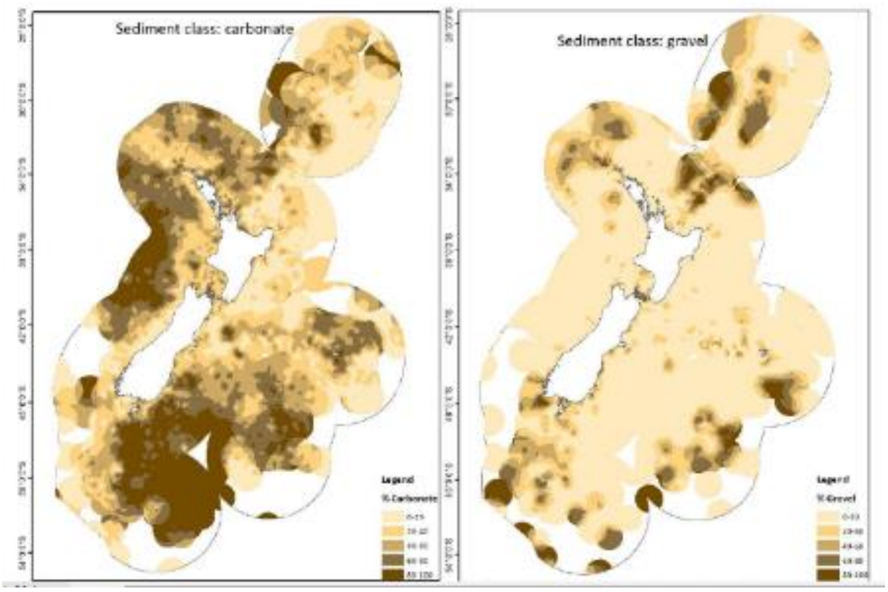
A summary of the observer and industry-reported catches of ETP and non-ETP benthic species as published in the Annual Review Report for Deepwater Fisheries (FNZ, 2023) indicates that reported catches from these two independent sources align reasonably well (Table 42).

Table 42: Observed (O) and industry reported (IR) catch of benthic species (kg) by the core deepwater fleet for fishing years 2018/19 to 2021/22 (FNZ, 2023).

Species	2017/18		2018/19		2019/20		2020/21		2021/22	
	O	IR	O	IR	O	IR	O	IR	O	IR
Anemones	18,463	5,754	7,773	4,275	5,064	9,249	7,852	14,312	8,467	7,859
Corals	240	82	631	163	2,656	35	3,860	20	1,936	24
Corals (generic codes[37])	2,166	2,926	8,141	27,928	1,024	1,488	938	5,350	104	9,763
Hydroids	23	-	18	-	65	-	10		40	-
Sea pens	169	-	104	-	125	-	95		194	-
Sponges	47,692	89,452	18,752	78,622	30,639	57,909	33,772	49,936	15,204	34,291

Habitats

Broad scale habitat maps indicate that sand, mud and gravel are the primary habitat types in the fishery (Figure 68). Surficial sediment (>40% classes) in the main fishery areas in depth zone 200-800m with sand and carbonate being the dominant sediments across the fishery areas (Table 43).



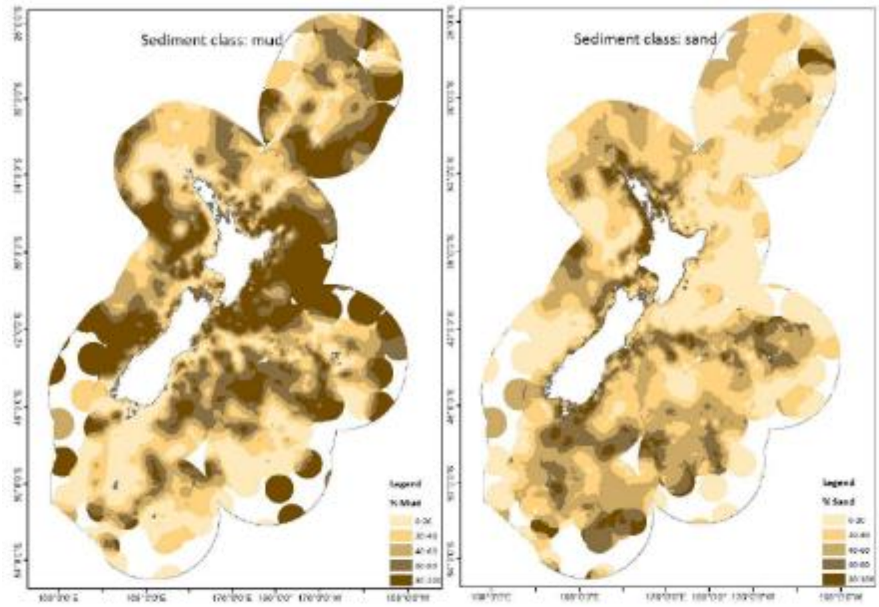


Figure 68: The interpolated distribution (%) of carbonate, gravel, mud, and sand based on the nzSEABED database. Source: (MacGibbon & Mules, 2023).

Table 43: Percentage overlap of the seafloor area of the substrate classes by the fishable area 1990–2021 and 2021 for all Tier 1 stocks. For gravel, mud, and sand, the percentage classes total 100% of the fishable area, while for carbonate the percentage represents the proportion that is carbonate versus noncarbonate. Source: (MacGibbon & Mules, 2023).

Substrate	Class (%)	Class area within fishable area (km²)	1990–2021 overlap (%)	2021 overlap (%)
Carbonate	0–20	138 252.7	63.5	14.9
Carbonate	20–40	282 469.8	48.4	9.0
Carbonate	40–60	275 070.0	33.6	4.3
Carbonate	60–80	288 732.7	22.8	3.0
Carbonate	80–100	369 402.8	21.2	2.2
Gravel	0–20	1 037 250.7	35.0	5.9
Gravel	20–40	188 550.0	37.4	5.7
Gravel	40–60	77 886.4	25.8	2.6
Gravel	60–80	26 682.0	22.1	0.7
Gravel	80–100	14 188.5	11.0	2.9
Mud	0–20	387 549.1	38.8	6.1
Mud	20–40	323 852.0	34.8	5.2
Mud	40–60	299 719.3	34.8	6.3
Mud	60–80	233 123.9	27.9	4.7
Mud	80–100	109 712.9	26.3	3.9
Sand	0–20	142 639.8	28.9	4.5
Sand	20–40	348 482.0	26.5	4.3
Sand	40–60	482 383.1	34.6	5.4
Sand	60–80	303 832.8	40.3	6.3
Sand	80–100	77 166.5	49.3	10.5

Benthic habitats and communities are impacted to varying extents by the impact of trawling depending on a range of factors, including:

- the type of gear used (design and weight) and the towing speed,
- features of seafloor habitats, including their natural disturbance regimes,
- the species present, and
- the frequency and intensity of fishing.

Previous studies show that recovery rates are slowest in stable, muddy or structurally complex habitats compared to sandy sediment communities that show little change after two to three bottom trawl passes per year (Kaiser, et al., 2006). Hiddink, et al., (2017) found that trawl gears removed 6–41% of faunal biomass per pass (average 15.5%), and that recovery times post-trawling were 1.9–6.4 years depending on the fisheries and environmental context. Of the trawl gears examined, otter trawls caused the least depletion, removing 6% of biota per pass and penetrating the seabed on average down to 2.4 cm (Hiddink, et al., 2017). Pitcher, et al., (2022) also estimated trawl depletion rates of benthic communities in mud, sand, and gravel habitats for a range of trawl gear types, average depletion rates ranged from 0.047 to 0.261 depending on gear and habitat. Otter trawls caused the lowest depletion followed by beam trawls and towed dredges and depletion rates were lower in sand than in gravel and mud (Pitcher, et al., 2022). Some habitat-creating organisms require substantial periods to recover after trawling (e.g., > 8 years for some sponges, >10 years for corals, see Kaiser, et al., 2006)

More Sensitive Habitats

All black, gorgonian, stony, and hydrocorals are protected under the Wildlife Act 1953. However, SA3.1.2.2 requires that all benthic species should be assessed under habitats. Therefore, benthic species including protected corals are assessed under habitats and considered more sensitive habitats.

For the purpose of this assessment, less sensitive habitats are considered to be gravel, mud, and sand, upper and mid-slope, with more sensitive habitats designated as sand covered hard substrate with emergent fauna (i.e., sponges, bryozoans, corals) in line with FAO guidelines.

A Benthic Optimised Marine Environment Classification (BOMEC) was developed to identify ecologically distinct New Zealand bioregions (i.e., broad scale delineation of spatial patterns) (Figure 69), (Leathwick, et al., 2012). BOMEC is restricted to depths <3000 m depth and was developed using benthic community and environmental data, including sediment type. A BOMEC comprised of 15 bioregions across the NZ EEZ was used to assess the potential impact of bottom trawling on these bioregions. However, the modelled BOMEC regions are theoretical, have yet to be ground-truthed, and their efficacy for managing impacts of bottom trawling has yet to be determined.

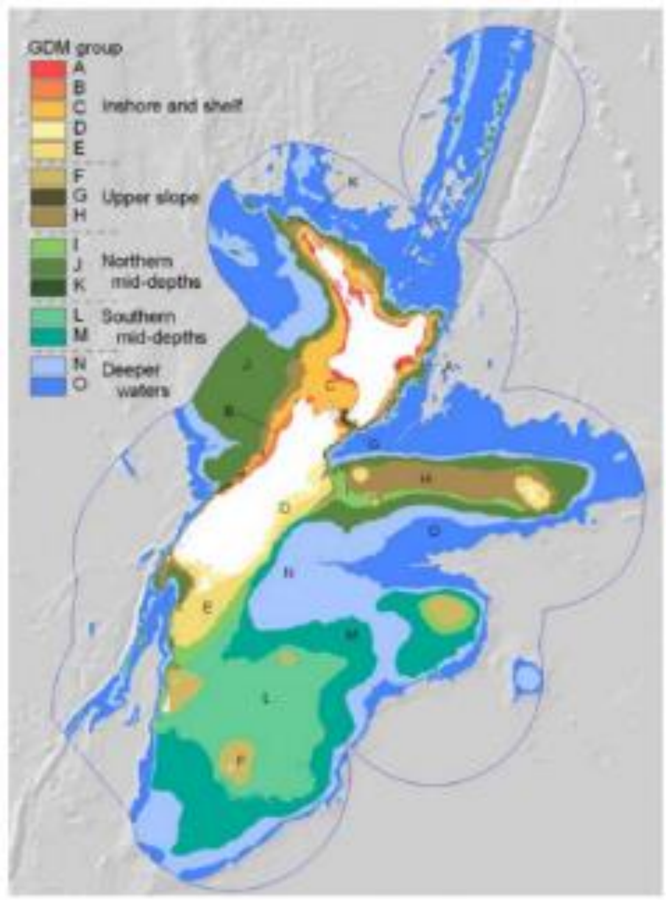


Figure 69: Map of the distribution of 15-class Benthic-Optimised Marine Environment Classification (BOMEC) classes. Source: Leathwick, et al., (2012).

When the footprint of the deepwater fishery is overlayed on the BOMEC classes, approximately 85% of the deepwater footprint is distributed over 6 BOMEC classes: J (23%), H (18%), L (16%), I (11%), C (10%), and E (7%). Hoki was primarily contacting benthos in classes: I (66.14%), H (28.12) and G (31.65%), while hake and ling primarily contacted classes G, H & I (Table 44).

Table 44: The total area of each BOMEC class within the EEZ+TS and the percentage of each area covered by the 1990-2021 footprint of Tier 1 deepwater species. Note: – indicates no overlap. Source: (MacGibbon & Mules, 2023).

		Footprint area overlap (%)									
Class	Area (km²)	HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU	Tier 1
A	30 661.00	0.00	0.50	0.39	0.03	0.01	0.13	0.01	0.22	1.23	2.46
B	12 786.10	0.38	6.16	0.65	2.93	0.01	0.09	0.13	0.05	0.36	10.21
C	90 256.50	0.09	3.12	27.87	0.37	0.01	0.10	–	0.62	1.72	33.09
D	28 085.70	0.02	3.04	1.70	0.65	0.07	0.14	–	0.01	4.34	8.25
E	61 258.00	0.39	9.00	14.39	2.30	0.13	0.03	0.01	0.16	25.38	34.01
F	38 775.80	0.04	1.08	0.31	1.17	0.01	0.00	5.09	0.76	11.24	17.66
G	6 702.30	1.14	31.65	0.27	11.37	0.06	1.44	–	1.48	0.08	42.21
H	138 399.10	5.58	28.12	7.72	7.25	0.05	0.16	0.02	8.31	5.24	43.69
I	52 008.30	3.75	66.14	0.64	8.57	0.56	0.24	4.38	0.10	9.75	73.92
J	312 604.90	3.16	12.02	0.32	0.85	2.50	10.64	0.01	0.83	0.58	24.91
K	1 200.20	–	0.23	–	–	–	0.03	–	–	–	0.26
L	198 578.40	0.45	15.89	0.03	3.85	0.03	0.00	9.32	2.73	2.16	28.42
M	233 837.40	0.08	4.53	0.00	0.09	2.88	0.37	0.26	0.01	0.17	7.88
N	495 154.20	0.00	0.31	0.01	0.01	0.42	1.78	0.00	0.03	0.06	2.37
O	1 006 911.10	–	0.00	–	0.00	0.02	0.04	–	0.00	0.00	0.05
All	2 707 219.00	0.78	6.18	1.73	1.06	0.64	1.63	0.87	0.77	1.56	12.14

Trawl footprint

Geospatial position reporting (GPR) devices, for position reporting, are required to be installed and operational on commercial fishing vessels. Data are therefore available to monitor the trawl footprint of the hoki/hake/ling fishery. Footprint data illustrates that the fishery operates in the 200-800m depth range and primarily fishes within the historic footprint (i.e., the same grounds are fished year-on-year).

The trawl footprint of New Zealand's trawl fisheries is assessed annually to monitor the scale and intensity of their interactions with the benthic habitat. The latest trawl footprint report released in July 2023 presents the spatial analysis of bottom-contacting trawl effort by commercial trawlers within the New Zealand 200 nm Exclusive Economic Zone and Territorial Sea (EEZ+TS), in waters open to trawling down to 1,600 m depth (the 'fishable area'), for different time periods. The hoki UoA has an area of 4,111,569 km2 (i.e. the extent of the EEZ and Territorial Sea) and a fishable area of 1,391,680 km2. Only 21,958 km2 was contacted in 2022 amounting to 0.53% of the allowable UoA area 1.6% of the fishable area.

MacGibbon & Mules (2023) analysed data from 1990-2021 to examine the extent of bottom contact by commercial trawling. Hoki data accounted for the majority of the annual tow data, with 447,248 tows for the time period and more than 20,000 tows in each year between 1996 and 2003. The data show there has been a major reduction in the overall footprint from the early 2000s, driven mainly by the reduced hoki TACC following completion of the fish-down period (Figure 70).

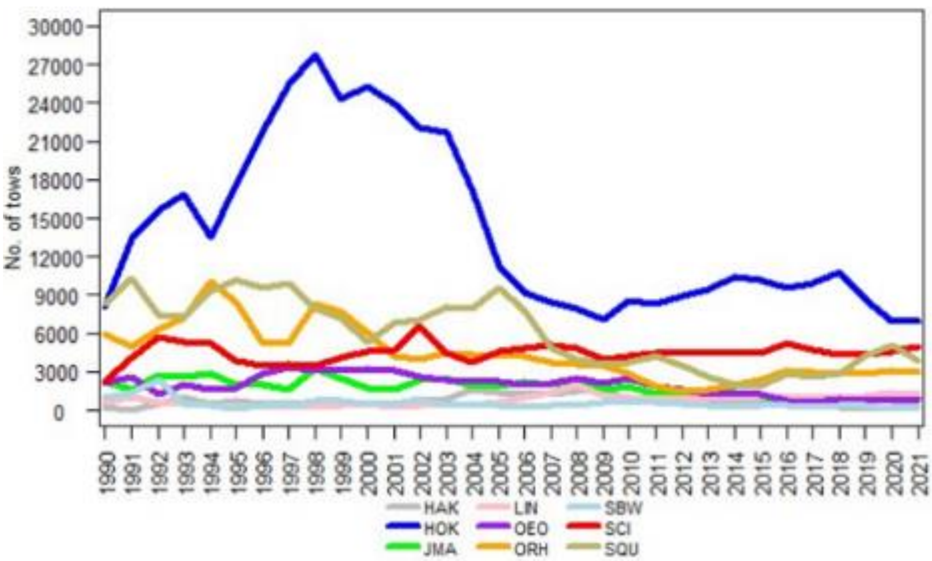


Figure 70: The number of bottom-contacting tows by year for the Deepwater Tier 1 species (MacGibbon and Mules, 2023).

MacGibbon & Mules, (2023) examined the aggregate number of 25 km^2 cells contacted by Tier 1 species as an indicator of fishery footprint, with hoki, hake and ling contacting 89% of the fished cells and with a footprint of 292,515 km^2 over the 30-year period 1990 - 2021. During 2021, the hoki, hake and ling footprint was much reduced at 22,830 km^2 and hoki, hake and ling tows accounted for approximately 51%, 2% and 4% of the overall deepwater Tier 1 species footprint respectively (Table 45).

Table 45: Percentages of the total number of cells contacted, aggregate area (km^2) and footprint (km^2) for Tier 1 targets 1990-2021 (left) and for 2021 (right). Note: the footprint of some target species overlap. Source: (MacGibbon & Mules, 2023)

	Percent of total Tier 1 for 1990–2021			Percent of total Tier 1 for 2021		
Target	Cells	Aggregate area	Footprint	Cells	Aggregate area	Footprint
HAK	12	2.8	6.4	5	1.1	1.8
HOK	58	55.1	50.9	38	52.1	50.5
JMA	17	6.2	14.3	14	4.7	6.9
LIN	19	2.2	8.7	8	3.5	3.9
OEO	15	1.3	5.3	5	0.5	0.7
ORH	25	4.1	13.4	22	9.1	13.4
SBW	11	1.3	7.1	3	0.8	1.3
SCI	17	6.7	6.4	8	12.7	11.3
SQU	22	20.5	12.9	11	15.6	10.1
Total	36 466	3 396 811.2	328 669.4	8 477	75 668.0	40 622.8

As hoki-targeting is by far the largest component of the hoki/hake/ling trawl fishery, and as hake and ling are often targeted on the same trips and in the same areas and depths using the same gear, quota changes for hoki may result in changes in effort and trawl footprint for all three species.

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 km^2 and 23,274 km^2 in 2020 and 2021, respectively).

In the most recent year for which trawl footprint data are available, 2021, hoki and hake tows occurred primarily in the 400 – 600 m and 600 – 800 m depth zones and in combination contacted only 8.6% of the area of these depth zones. Ling tows occurred primarily in the 200 – 400 m and 400 – 600 m depth zones and contacted only 0.69% area of these depth zones. Hoki, hake and ling target tows combined contacted only 1.64% of the fishable area (i.e. depths less than 1,600 m), (Table 46). Analysis of trawl tow data showed that the median fishing depth for bottom-contacting hoki, hake and ling-targeted tows was 480 m for the period 1989-90 to 2022-23 and 492 m for the most recent year i.e. 2022-23 (L. Easterbrook-Clark, GNS Science, pers. comm.).

Over the entire period for which trawl footprint data are available (i.e. 1990 – 2021), hoki, hake and ling target tows contacted 15.6% of the fishable area (Table 47), showing that a considerably reduced area of the seabed is now being contacted.

Table 46: 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 (km²)	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 47: 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 (km²)	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

Benthic interactions

Figure 71 illustrates the probability of capture distribution for southern blue whiting, based on the probability of capture (%) of a fish in a standardised trawl.

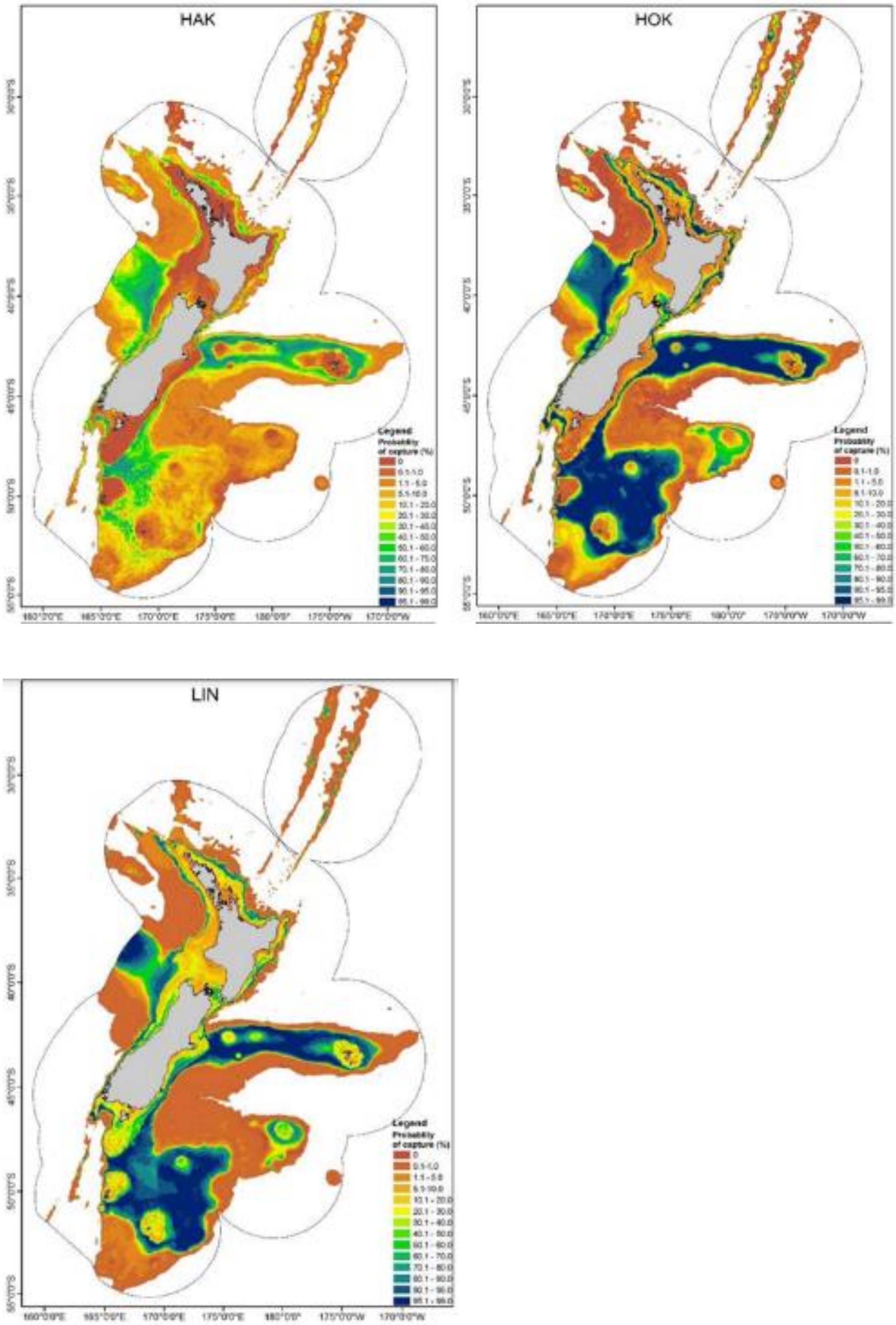


Figure 71: The extent of the predicted distribution of the preferred habitat for hake (upper left), hoki (upper right and ling (lower left) (after Leathwick et al. 2006), where the preferred habitat represents the probability of capture of that species in a standardised trawl in waters down to 1950 m depth.

The overlap of the hoki/hake/ling fishery footprints on the preferred habitat distributions show that targeted trawls occur in areas where the species are most likely to be captured (i.e. predominantly in the 70% – 95% probability of occurrence areas), (Figure 72; Figure 73; Table 48).

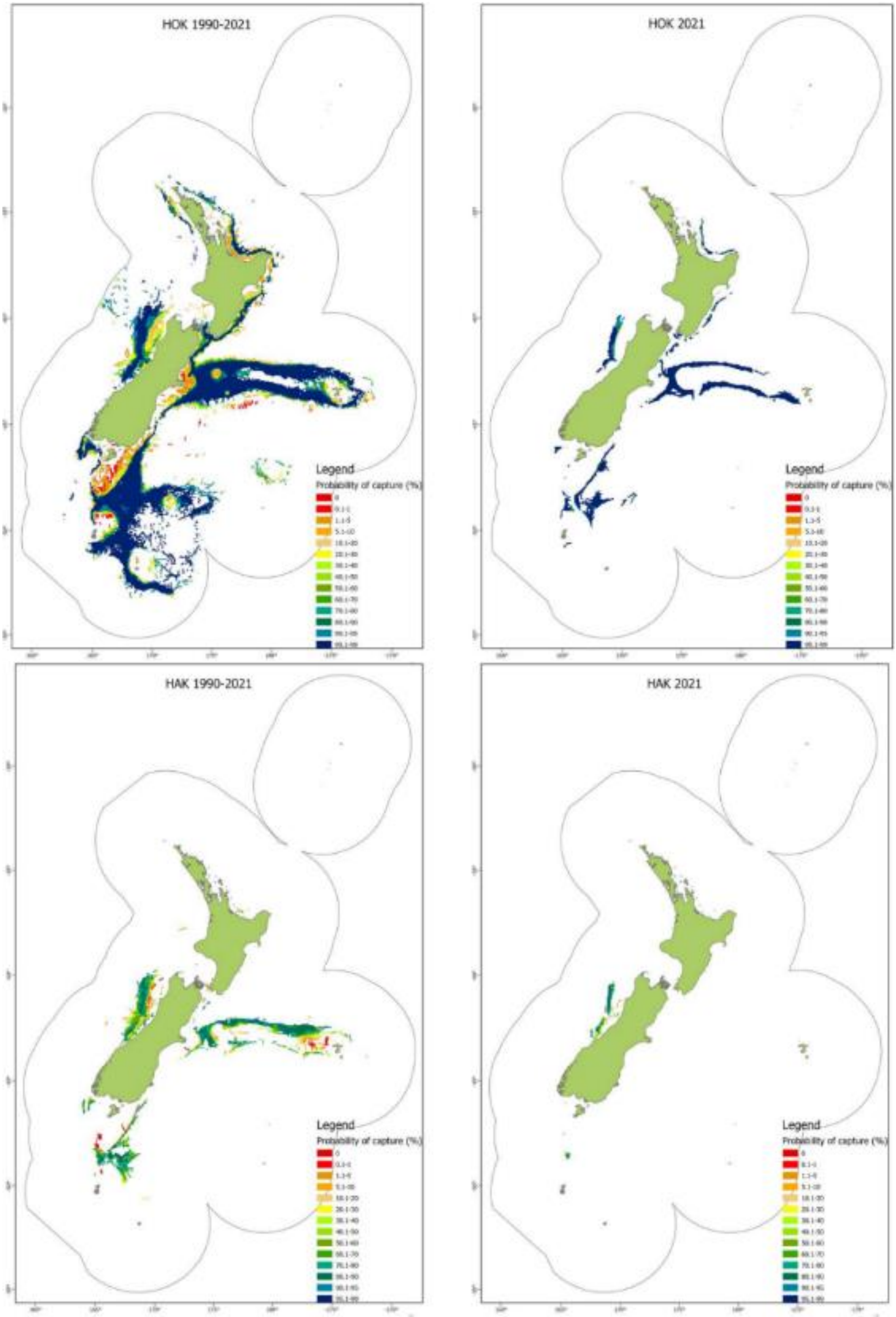


Figure 72: Distribution of the 1990–2021 (left) and the 2021 trawl footprints (right) for hoki (top) and hake (bottom), displayed by 25 km^2 contacted cell, relative to the probability of capture for that species (after Leathwick et al. 2006).

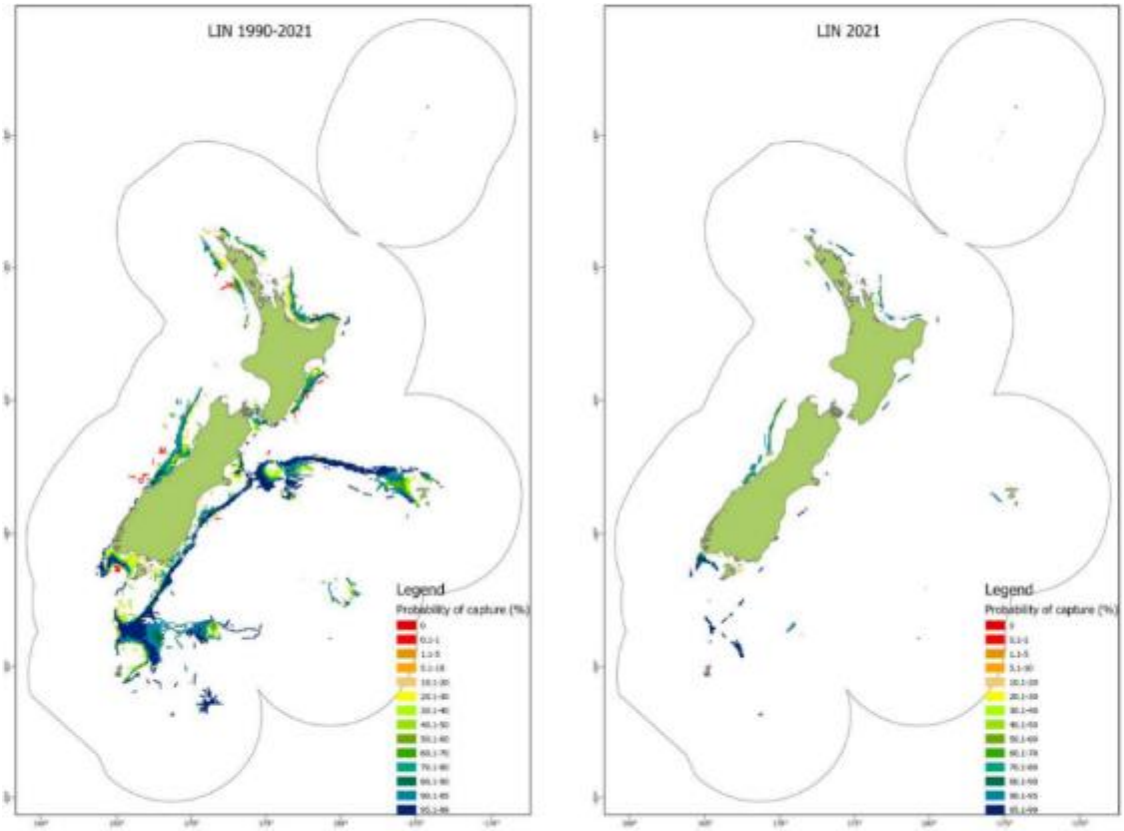


Figure 73: Distribution of the 1990–2021 (left) and the 2021 trawl footprints (right) for ling, displayed by 25 km^2 contacted cell, relative to the probability of capture for that species (after Leathwick et al. 2006).

Table 48: 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	HAK footprint overlap (%)		HOK area	HOK footprint overlap (%)		LIN area	LIN footprint overlap (%)	
(%)	(km^2)	1990–2021	2021	(km^2)	1990–2021	2021	(km^2)	1990–2021	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

The trawl footprints for the hoki/hake/ling trawl fisheries over the period 1989-90 to 2022-23, and for the 2022-23 fishing year alone, show that the current annual benthic impact is, by comparison, very minor (Figure 74).

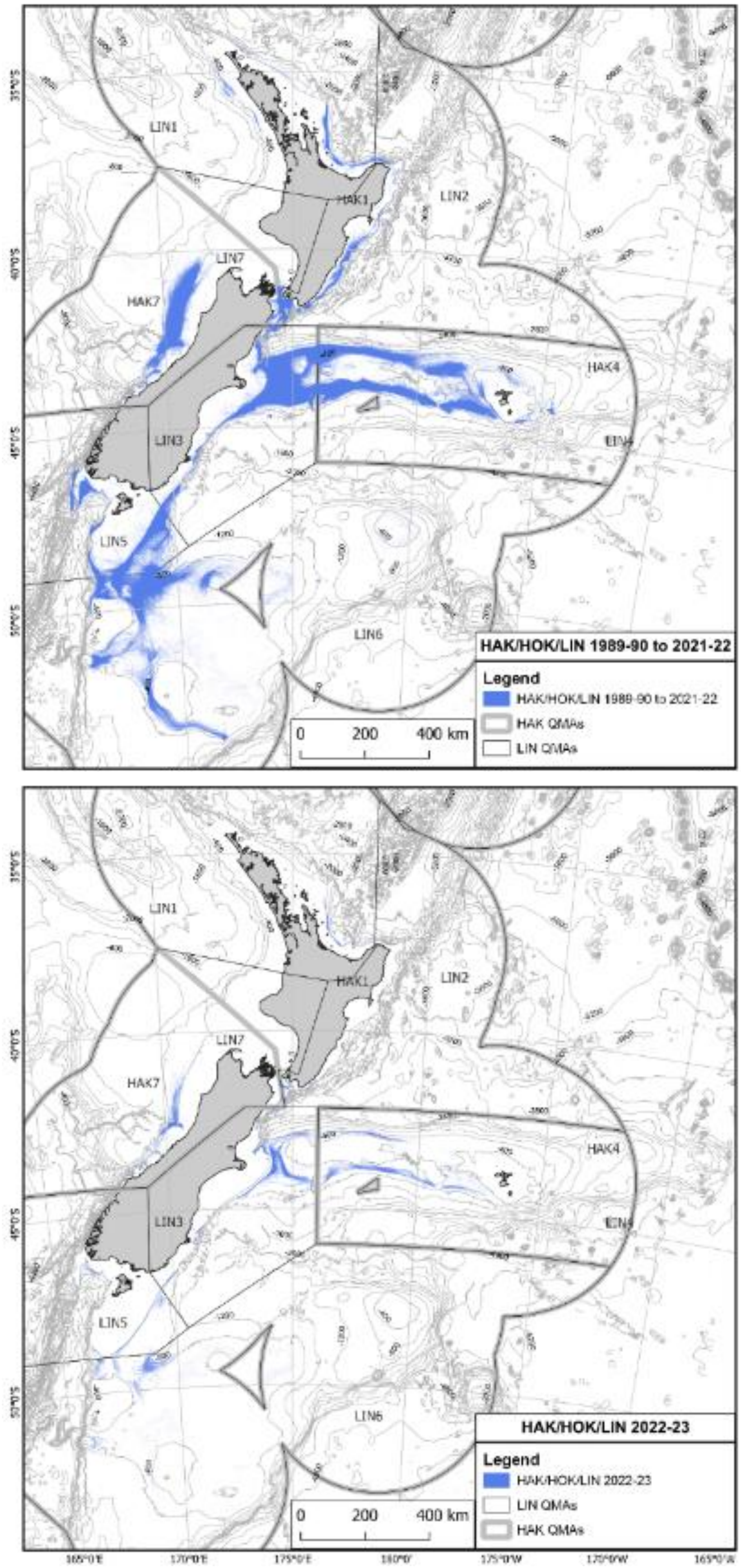


Figure 74: Hoki/hake/ling trawl footprint for the period 1989-90 to 2022-23 (Top) and for the 2022-23 fishing season (Bottom). Data source: FNZ Rep Log 15702).

Benthic Habitat Management

The National Fisheries Plan for Deepwater and Middle Depth Fisheries has an environmental outcome to manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the adverse effects of these fisheries on benthic habitats (Fisheries New Zealand, 2019b).

Approximately 34% of the New Zealand EEZ is considered 'fishable', meaning seabed areas shallower than 1,600 metres and open to fishing (i.e., not within a Benthic Protection Area (BPA) or a Seamount Closure Area (SCA)). Since 2007, management measures to address the effects of trawl activity have focused on avoiding benthic impacts through the implementation of spatial closures. More than 30% of the NZ EEZ is protected from the fishing impacts of bottom trawl, through BPAs and SCAs which were implemented to avoid adverse effects of fishing on the benthic environment (Figure 75). There are a total of 17 Benthic Protection Areas (BPAs), representatively distributed around the EEZ, and 17 ‘seamount’ closures, which 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.

Impacts of fishing on benthic habitats are monitored through annual reporting of the trawl footprint and the capture of benthic organisms (see Fisheries New Zealand, 2022a).

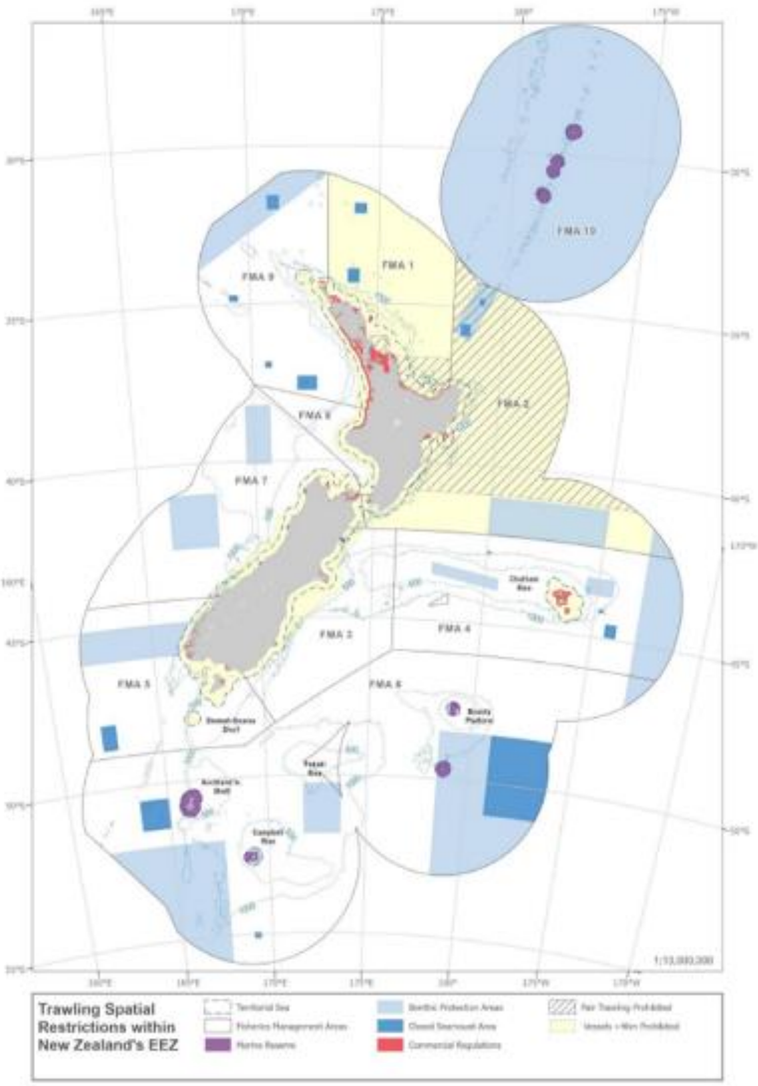


Figure 75: Map of the major spatial restrictions to trawling and Fisheries Management Areas (FMAs) within the outer boundary of the New Zealand EEZ.

Trawl footprint overlap with modelled predictive distributions

Habitat suitability models have been developed to produce predicted habitat distributions for sessile benthic taxa in the New Zealand EEZ (e.g. Anderson et al., 2014, 2015, 2019; Bowden et al., 2019, 2019a; Georgian et al., 2019).

The approach used in all of these modelling exercises is essentially to define relationships between point-sampled (i.e. observed) faunal data and environmental gradients to predict how individual benthic taxa and communities vary spatially over large areas (e.g. Chatham Rise). Recent modelling has used a merged benthic invertebrate occurrence dataset from five seabed photographic surveys to inform development of improved predictive models at both single taxon levels, using Random Forest RF) and Boosted Regression Tree (BRT) decision-tree methods, and at community levels, using Gradient Forest (GF) and Regions of Common Profile (RCP) methods (Bowden et al., 2019). The use of these quantitative datasets with true absences and resolution at a finer scale, represent major refinements on the earlier models.

The accuracy and spatial resolution of these models is dependent on the quality and consistency of fine-scale information on the sediment types and topography of the seabed. This is significant because the distribution of sessile fauna such as corals and other habitat-forming fauna is defined by the availability of hard substrata, which is highly patchy (Bowden et al., op cit.). The resolution of both the input data and the predicted outputs from the recent modelling are at a reasonably fine scale of 1 x 1 km cells and the predicted abundances of benthic taxa are presented as the number of individuals per 1000 m^{-2}. The relative confidence in the predictions is assessed using a bootstrapping technique, at the scale of individual cells, to produce spatially explicit uncertainty measures. Model uncertainties are calculated as the coefficient of variation (CV) of the bootstrap output (Bowden et al., op cit.).

As a basis for estimating the impact of the hoki/hake/ling fisheries on sensitive benthic habitats, the recent trawl footprint for the period 2018-19 to 2022-23 fishing years was plotted against predicted distributions for protected corals, bryozoans, sponges and anemones at the >50th percentile level. The analyses indicate that the overlap of the hoki/hake/ling trawl fisheries on sessile benthic invertebrate habitats is very slight and that the UoA fisheries do not therefore have an adverse effect on sensitive benthic habitats (Figure 76; Figure 77; Figure 78; Figure 79; Table 49).

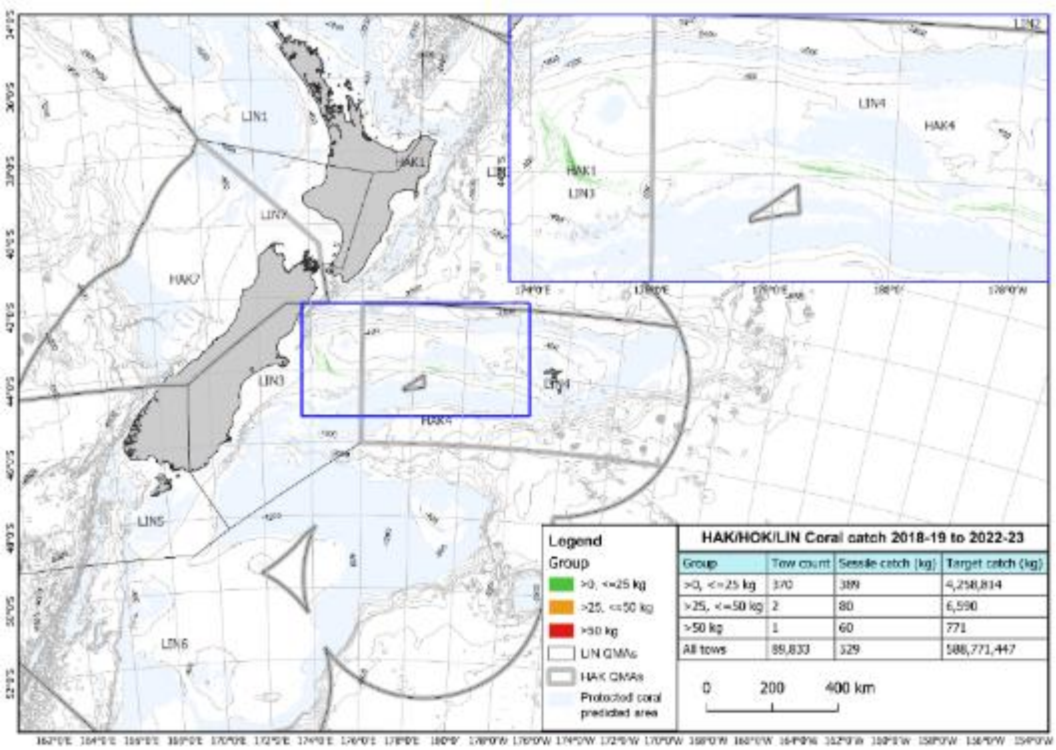


Figure 76: Plotted HOK/HAK/LIN trawl tracks for tows with incidental captures of ETP corals (by catch category) for the period 2018-19 to 2022-23, and predicted coral habitat distribution areas (light blue shading).

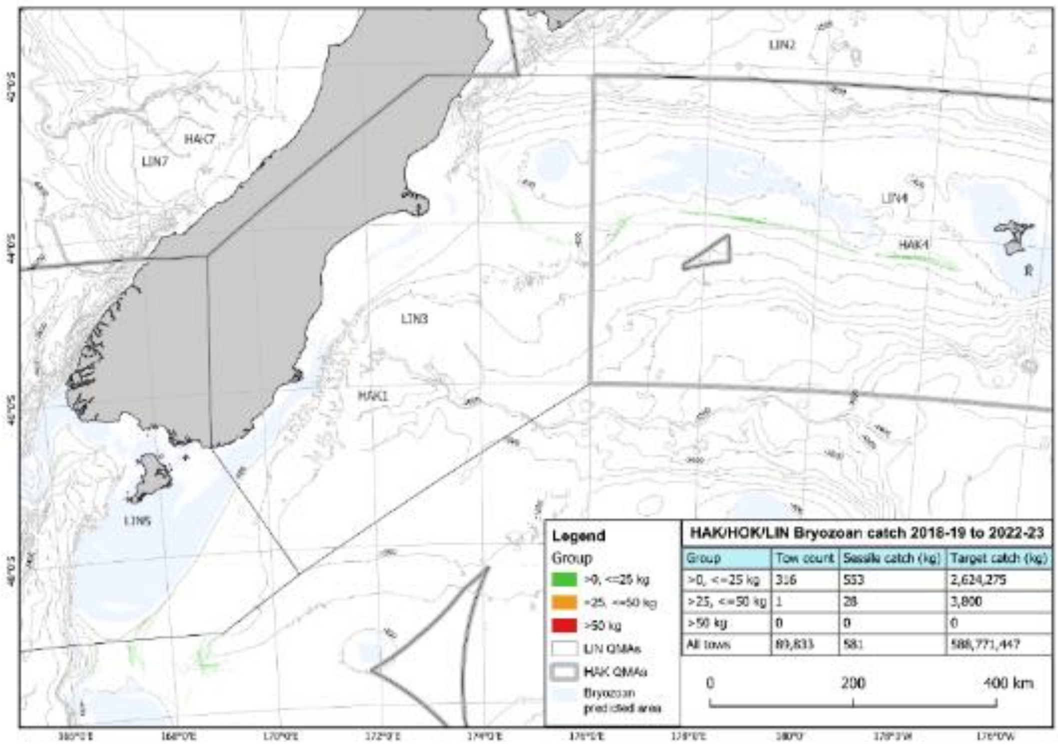


Figure 77: Plotted HOK/HAK/LIN trawl tracks for tows with incidental captures of bryozoans (by catch category) for the period 2018-19 to 2022-23, and predicted bryozoan habitat distribution areas (light blue shading).

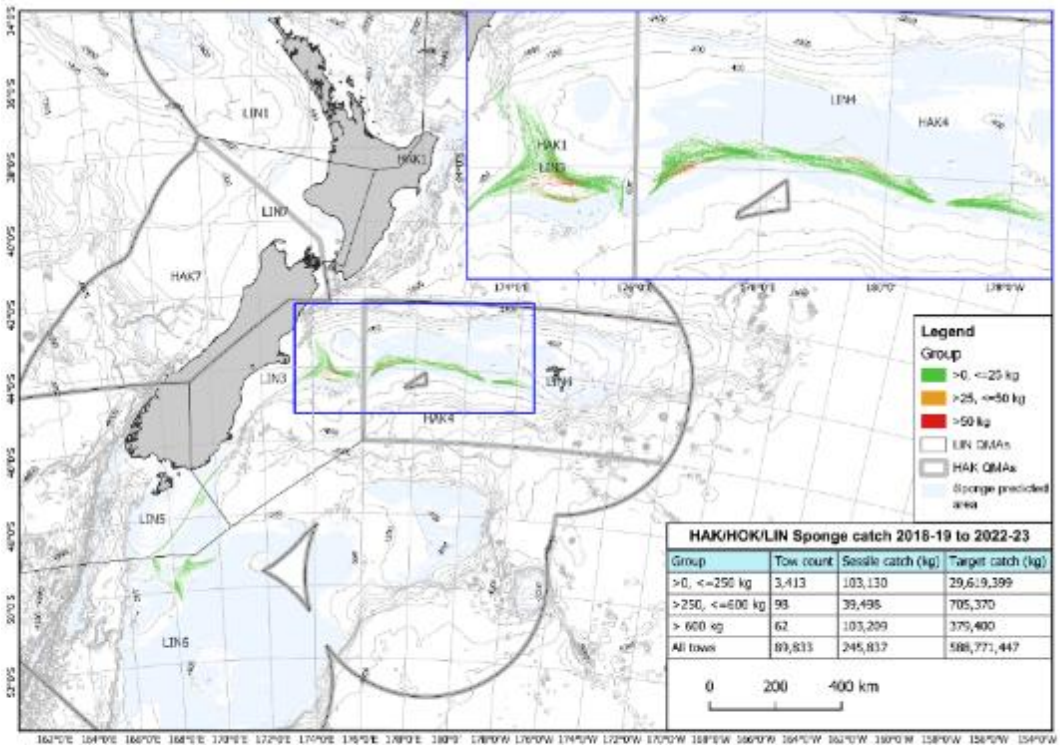


Figure 78: Plotted HOK/HAK/LIN trawl tracks for tows with incidental captures of sponges (by catch category) for the period 2018-19 to 2022-23, and predicted sponge habitat distribution areas (light blue shading).

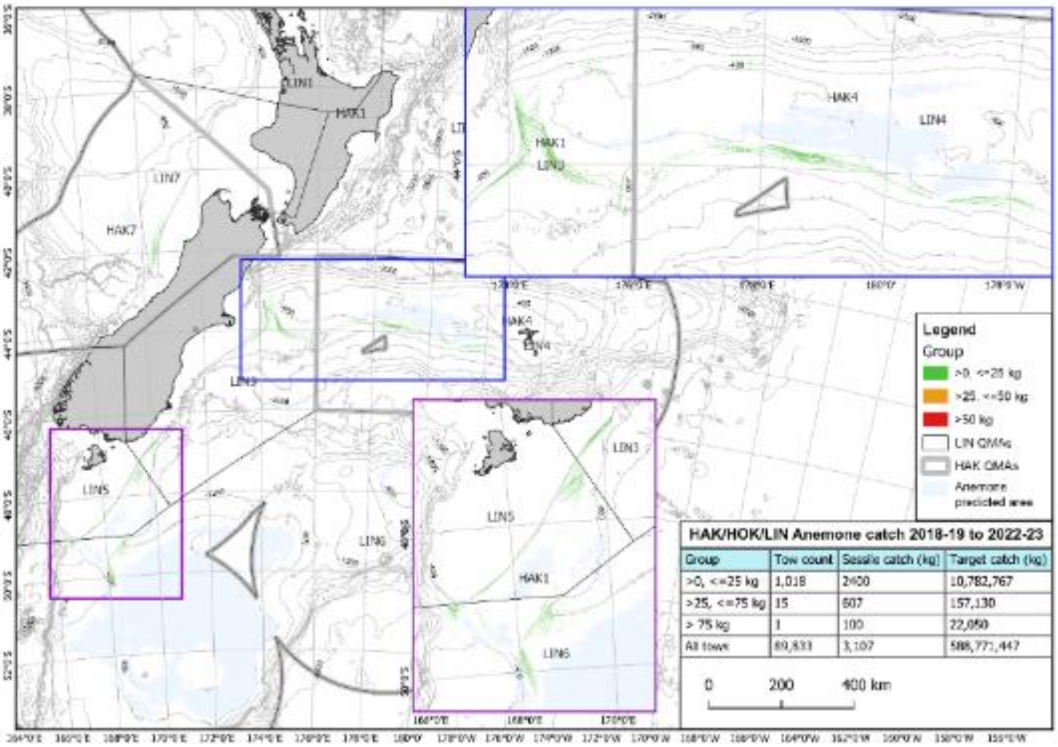


Figure 79: Plotted HOK/HAK/LIN trawl tracks for tows with incidental captures of anemones (by catch category) for the period 2018-19 to 2022-23, and predicted anemone habitat distribution areas (light blue shading).

Table 49: Hoki/hake/ling trawl footprint overlap with predicted distributions of benthic habitat-forming taxa. Data source: FNZ. Analysis: L. Easterbrook-Clark, GNS Science (pers. comm.)

Taxa	Parameters	Metrics
ETP Corals	Predicted distribution (km^2) within UoAs	961,512.63
	Trawl footprint in predicted area (km^2)	826.04
	Percentage of predicted area towed	**0.09%**
Bryozoans	Predicted distribution (km^2) within UoAs	139,796.13
	Trawl footprint in predicted area (km^2)	923.34
	Percentage of predicted area towed	**0.66%**
Sponges	Predicted distribution (km^2) within UoAs	631,368.81
	Trawl footprint in predicted area (km^2)	4,221.86
	Percentage of predicted area towed	**0.67%**
Anemones	Predicted distribution (km^2) within UoAs	183,677.13
	Trawl footprint in predicted area (km^2)	2,047.60
	Percentage of predicted area towed	**1.11%**

Information

All vessels have GPR systems installed, and the trawl footprint of New Zealand's trawl fisheries is assessed annually to monitor interactions with benthic habitats. The trawl footprint has been determined for each year commencing in 1989-90 for all the main deep water target fisheries (Seafood New Zealand, 2023a).

Several research initiatives related to the benthic effects of fishing are detailed in the Annual Operational Plan for Deepwater Fisheries (Fisheries New Zealand, 2021a) and include the following projects:

- BEN2020-01 Extent and intensity of seabed contact by mobile bottom fishing in the New Zealand Territorial Sea and Exclusive Economic Zone (trawl footprint)
- BEN2020-07 Extent and intensity of trawl effort on or near underwater topographic features in New Zealand's Exclusive Economic Zone
- BEN2019-05 Towards the development of a spatial decision support tool for managing the impacts of bottom fishing on in-zone, particularly vulnerable or sensitive habitats
- INT2021-02 Characterisation of protected coral interactions (Proteus).

In addition, Pitcher, et al., (2022) developed a quantitative model of the Relative Benthic Status (RBS) of the seabed in 24 regions of the world to provide an indication of broad scale patterns. The mean regional RBS for New Zealand, was high (0.982), with 68.7% of the region untrawled (i.e. RBS = 1). Although 98.1% of the New Zealand region has an RBS >0.8, indicating that in most of the region the abundance of biota is at 80% or greater of pre-trawling levels (Table 50), 0.05% of the region is depleted (i.e. RBS=0).

Table 50: Regional Swept Area Ratio (SAR) and Relative Benthic Status (RBS) for 24 regions worldwide from (Pitcher, et al., 2022).

#	Region Name	Continent	Coverage %	Area (km²×10³)	Regional SAR	Footprint uniform %	Sediment source	Regional mean RBS	%area of region RBS>0.8	%area of region RBS=0	%area of region RBS=1
1	Adriatic Sea (GFCM 2.1)	Europe	72	39,167	11.009	81.1	dbSEABED	0.247	20.9	68.22	17.3
2	West of Iberia (ICES 9a)	Europe	81	40,303	5.335	66.1	dbSEABED	0.596	46.4	20.85	16.1
3	Skagerrak and Kattegat (ICES 3a)	Europe	100	54,894	3.328	54.4	dbSEABED	0.633	55.1	22.60	26.7
4	Tyrrhenian Sea (GFCM 1.3)	Europe	82	137,924	2.787	51.9	dbSEABED	0.731	62.2	12.24	31.6
5	Western Baltic Sea (ICES 23-25)	Europe	72	87,070	1.282	38.9	dbSEABED	0.816	72.9	6.01	39.5
6	North Sea (ICES 6a,b,c)	Europe	86	586,108	1.215	52.1	dbSEABED	0.824	71.8	3.43	11.2
7	Aegean Sea (GFCM 3.1)	Europe	75	175,416	1.064	34.4	dbSEABED	0.834	74.4	5.06	47.6
8	Irish Sea (ICES 7a)	Europe	83	48,198	1.459	28.5	dbSEABED	0.836	80.6	9.10	17.9
9	North Benguela Current	Africa	95	203,002	1.018	28.0	dbSEABED	0.870	78.7	3.13	63.0
10	West of Scotland (ICES 6a)	Europe	81	160,640	0.506	24.2	dbSEABED	0.921	88.2	1.32	33.6
11	South Benguela Current	Africa	97	122,404	0.453	14.0	dbSEABED	0.949	91.7	0.72	70.1
12	Argentina	Americas	96	910,449	0.287	18.0	dbSEABED	0.966	96.0	0.13	54.7
13	East Agulhas Current	Africa	93	139,552	0.266	11.4	dbSEABED	0.967	95.2	0.44	61.8
14	Southeast Australian Shelf	Australasia	100	269,868	0.156	10.6	MARS	0.981	97.6	0.01	67.7
15	New Zealand	Australasia	90	1,052,723	0.118	9.2	dbSEABED	0.982	98.1	0.05	68.7
16	North California Current	Americas	100	119,327	0.107	10.0	dbSEABED	0.984	99.2	0.00	42.8
17	Northeast Australian Shelf	Australasia	100	529,357	0.129	6.7	MARS	0.985	97.9	0.17	78.6
18	East Bering Sea	Americas	97	797,969	0.073	6.4	dbSEABED	0.990	99.5	0.02	72.8
19	Aleutian Islands	Americas	97	94,721	0.026	1.8	dbSEABED	0.994	99.3	0.06	88.5
20	Gulf of Alaska	Americas	97	345,159	0.034	2.4	dbSEABED	0.994	99.4	0.02	87.7
21	Southwest Australian Shelf	Australasia	100	348,963	0.037	2.8	MARS	0.995	99.3	0.00	89.5
22	North Australian Shelf	Australasia	100	793,238	0.024	2.1	MARS	0.996	99.8	<0.01	83.8
23	Northwest Australian Shelf	Australasia	100	679,604	0.024	1.7	MARS	0.997	99.7	0.01	93.0
24	South Chile	Americas	85	188,910	0.005	0.5	dbSEABED	0.999	99.9	0.00	92.6
		All regions		**7,924,964**	**0.417**	**14.4**		**0.951**	**93.2**	**1.46**	**66.1**

Pitcher, et al., (2022) also suggest that if an acceptable threshold is set at RBS > 0.8 for >80% (see dotted lines on Figure 80), 15 regions, including New Zealand, have <2.5% probability of not meeting the >80% objective. Therefore, evidence from Pitcher, et al., (2022) indicates that the UoA is highly unlikely to reduce structure and function of the commonly encountered habitats (less sensitive) with moderate sensitivity to a point where there would be serious or irreversible harm (i.e. where the reduction in habitat structure, biological diversity, abundance and function is such that the habitat would be unable to recover to at least 80% of its unimpacted structure and function within 20 years if fishing were to cease entirely).

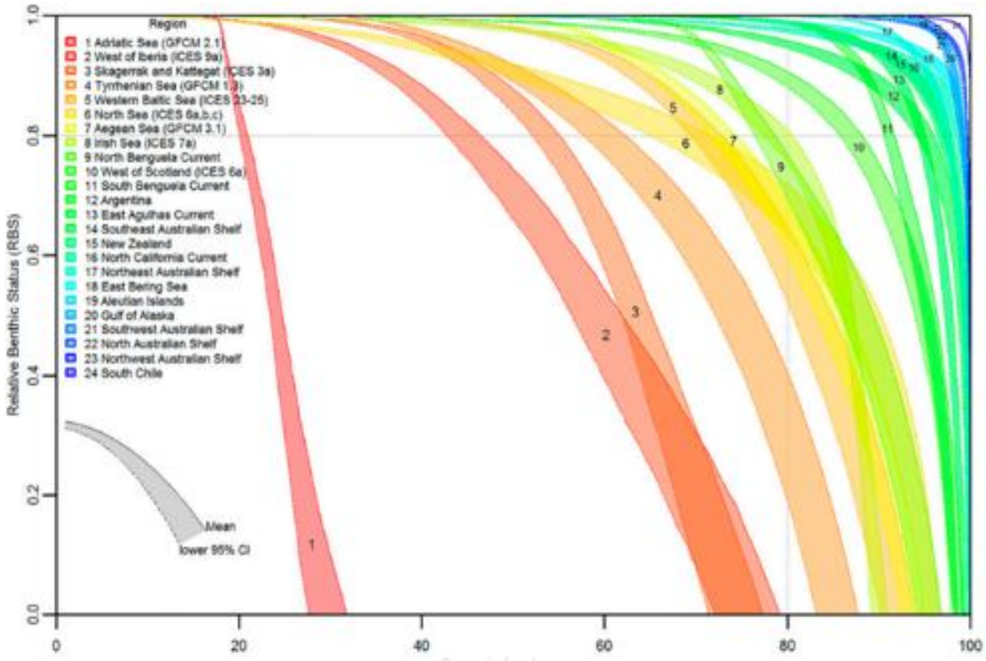


Figure 80: Regional RBS for 24 regions worldwide, for additional explanation see figure caption above. Source: Pitcher, et al., (2022). Note: Northeast Australia (Region 17) is the region in which the UoA operates.

Similarly, Pitcher, et al., (2022) calculated the percentage of each region where trawl Swept Area Ratio (SAR) exceeded an estimated local extinction threshold for highly sensitive biota (i.e., SAR > 0.35). In New Zealand, the percentage of the area where the SAR exceeded >0.35 was <20% (Figure 81). Pitcher, et al., (2022) also calculated the percentage of each region with a trawl SAR of <0.07, which would allow highly sensitive biota to maintain their status at >0.8. Values ranged from 20 – 95%, with New Zealand at ~80% (Figure 81). Therefore, the UoA is unlikely to reduce structure and function of VMEs to a point where there would be serious or irreversible harm (Pitcher, et al., 2022).

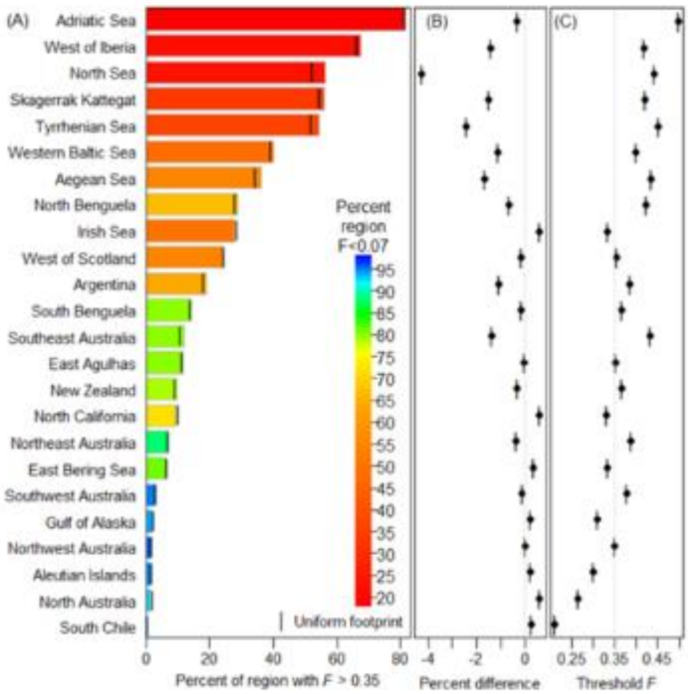


Figure 81: Results for highly sensitive biota types for 24 regions worldwide, for additional explanation see Figure 64 caption above. Source: Pitcher, et al., (2022).

Habitats research & innovation

Fisheries New Zealand and Seafood New Zealand have jointly developed a Draft Fisheries Industry Transformation Plan, one of the main objectives of which is to strengthen environmental performance through '*investing in innovation to accelerate selective fishing and further reduce benthic impacts and protected species interactions*' (FNZ, 2023). This will be achieved via the establishment of a joint industry/government project to source and develop technology that minimises adverse impact on the ocean floor to the maximum extent practicable through incentivising and facilitating fast adoption of proven efficient and environmentally sustainable fishing gear and methods by fishers. Government will facilitate this initiative by reviewing regulatory barriers to fishing innovation.

An example of an innovation already achieved is the development of new fish harvesting technology in 2019 by Precision Seafood Harvesting and which has been approved for commercial use for deepwater fish species in New Zealand. This Modular Harvesting System (MHS) replaces the traditional mesh in the lengthener and cod-end of the trawl net with a meshless canvas tube. The tube design results in reduced water flow in the codend, meaning fish are not exhausted during capture, and it eliminates squashing of the fish during hauling. In addition, there are escape holes allowing escapement of small fish. The benefits of MHS include improved quality of landed fish, better catch selectivity, increased survivability of unwanted bycatch, reduced captures of seabirds (many seabird captures involve their entanglement in meshes while attempting to feed on scraps during hauling, and enhanced survival of marine mammals which may have entered the net (Figure 82). This MHS system requires modifications to vessels' trawl deck layout and is being rolled out progressively.

Figure 82: The Modular Harvesting System (MHS) in use.

Another example is the development in New Zealand of DeepSet, a trawl-net-attached camera which uses machine-learning algorithms to identify species entering a trawl net and for this information to be transmitted to the vessel in near-real-time. This allows operators to quickly identify and reduce catches of non-fish protected species and non-target fish species (Radcliffe, 2023).

A further example is the development of SMART-Cam, a trawl-net-attached camera system (Figure 83) designed to record high quality imagery of the seabed during the course of commercial fishing operations. On retrieval of the net aboard the vessel, imagery from the camera is automatically transmitted to a computer on the bridge. Ancillary metadata (e.g. latitude & longitude, date, time, water depth) are recorded for each deployment to enable analysed digital imagery to be geo-referenced. The high-resolution images will be analysed using AI technology to identify species diversity and abundance. The SMART-Cam initiative will provide comprehensive data on the nature of the fished seabed, to depths of around 1,000 m, as a basis to inform benthic habitat management. This system, funded by quota owners and coordinated by Deepwater Council, is undergoing trials and it is anticipated that roll-out to the deepwater fleet will commence during 2025.

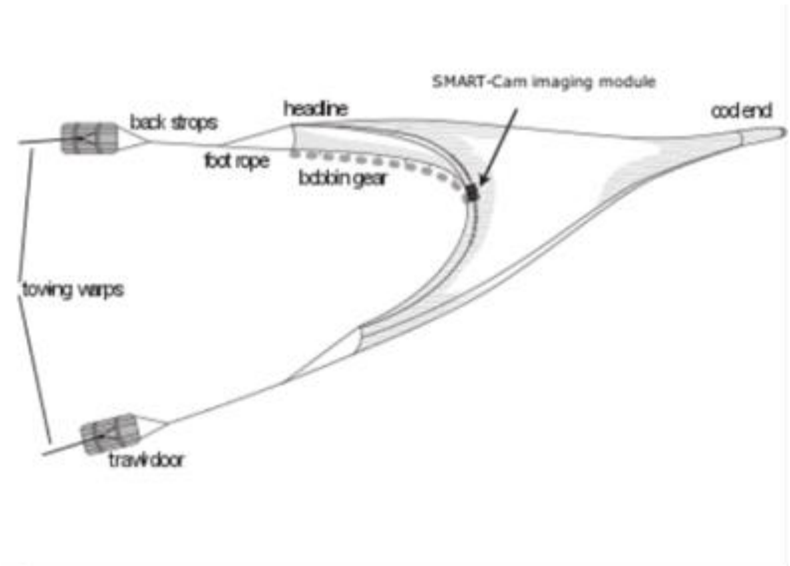


Figure 83: Illustration of SMART-Cam attachment on the headline of a bottom trawl net.

An initiative, implemented by Fisheries New Zealand and the Department of Conservation in 2022, is the Forum to Manage the Effects of Bottom Trawling, which will make recommendations on potential management measures to avoid, remedy or mitigate any adverse effects of trawling on the benthic environment (FNZ & DOC, 2022). Forum members included representatives from eNGOs, the fishing industry and Maori. The primary approach to achieving the Forum objectives is to identify potential additional areas for closure as a basis for protection of sensitive benthic habitats and communities. Analyses using species distribution modelling have identified potential 'coral hotspots' (Anderson et al., 2023), for consideration by the Forum.

The Aotearoa New Zealand Biodiversity Strategy (ANZBS), in concert with the Forum, has as an objective to '*Explore options to further reduce the effects of bottom trawling on benthic biodiversity through spatial gear restrictions and innovative gear design, whilst allowing for the sustainable utilisation of fisheries resources*.' (DOC, 2022).

Ecosystem

Hoki are a key biological component of the upper slope (200–800 m) ecosystem and is the species with the highest biomass. Hoki preys on lantern fishes and other midwater fishes, with larger hoki (over 80 cm) consuming proportionately more than smaller hoki (see Fisheries New Zealand, 2023a). The diet of hoki overlaps with the diets of alfonsino, arrow squid, hake, javelinfish, Ray's bream, and shovelnose dogfish. While hoki is prey for hake, stargazers, smooth skates, several deepwater shark species and ling.

Research into deepwater ecosystems in the New Zealand EEZ is most advanced in the vicinity of Chatham Rise region. Primary production is high in the region due to the convergence of subantarctic and subtropical water and the region supports valuable deepwater fisheries, an unusually rich benthic ecosystem and large seabird populations (Fisheries New Zealand, 2022b). Ecosystem modelling of the Chatham Rise food web has been conducted since the mid-2000s (see Fisheries New Zealand, 2022b).

Tuck, et al., (2009) used data from the Sub-Antarctic and Chatham Rise trawl surveys to develop ecosystem indicators using diversity, fish size, and trophic level. Species-based indicators appeared to identify some changes correlated with fishing intensity with increasing evenness (reducing diversity) but no evidence of species disappearing from the food-web. Some size characteristics of fish in research trawls on the Chatham Rise had changed, with fewer larger or heavier fish, although the median length of the catch did not change.

O' Driscoll, et al., (2011) found the spatial patterns in mesopelagic fish abundance closely matched the distribution of hoki and suggested that prey availability influences hoki distribution, but that hoki abundance is being driven by other factors such as recruitment variability and fishing. There was no evidence for a link between hoki and mesopelagic prey abundance and there were no obvious correlations between mesopelagic fish abundance and environmental indices (O'Driscoll, et al., 2011).

Pinkerton, (2011) developed a balanced trophic model of Chatham Rise with the focus of the model on the role of demersal fish in the food web, including hoki, orange roughy, smooth oreo, black oreo, ling, silver warehou, hake, javelinfish and barracouta and three fish groups: rattails, dogfish and other demersal species. The model suggests that benthic invertebrates, macrozooplankton and mesopelagic fish had particularly high ecological importance in the foodweb.

Recently several papers have been published on the Chatham Rise Atlantis model (see (McGregor, et al., 2019, McGregor, et al., 2020). The Chatham Rise Atlantis model area comprises waters from the shoreline around Chatham Islands to depths of 1,300 m along the Chatham Rise. The model produces similar results to fisheries stock assessment models for key fisheries species (McGregor, et al., 2020). The key species groups were orange roughy, hoki, pelagic fish small (primarily myctophids), and spiny dogfish. The model components that have knowledge gaps and are most likely to influence model results were oceanographic variables, and the aggregate species groups 'seabird' and 'cetacean other' with lower trophic species groups to be more susceptible to initialisation uncertainty (McGregor, et al., 2020).

Ecosystem monitoring

Three series of scientific trawls in New Zealand waters are particularly valuable for understanding ecosystem dynamics and for monitoring for trophic and ecosystem-level effects at the level of the demersal fish community (Tuck et al. 2009):

- A scientific trawl survey has been carried out on the Chatham Rise region approximately annually since 1992
- A similar scientific trawl survey has been carried out over the Sub-Antarctic plateau over the same period, but less frequently (Bagley & O'Driscoll 2012, Tuck et al. 2009)
- 15 scientific trawl surveys have been carried out in the Hauraki Gulf region between 1980 and 2000.

These surveys used a consistent methodology and were used to investigate change in a series of indicators in the demersal fish community. Data from Chatham Rise trawl surveys between 1992 and 2007 showed evidence of increasing evenness (i.e. reduced diversity), but no evidence that species were being lost from the food web. Some size characteristics of fish had changed, with fewer fish longer than 30 cm or heavier than 750 g being taken by trawl gear, although the median length of the catch did not change (Tuck et al.,2009).

The mean trophic level index (MTI) in the demersal fish community also decreased over the same period, more in the trawl survey data than in the commercial catch data (Pinkerton, 2010). The proportion of piscivorous fish and of true demersal (rather than bentho-pelagic) species also declined over this period (Tuck et al. 2009). Interestingly, threatened species and species defined as 'low-resilience', such as dogfish and rays, increased relative to other species on the Chatham Rise and may have been due to a combination of a lack of incentive to catch these species by the fishing fleet and an increase in offal and discards that benefit demersal scavengers. There were changes in the spatial distribution of fish with 16 out of 47 species showing changes in the proportion of the study area over which 90% of their abundance by weight was caught. Of these, half showed declining range and half showed increasing range. The species showing range contractions were generally the more abundant species whereas the species expanding in spatial range were generally the less abundant species.

Examination of the diets of hoki, hake and ling on the Chatham Rise between 1990 and 2009 showed some marked between-year differences in ling diet but no trends were detected (Dunn et al. 2009; Horn & Dunn 2010). Discards and offal from fisheries were found to be an important part of the diets of deepwater fish and accounted for up to a quarter of the diet of smooth skate (*Raja innominata*), (Dunn et al. 2009, Forman & Dunn 2012).

An estimated 11 000 - 14 000 t per year of non-commercial species and 600 - 2 100 t per year of hoki are discarded by trawl fisheries (Anderson & Smith, 2005), leading to the potential for a significant modification of the diet of scavenging species (Forman & Dunn 2012). Interpreting changes in diet from discards in a way that can inform fisheries management is not straightforward as the changes covered a period of declining hoki spawning biomass (McKenzie 2013) and during a time when evidence of climate variation was noted, namely a shift in the prevalence of Kidson weather types (Kidson 2000) between 1992 and 2007 (Hurst et al. 2012). Disentangling these environmental and fishery drivers of changes to indicators of the demersal fish communities has not yet been attempted in New Zealand.

Since the launch of NZ's Biodiversity Strategy 2000, Fisheries New Zealand has run a Marine Biodiversity Research Programme with 67 projects to date, addressing biodiversity knowledge gaps. Research projects pertinent to the deepwater environment include:

- ZBD2020-07 Recovery of Seamount Communities
- ZBD2020-06 Recovery of biogenic habitats
- ZBD2019-11 Development of Electronic Automated Reporting System (EARS) to improve seabird bycatch monitoring
- ZBD2019-01 Quantifying benthic habitats

- ZBD2019-04 Plastics and marine debris across the ocean floor in New Zealand waters
- BD2018-01 5-year continuous plankton survey (Phase 3)
- ZBD2018-05 Ecosystem function and regime shifts in the Subantarctic
- ZBD2016-11 Quantifying benthic biodiversity across natural gradients
- ZBD2016-04 Organic Carbon Recycling in Deepwater
- ZBD2014-03 Sublethal effects of environmental change on fish populations.

Climate change

Cummings, et al., (2021) reviewed the biological and ecological characteristics of 32 commercial fisheries species or species groups and evaluated their potential to be impacted by climate related changes. For offshore species information was sparse. However, for hoki there are known changes in growth rate over time the cause of which is unknown but maybe due to density dependence with hake switching prey in response to low hoki density. There is also a suspected shift in availability of hoki in the Sub-Antarctic, which may be a response to environmental change (Cummings, et al., 2021). However, in the Sub-Antarctic there were changes to several ecosystem components (predators, prey, and competitors of hoki) during anomalously warm and cold years in the 2000s, therefore the links to hoki biomass remain unclear (O'Driscoll et al. 2011). The Chatham Rise Atlantis model has suggested trends in stock abundance (for hoki and other species) which is estimated in stock assessment models to be due to trends in recruitment but may be due to trends in natural mortality rate due to ecosystem changes or species interactions. Overall, based on published literature and expert opinion, the risk of future projected environmental change to hoki and other key Tier 1 stocks was considered low. However, further research is still in progress.

Current climate change research projects include:

- ZBD2018-02 Climate change, fish distribution meta-analysis
- ZBD2018- 03 Climate variability, trends, and fish population parameters
- ZBD2014-09 Climate change risks and opportunities.

Key P2 references

Abraham, E.R., Neubauer, P., Berkenbusch, K. & Richard, Y. (2017). Assessment of the risk to New Zealand marine mammals from commercial fisheries. New Zealand Aquatic Environment and Biodiversity Report 189. https://fs.fish.govt.nz/Doc/24554/AEBR-2017-189-Marine-mammal-risk-assessment.pdf.ashx

ACAP. (2009). Agreement on the Conservation of Albatrosses and Petrels Species assessment: Buller's Albatross *Thalassarche bulleri*. http://www.acap.aq.

Anderson, O F; Smith, M H (2005) Fish discards and non-target fish catch in the New Zealand hoki trawl fishery, 1999–2000 to 2002–03. New Zealand Fisheries Assessment Report 2005/3. 37 p.

Anderson, O.F., Edwards, C.T.T. & Ballara (2019). Non-target fish and invertebrate catch and discards in New Zealand hoki, hake, ling, silver warehou, and white warehou trawl fisheries from 1990–91 to 2016–17. New Zealand Aquatic Environment and Biodiversity Report No. 220. 117 p. https://fs.fish.govt.nz/Doc/24700/AEBR-2019-220-Non-target-catch-and-discards.pdf.ash

Anderson, O. Tracey, D., Bostock, H., Williams, M. and Clark, M. (2014). Refined habitat suitability modelling for protected coral species in the New Zealand EEZ. NIWA Client Report prepared for Department of Conservation, WLG2014-69. 46 p.

Anderson, O., Mikaloff Fletcher, S. and Bostock, H. (2015). Development of models for predicting future distributions of protected coral species in the New Zealand Region. NIWA Client Report prepared for Department of Conservation. WLG2015-65. 28 p. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/models-predicting-future-distributions-corals-nz-niwa-dec-2015.pdf

Anderson, O., Tracey, D. and Rowden, A. (2019). Habitat suitability modelling for Protected Corals in New Zealand Waters. Final methodology report, prepared for Conservation Services Programme, Dept. Conservation, April 2019. 20 p. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/pop2018-01-finalmethods.pdf

Anderson, O., Schnabel, K., Bowden, D., Davey, N. & Hart, A. (2023). Identification of protected coral hotspots using species distribution modelling. Report prepared for Project POP2021-02, Conservation Services Programme, Department of Conservation. 63 p. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/202223-annual-plan/pop2021-02-protected-coral-hotspots-final-report.pdf

Baird, S.J. & Mules, R. (2021). Extent of bottom contact by commercial trawling and dredging in New Zealand waters, 1989–90 to 2018–19. Draft New Zealand Aquatic Environment and Biodiversity Report No. 260. 161 p. https://www.mpi.govt.nz/dmsdocument/45028-AEBR-260-Extent-of-bottom-contact-by-commercial-trawling-and-dredging-in-New-Zealand-waters-198990-to-201819

Baker, B.& Jensz, K. (2019). 2018 aerial survey of Salvin's albatross at the Bounty Islands. Final report to the Conservation Services Programme, Department of Conservation. Latitude 42, Australia. 11 p. https://www.doc.govt.nz/our-work/conservation-services-programme/csp-reports/201819/salvins-albatross-bounty-islands-population-project/

Baker, G.B., Jensz, K., Cunningham, R., Robertson, G., Sagar, P., Thompson, D.R. & Double, M.C. (2023). Population assessment of White-capped Albatrosses *Thalassarche steadi* in New Zealand. Emu – Austral Ornithology, Volume 123, 2023 – Issue 1. https://doi.org/10.1080/01584197.2022.2161915

Baker, C.S., Boren, L., Childerhouse, S., Constantine, R., van Helden, A., Lundquist, D., Rayment W. & Rolfe,J.R. (2019). Conservation status of New Zealand marine mammals, 2019. New Zealand Threat Classification Series 29. 18 p. https://www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs29entire.pdf

Bell, M. (2022). Motuhara seabird research: field trip report January 2022. POP2021-03 final report prepared by Toroa Consulting Limited for the Conservation Services Programme, Department of Conservation. 12 p. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/202122-annual-plan/pop2021-03-chatham-island-seabird-research-2022-final-report.pdf

Bell, E.A., Lamb, S. & Maclean, C. (2023). Key demographic parameters and population trends of tākoketai/black petrels (*Procellaria parkinsoni*) on Aotea/Great Barrier Island: 2022/23. Unpublished Wildlife Management International Ltd. Technical Report to the Conservation Services Programme, Department of Conservation, Wellington. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/202223-annual-plan/pop2022-01-takoketai-black-petrel-aotea-2022-2023-season-monitoring-final-report.pdf

Berkenbusch, K., Abraham, E.R. & Torres, L. (2013). New Zealand marine mammals and commercial fisheries. New Zealand Aquatic Environment and Biodiversity Report No. 119. https://docs.niwa.co.nz/library/public/AEBR_119.pdf

Bilewitch, J.P. and Tracey, D. 2020. Protected coral connectivity in New Zealand. Final Report for project POP2018-06 prepared by NIWA for the Conservation Services Programme, Department of Conservation. DOC19306-POP201806.32 p. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/pre-2019-annual-plans/pop2018-06-protected-coral-connectivity-final-report.pdf

Bowden, D., Anderson, O.F., Escobar-Flores, P., Rowden, A.A. and Clark, M.R. (2019). Quantifying benthic biodiversity: using seafloor image data to build single-taxon and community distribution models for Chatham Rise, New Zealand. New Zealand Aquatic Environment and Biodiversity Report No. 221. 64 p. https://www.mpi.govt.nz/dmsdocument/37823-AEBR-235-Quantifying-benthic-biodiversity-using-seafloor-image-data-to-build-single-taxon-and-community-distribution-models-for-Chatham-Rise-New-Zealand.

Bowden, D., Rowden, A., Anderson, O., Clark, M., Hart, A., Davey, N., Carter, M. and Chin, C. (2019a). Quantifying benthic biodiversity: developing a dataset of benthic invertebrate faunal distributions from seabed photographic surveys of Chatham Rise. New Zealand Aquatic Environment and Biodiversity Report No. 221. 35 p. https://www.mpi.govt.nz/dmsdocument/35616-AEBR-221-Quantifying-benthic-diversity-developing-a-dataset-of-benthic-invertebrate-faunal-distributions-from-seabed-photographic-surveys-of-Chatham-Rise.

Burgin, D. & Ray, S. 2022. Flesh-footed shearwater population monitoring and estimates: 2021/22 season. POP2021-04 final report prepared by Wildlife Management International Limited for the Department of Conservation, Wellington. 24p. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/202122-annual-plan/pop2021-04-flesh-footed-shearwater-monitoring-ohinau-and-lady-alice-islands-2021-22-final-report.pdf

Cleal, J. (2019). Deepwater Group Environmental Liaison Officer (ELO) Report 2018-19. 10 p. https://deepwatergroup.org/wp-content/uploads/2021/04/Cleal-2019-ELO-Report-2018-19.pdf

Cleal, J. (2020). Deepwater Group Environmental Liaison Officer (ELO) Report for the 2019-20 Fishing Year. 7 p. https://deepwatergroup.org/wp-content/uploads/2021/04/Cleal-2020-ELO-Report-2019-20.pdf

Cleal, J. (2021). Deepwater Group Environmental Liaison Officer (ELO) Report for the 2020-21 Fishing Year. 7 p.https://deepwatergroup.org/wp-content/uploads/2023/08/FVMS-ELO-Report-2021-22.pdf

Cleal, J. (2022). Deepwater Group Environmental Liaison Officer (ELO) Report for the 2021-22 Fishing Year. 9 p https://deepwatergroup.org/wp-content/uploads/2023/08/FVMS-ELO-Report-2021-22.pdf

Cleal, J. (2023). Deepwater Group Environmental Liaison Officer (ELO) Report for the 2022-23 Fishing Year. https://deepwatergroup.org/wp-content/uploads/2024/09/FVMS-ELO-2022-23-Report-V2-Feb-2024.pdf

Cummings, V., Lundquist, C., Dunn, M., Francis, M., Horn, P., Law, C., . . . Mielbrecht, E. (2021b). *Assessment of potential effects of climate-related changes in coastal and offshore waters on New Zealand's seafood sector.* Wellington: Fisheries New Zealand. Retrieved from https://fs.fish.govt.nz/Doc/24891/AEBR-261-Assessment-Of-Potential-Effects-Of-Climate-Change-On-Seafood-Sector-3389.pdf.ashx

DOC & MPI (2017). New Zealand sea lion/rāpoka Threat Management Plan 2017 – 2022. 17 p. https://www.doc.govt.nz/globalassets/documents/conservation/native-animals/marine-mammals/nz-sea-lion-tmp/nz-sea-lion-threat-management-plan.pdf

DOC (2022). Aotearoa New Zealand Biodiversity Strategy, Implementation Plan. 52 p. https://www.doc.govt.nz/globalassets/documents/conservation/biodiversity/anzbs-implementation-plan-2022.pdf

DOC (2023). Conservation Services Programme Annual Plan 2023/24. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/plans-and-submissions/202324/final-csp-annual-plan-2023-24.pdf

DOC (2024). Conservation Services Programme DRAFT Annual Plan 2024/25. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/plans-and-submissions/202425/draft-csp-annual-plan-2024-25.pdf

Dragonfly (2019). Protected species bycatch 2002-03 to 2017-18. https://psc.dragonfly.co.nz/2019v1/released/

Dunn, M R; Hurst, R; Renwick, J; Francis, R I C C; Devine, J; McKenzie, A (2009) Fish abundance and climate trends in New Zealand. New Zealand Aquatic Environment and Biodiversity Report No. 31. 75 p.

DWC (2023). Seasonal mitigation measures for hoki target trawl in FMA 3 & 4. Circular to vessels for completion and addition to Operational Procedures manual. 1 p.

DWG (2024). Operational Procedures. https://deepwatergroup.org/newsresources/op-manual/

DWC (2024). Sharks Fins Naturally Attached Operational Procedures. 3 p. https://deepwatergroup.org/wp-content/uploads/2020/10/Sharks-OP-V3.pdf

Edwards, C. T. T. & Dunn, A. (2021). Assessment of risk factors for seabird net captures in selected sub-Antarctic trawl fisheries. New Zealand Aquatic Environment and Biodiversity Report No. 266. p. 51. Ministry for Primary Industries, Wellington. https://docs.niwa.co.nz/library/public/NZAEBR-266.pdf

Edwards, C.T.T., Peatman, T., Goad D. & Webber, D.N. (2023). Update to the risk assessment for New Zealand seabirds. New Zealand Aquatic Environment and Biodiversity Report No. 314. 66 p. https://www.mpi.govt.nz/dmsdocument/57181/direct

Edwards, C., Peatman, T., Goad, D. & Webber, D. (2023a). Fishery data inputs for the New Zealand Seabird Risk Assessment. New Zealand Aquatic Environment and Biodiversity Report No. 313. 117 p. https://www.mpi.govt.nz/dmsdocument/57274-AEBR-313-Fishery-data-inputs-for-the-New-Zealand-Seabird-Risk-Assessment

Edwards, C.T.T. & Mormede, S. (2023). Temporal and spatial distribution of nontarget catch and non-target catch species in deepwater fisheries. New Zealand Aquatic Environment and Biodiversity Report No. 303. 81 p. https://www.mpi.govt.nz/dmsdocument/55120/direct

Elliot, G. & Walker K. (2022). Estimating the number of white-chinned petrels breeding on Antipodes Island. POP2019-03 Final Report for the Department of Conservation. Albatross Research, Nelson. 17 pp. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/201920-annual-plan/pop2019-03--white-chinned-petrel-on-antipodes-final-report.pdf

Finucci, B., Edwards, C.T.T., Anderson, O.F. and Ballara, S.L. (2019). Fish and invertebrate bycatch in New Zealand deepwater fisheries from 1990-91 to 2016-17. New Zealand Aquatic Environment and Biodiversity report No. 210. 77 p. https://www.mpi.govt.nz/dmsdocument/34323-AEBR-210-Fish-and-invertebrate-bycatch-in-New-Zealand-deepwater-fisheries-from-199091-until-201617

FNZ (2019). National Fisheries Plan for Deepwater and Middle-depth Fisheries 2019. Fisheries New Zealand Technical Paper No: 2019/03. 34 p. https://www.mpi.govt.nz/dmsdocument/3967/direct

FNZ (2019). Operational Plan to manage the incidental capture of New Zealand sea lions in the southern squid trawl fishery (SQU6T). V 1.0. 9 p. https://www.mpi.govt.nz/dmsdocument/38189/direct

FNZ (2019a). Protected Fish Species Reporting Requirements for Non-Fish/Protected Species. Fisheries Management Fact Sheet 5. 3 p. https://www.mpi.govt.nz/dmsdocument/7245/direct

FNZ (2020). National Plan of Action – Seabirds 2020. Supporting Document. 49 p. https://www.mpi.govt.nz/dmsdocument/40658-National-Plan-Of-Action-Seabirds-2020-supporting-document

FNZ (2020a). National Plan of Action – Seabirds 2020. Seabird Annual Report 2018/19. Fisheries New Zealand Information Paper No: 2020/08. 67 p. https://www.mpi.govt.nz/dmsdocument/42622-National-Plan-of-Action-Seabirds-2020-201819-report

FNZ (2020b). National Plan of Action – Seabirds 2020. Implementation Plan v2. 14 p. https://www.mpi.govt.nz/dmsdocument/40655-National-Plan-Of-Action-Seabirds-2020-Implementation-Plan

FNZ (2020c). Spatially Explicit Fisheries Risk Assessment (SEFRA) - Technical Summary. Aquatic Environment and Biodiversity Annual Review, Chapter 3. https://docs.niwa.co.nz/library/public/AEBAR-2020.pdf

FNZ (2021). Protected species bycatch 2002-03 to 2020-21. https://protectedspeciescaptures.nz/PSCv6/

FNZ (2022). Benthic (seabed) impacts – Technical Summary. Aquatic Environment and Biodiversity Annual Review, Chapter 11. https://www.mpi.govt.nz/dmsdocument/51682-Chapter-11-Benthic-seabed-impacts

FNZ (2022a) National Plan of Action - Seabirds 2020 Seabird Annual Report 2020/21. Fisheries New Zealand Information Paper No: 2022/02 https://www.mpi.govt.nz/dmsdocument/52396/direct

FNZ (2022b). Aquatic Environment and Biodiversity Annual Review 2021. Compiled by the Aquatic Environment Team, Fisheries Science and Information, Fisheries New Zealand, Wellington New Zealand. 779 p. https://www.mpi.govt.nz/dmsdocument/51472-Aquatic-Environment-and-Biodiversity-Annual-Review-AEBAR-2021-A-summary-of-environmental-interactions-between-the-seafood-sector-and-the-aquatic-environment

FNZ (2022c). Annual Operational Plan for Deepwater Fisheries 2022/23. Fisheries New Zealand Technical Paper No: 2022/01. https://www.mpi.govt.nz/dmsdocument/51892-Annual-Operational-Plan-for-Deepwater-Fisheries-202223

FNZ (2023). National Plan of Action – Seabirds 2020. Seabird Annual Report 2021/22. Fisheries New Zealand Information Paper No: 2023/04. 104 p. https://www.mpi.govt.nz/dmsdocument/58780/direct

FNZ (2023a). Deepwater Annual Review Report 2021/22. Fisheries New Zealand Technical Paper No: 2023/01. https://deepwatergroup.org/wp-content/uploads/2023/10/DRAFT-ARR-2021-22.pdf

Forman, J S; Dunn, M R (2012) Diet and scavenging habits of the smooth skate *Dipturus innominatus*. Journal of Fish Biology 80 (5): 1546–62. doi:10.1111/j.1095-8649.2012.03255.x.

Francis, M. (2017). Review of commercial fishery interactions and population information for New Zealand basking shark. Prepared for Department of Conservation. 44 p. http://www.doc.govt.nz/our-work/conservation-services-programme/csp-reports/2016-17/updated-basking-shark-bycatch-review-2016-17/

Georgian, S.E., Anderson, O.F. and Rowden, A.A. (2019). Ensemble habitat suitability modelling of vulnerable marine ecosystem indicator taxa to inform deep-sea fisheries management in the South Pacific Ocean. *Fisheries Research* **211 (2019):** 256-274. https://reader.elsevier.com/reader/sd/pii/S0165783618303321?token=2AB9A4092207207603D

F1979BA65B58A20A94BA95749D8A08EF44032DD2F79EBA9C12C32D7B42BBE199089A961D84F8C&originRegion=us-east-1&originCreation=20210827033144.

Gilman, E., Musyl, M., Suuronen, P. *et al.* (2021). Highest risk abandoned, lost and discarded fishing gear. *Sci Rep* **11**, 7195. https://doi.org/10.1038/s41598-021-86123-3.

Helson, J., Leslie, S., Clement, G., Wells, R. & Wood, R. (2010). Private rights, public benefits: Industry-driven seabed protection. Marine Policy 34, 557–566. https://deepwatergroup.org/wp-content/uploads/2021/11/Helson-et-al-2010-Private-Rights-Public-Benefits-Industry-driven-seabed-protection.pdf

Hiddink, J. G., Jennings, S. J., Sciberras, M., Szostek, C. L., Hughes, K. M., Ellis, N., Rijnsdorp, A. D., McConnaughey, R. A., Mazor, T., Hilborn, R., Collie, J. S., Pitcher, C. R., Amoroso, R. O., Parma, A. M., Suuronen, P. & Kaiser, M. J. (2017). Global analysis of depletion and recovery of seabed biota after bottom trawling disturbance. PNAS, 114(21), 8301-8306. https://www.pnas.org/doi/pdf/10.1073/pnas.1618858114

Horn, P; Dunn, M R (2010) Inter-annual variability in the diets of hoki, hake, and ling on the Chatham Rise from 1990 to 2009. New Zealand Aquatic Environment and Biodiversity Report No. 54. 57 p. https://fs.fish.govt.nz/Doc/22315/AEBR_54.pdf.ashx

Hoyle, S. D., Edwards, C. T., Roux, M.-J., Clarke, S. C., & Francis, M. P. (2017). Southern Hemisphere porbeagle shark stock status assessment. Wellington: NIWA. Retrieved from Southern Hemisphere porbeagle shark stock status assessment.

Hurst, R J; Renwick, J A; Sutton, P J H; Uddstrom, M J; Kennan, S C; Law, C S; Rickard, G J; Korpela, A; Stewart, C; Evans, J (2012) Climate and oceanographic trends of potential relevance to fisheries in the New Zealand fisheries region. New Zealand Aquatic Environment and Biodiversity Report No. 90. 202 p.

James, G.D. & Stahl, J.C. (2000). Diet of southern Buller's albatross (*Diomedea bulleri bulleri*) and the importance of fishery discards during chick rearing. New Zealand Journal of Marine and Freshwater Research 34: 435-454.

Kaiser, M., Clarke, K., Hinz, H., Austen, M., Somerfield, P., & Karakassis, I. (2006). Global analysis of response and recovery of benthic biota to fishing. *Marine Ecology Progress Series , 311*, 1– 14. https://www.researchgate.net/publication/222092690_Global_analysis_and_recovery_of_benthic_biota_to_fishing_Mar_Ecol_Prog_Ser

Kidson, J W (2000) An analysis of New Zealand synoptic types and their use in defining weather regimes. International Journal of Climatology 20: 299–316.

(2021). Notice to Vessel on Statutory Reporting Requirements. MPI Compliance example letter for forwarding to operators. 1 p. https://deepwatergroup.org/wp-content/uploads/2021/04/MPI-2021-Notice-to-Vessel-on-Statutory-Reporting-Requirements-Example.pdf

MacGibbon, D.J. & Mules, R. (2023). Extent and intensity of bottom contact by commercial trawling and shellfish dredging in New Zealand waters, 1990–2021. New Zealand Aquatic Environment and Biodiversity Report No. 316. 174 p. https://fs.fish.govt.nz/Doc/25518/AEBR-316-Bottom-Contact-Of-Commercial-Trawl-And-Dredge-Fisheries-New-Zealand-1990-2021-4360-2023.pdf.ashx

McGregor, V., Fulton, E., & Dunn, M. (2020). Addressing initialisation uncertainty for end-to-end ecosystem models: application to the Chatham Rise Atlantis model. *Peer J.* https://peerj.com/articles/9254

McGregor, V., Horn, P., Fulton, E., & Dunn, M. (2019). From data compilation to model validation: a comprehensive analysis of a full deep-sea ecosystem model of the Chatham Rise. *Peer J.* https://peerj.com/articles/6517/#intro

McKenzie, A (2013) Assessment of hoki (*Macruronus novaezelandiae*) in 2012. New Zealand Fisheries Assessment Report 2013/27. 65 p. https://fs.fish.govt.nz/Doc/23149/FAR_2013_27_2626_DEE2010-02HOKA,%20Obj.1,%20CS2.pdf.ashx

Moore, B.R. & Finucci, B. (2924). Estimation of release survival of pelagic sharks and fish in New Zealand commercial fisheries. New zealand Fisheries Assessment Report 2024/07. 129 p. https://www.mpi.govt.nz/dmsdocument/61033/direct

Newman, J., Scott, D., Bragg, C., McKechnie, S., Moller, H. & Fletcher, D. (2009). Estimating regional population size and annual harvest intensity of the sooty shearwater in New Zealand. New *Zealand Journal of Zoology* **36:** 307-323. https://www.stats.otago.ac.nz/webdata/resources/david_fletcher/Newman_et_al_2009b.pdf

O'Driscoll, R. L., Hurst, R. J., Dunn, M. R., Gauthier, S., & Ballara, S. L. (2011). *Trends in relative mesopelagic biomass using time series of acoustic backscatter data from trawl surveys.* Wellington: NIWA. https://docs.niwa.co.nz/library/public/NZAEBR76.pdf

Pavanato H., Schattschneider J., Childerhouse S. & Briscoe D. (2023). Assessment of New Zealand fur seal / kekeno bycatch by trawlers in the Cook Strait hoki fishery. Prepared for Department of Conservation. Cawthron Report No. 3854. 32 p. plus appendices. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/202223-annual-plan/pop2021-06-assessment-of-nz-fur-seal-bycatch-by-trawlers-in-the-cook-strait-hoki-fishery-final-report.pdf

Pinkerton, M H (2010) Headline indicators for the New Zealand ocean. NIWA report. 42 p. https://niwa.co.nz/sites/default/files/headline_indicators_59.pdf

Pitcher, C. R., Hiddink, J.G., Jennings, S., Collie, J., Parma, A. M., Amoroso, R., Mazor, T., Sciberras, M., McConnaughey, R.A., Rijnsdorp, A.D., Kaiser, M.J., Suuronen, P. & Hilborn, R. (2022). Trawl impacts on the relative status of biotic communities of seabed sedimentary habitats in 24 regions worldwide. *PNAS, 119*(2). https://www.pnas.org/doi/full/10.1073/pnas.2109449119

Radcliffe, K. (2023). Fishing tech all set to net the catch of the day and nothing else. Stuff news article, May 13, 2023. https://www.stuff.co.nz/nelson-mail/300872637/fishing-tech-all-set-to-net-the-catch-of-the-day-and-nothing-else

Reid, K., Baker, G. B. & Wells, R. (2023): Mitigation of seabird bycatch in New Zealand squid trawl fisheries provides hope for ongoing solutions, **Emu - Austral Ornithology**, DOI: 10.1080/01584197.2023.2214580. 11 p.

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. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/201920-annual-plan/pop-2019-05-fur-seal-bounty-islands-final-report.pdf

Richard, Y., Abraham, E. & Berkenbusch, K. (2017). Assessment of the risk of commercial fisheries to New Zealand seabirds, 2006–07 to 2014–15. New Zealand Aquatic Environment and Biodiversity Report 191. 104 p. https://docs.niwa.co.nz/library/public/NZAEBR-191.pdf

Richard, Y., Abraham, E. R. & Berkenbusch, K. (2020). Assessment of the risk of commercial fisheries to New Zealand seabirds, 2006–07 to 2016–17. New Zealand Aquatic Environment and Biodiversity Report No. 237. 57 p. https://www.mpi.govt.nz/dmsdocument/39407-aebr-237-assessment-of-the-risk-of-commercial-fisheries-to-new-zealand-seabirds-200607-to-201617

Roberts, J.O., Webber, D.N., Goad, D.W., Arnould, J.P.Y., Bell, E.A., Crowe, P., Deppe, L., Elliott, G.P., Landers T.J., Freeman, A.N.D., Mattern, T., Moore, P.J., Nicholls, D.G., Parker, G.P., Rexer-Huber, K., Taylor, G.A., Thompson, D.R., Walker, K.J., Waugh, S.M. & Young, M.J. (2022). Spatial distribution modelling of at-risk seabirds in New Zealand commercial fisheries. New Zealand Aquatic Environment and Biodiversity Report No. 298. 167 p. https://docs.niwa.co.nz/library/public/NZAEBR-298.pdf

Robertson, H. A., Dowding, J. E., Elliott, G. P., Hitchmough, R. A., Miskelly, C. M., O'Donnell, C. F. J., Powlesland, R. G., Sagar, P. M., Scofield, R. P. & Taylor, G. A. (2013). Conservation status of New Zealand birds, 2012. NZ Threat Classification Series 4. Department of Conservation. Wellington. https://www.doc.govt.nz/Documents/science-and-technical/nztcs4entire.pdf

Sagar, P., Rexer-Huber, K., Thompson, D., Parker, G. 2024. Population studies of southern Buller's albatrosses at Tini Heke / The Snares Islands and Hautere / Solander Islands. DRAFT Final report to the Conservation Services Programme, Department of Conservation. Parker Conservation, Dunedin. 13 p. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/meetings/2024/twg-14-jun/pop2023-02-population-studies-of-southern-bullers-albatross-draft-report.pdf

Sharp, B. R., Waugh, S. M. & Walker, N. A. (2009). A risk assessment framework for incidental seabird mortality associated with New Zealand fishing in the New Zealand EEZ. https://www.ccsbt.org/system/files/resource/en/4d9159d9050e0/erswg8_16.pdf

Steele-Mortimer, B. & Wells, R. (2023). Net Capture Programme: Investigating new tools to mitigate seabird net captures in demersal and pelagic trawl fisheries. Eleventh Meeting of the Seabird Bycatch Working Group, Edinburgh, United Kingdom, 15 – 17 May 2023. SBWG11 Doc 17 Rev 1. 40 p. https://deepwatergroup.org/wp-content/uploads/2024/09/Steele-Mortimer-Wells-2023.-Net-Capture-Mitigation-Trials-2023.pdf

Thompson, D., Sagar, P., Baker, B. & Jensz, K. 2017. *Southern Buller's Albatross Survey at the Solander Islands 2016 Buller's Albatross at the Solander Islands. Prepared for Department of Conservation April 2017*. Wellington: National Institute of Water & Atmospheric Research Ltd. 18 pp.

Thompson, D. & Sagar, P. (2022). Population studies of southern Buller's albatross on The Snares. Report for POP2019-04 for the Department of Conservation. Wellington, NIWA. 20 pp. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/201920-annual-plan/pop2019-04-southern-bullers-albatross-on-the-snares.pdf

Tracey, D.M. and Hjorvarsdottir, F. (eds, comps) (2019). The State of Knowledge of Deep-Sea Corals in the New Zealand Region. NIWA Science and Technology Series Number 84. 140 p. https://niwa.co.nz/sites/niwa.co.nz/files/Deepsea-corals-NZ-2019-NIWA-SciTechSeries-84.pdf

Tremblay-Boyer, L. & Berkenbusch, K. (2022). Characterisation of marine mammal interactions with fisheries & bycatch mitigation. Final report for INT2019- 03 prepared by Dragonfly Data Science for the Conservation Services Programme, Department of Conservation. 67 p. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/201920-annual-plan/int2019-03-characterisation-of-marine-mammal-with-fisheries-and-bycatch-mitigation.pdf

Tuck, I., Cole, R., & Devine, J. (2009). Ecosystem indicators for New Zealand fisheries. Wellington: Minsistry of Fisheries. https://deepwatergroup.org/wp-content/uploads/2013/08/Tuck-et-al-2009-Ecosystem-Indicators1.pdf

Waugh, S., Barbraud, C., Delord, K., Simister, K., Baker, G., Hedley G., Wilson, K. & Rands, D. (2020). Changes in population density and response to storm damage for Westland petrels 2007 – 2019. Report prepared for the Conservation Services Programme, Department of Conservation published in *Marine Ornithology* **48:** 273-281. https://www.doc.govt.nz/our-work/conservation-services-programme/csp-reports/201819/westland-petrel-population-size-estimate/

Wells, R., Malloy, J., Steele-Mortimer, B. & Debski, I. (2021). Seeking solutions to net captures in New Zealand Squid Trawl Fishery. SBWG10 Inf 14. ACAP. https://www.acap.aq/working-groups/seabird-bycatch-working-group/sbwg-10/sbwg10-information-papers/3801-sbwg10-inf-14-solutions-to-net-captures-in-new-zealand-squid-trawl/file.

Young, M. & Manno, K. (2022). Auckland Islands 2021/22 New Zealand Sea Lion /pakake/whakahao field research report. Conservation Services Programme pup count. Prepared for the Department of Conservation (DOC). 34 p. https://www.doc.govt.nz/globalassets/documents/conservation/marine-and-coastal/marine-conservation-services/reports/draft-reports/pop2018-03-nzsl-pup-count-draft-report-2021-22.pdf

Zhang, J., Bell, E.A. & Roberts, J.O. (2020). Demographic assessment of black petrels (Procellaria parkinsoni) at Great Barrier Island (Aotea Island). New Zealand Aquatic Environment and Biodiversity Report No. 244. 48 p. https://www.mpi.govt.nz/dmsdocument/41869/direct.

P3 - OVERVIEW OF MANAGEMENT INFORMATION

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.

Legal & customary framework

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 a species 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 deepwater 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, Seafood New Zealand Deepwater Council (DWC, then DWG) and Fisheries New Zealand (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 the Department of Conservation (DOC) actively consult with interested parties to inform management decisions through their open scientific working groups and public consultation processes.

Compliance & enforcement

The Ministry for Primary Industries (MPI) 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 audits commercial vessel catch-effort and landing reports and reconciles these against multiple sources including VMS records, data collected by onboard MPI observers, and catch landing records from LFRs to ensure that all catches are reported correctly.

Commercial fishers 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 fishers from over-catching their ACE holdings.

The extensive regulations governing these fisheries are complemented by additional industry-agreed non-regulatory measures, known as the New Zealand Deepwater Fisheries Operational Procedures. The Minister for Oceans & Fisheries relies on the effectiveness of both regulatory and non-regulatory measures to ensure the sustainable management of these fisheries.

As part of DWC's Operational Procedures, DWC has an Environmental Liaison Officer whose role is to liaise with vessel operators, skippers and MPI to assist with the effective implementation of these Operational Procedures.

MPI Fishery Officers carried out a total of 210 in-port and at-sea inspections for the period 1 January 2019 to 31 December 2023. 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 51) (G. Lydon FNZ, pers. comm.).

Table 51: 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 2023.

		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	
	In port (deep-water vessels	4	0	0
	At sea	3	2	0
	Total	**12**	**15**	**0**
2022	In port (inshore vessels)	9	17	
	In port (deep-water vessels	4	1	2
	At sea	4	0	0
	Total	**17**	**18**	**2**
2023	In port (inshore vessels)	17	19	
	In port (deep-water vessels	9		0
	At sea	1	1	0
	Total	**27**	**20**	**0**
	Grand total	**117**	**87**	**6**

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 52 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 which provided a summary of proposed technical amendments to fisheries regulations and why 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.

DWC's 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 52: 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 53 and Table 54) (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 55). 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 56).

Table 53: 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 54: 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 55: 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 56: 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

Key P3 references

DWG (2018a) Deepwater Trawl - Reporting Operational Procedures Version 3.0 https://deepwatergroup.org/wp-content/uploads/2018/10/Reporting-OP-Version-3.pdf

DWG (2018b) Deepwater Trawl Seabirds Operational Procedures Version 6.0 https://deepwatergroup.org/wp-content/uploads/2018/12/Seabirds-OP-V6.pdf

DWG (2018c) Deepwater Trawl Marine Mammals Operational Procedures Version 9.0 https://deepwatergroup.org/wp-content/uploads/2018/11/MMOP-Version-9-2.pdf

DWG (2019). FNZ-Deepwater Operator's Meeting Summary and Action Points Dec19. 2 p. https://deepwatergroup.org/wp-content/uploads/2021/04/DWG-2020a-FNZ-Deepwater-Operators-Meeting-Summary-and-action-points-Jun20.pdf

DWG (2020) Deepwater Trawl Sharks Operational Procedures Version 3.0

DWG (2020a). FNZ-Deepwater Operator's Meeting Agenda Jun20. 1 p. https://deepwatergroup.org/wp-content/uploads/2021/04/DWG-2020-FNZ-Deepwater-Operators-Meeting-Agenda-June-2020.pdf

DWG (2021). Operational Procedures. https://deepwatergroup.org/newsresources/op-manual/

DWG (2022) Deepwater Trawl Benthic Operational Procedures 2022-23 https://deepwatergroup.org/wp-content/uploads/2022/09/Benthic-OP-version-2022-23.pdf

DWG (2023) Ling Bottom Longline LIN 2 - 7 Operational Procedures Version 4.0 https://deepwatergroup.org/wp-content/uploads/2023/03/BLL-OP-V4.0-Feb-2023.pdf

FNZ (2019) National Fisheries Plan for Deepwater and Middle-depth Fisheries 2019. Fisheries New Zealand Technical Paper No: 2019/03. ISBN No: 978-1-77665-816-9 (online) https://www.mpi.govt.nz/dmsdocument/3967-National-Fisheries-Plan-for-Deepwater-and-Middle-depth-Fisheries-2019

FNZ (2019a) Review of the National Plan of Action - Seabirds (2013). ISBN No: 978-1-99-001705-6 (online) https://www.mpi.govt.nz/dmsdocument/38057-National-Plan-of-Action-Seabirds-2013-review-document

FNZ (2019b). Protected Fish Species Reporting Requirements for Non-Fish/Protected Species. Fisheries Management Fact Sheet 5. 3 p. https://www.mpi.govt.nz/dmsdocument/7245/direct

FNZ (2020) National Plan of Action – Seabirds 2020 Reducing the incidental mortality of seabirds in fisheries. ISBN No: 978-1-99-001762-9 (online) https://www.mpi.govt.nz/dmsdocument/40652-National-Plan-Of-Action-Seabirds-2020-Report

FNZ (2020a) National Plan of Action – Seabirds 2020 Supporting document ISBN No: 978-1-98-859485-9 (online) https://www.mpi.govt.nz/dmsdocument/38054-National-Plan-of-Action-Seabirds-2020-supporting-document

FNZ (2021) Medium Term Research Plan for Deepwater Fisheries 2021/22 – 2025/26 Fisheries New Zealand Information Paper No: 2021/16 ISBN No: 978-1-99-100999-9 (online). https://www.mpi.govt.nz/dmsdocument/21746-Medium-Term-Research-Plan-for-Deepwater-Fisheries-Report

FNZ (2022) National Plan of Action for the Conservation and Management of Sharks 2022 Draft for Consultation https://www.mpi.govt.nz/dmsdocument/52438-Draft-National-Plan-of-Action-for-the-Conservation-and-Management-of-Sharks-2022

FNZ (2022a) Review of NPOA Sharks 2013: Progress against Objectives and Actions https://www.mpi.govt.nz/dmsdocument/52441-Review-of-National-Plan-of-Action-Sharks-2013

FNZ (2022b) Annual Operational Plan for Deepwater Fisheries 2022/23. Fisheries New Zealand Technical Paper No: 2022/01. ISBN No: 978-1-99-102697-2 (online) https://www.mpi.govt.nz/dmsdocument/51892-Annual-Operational-Plan-for-Deepwater-Fisheries-202223

FNZ (2022c) Annual Review Report for Deepwater Fisheries 2020/21 Fisheries New Zealand Technical Paper No: 2022/02. ISBN No: 978-1-99-103941-5 (online) https://www.mpi.govt.nz/dmsdocument/51895/direct

FNZ (2022d) Summary of proposed amendments to fisheries regulations https://www.mpi.govt.nz/dmsdocument/49297/direct

FNZ (2022e). Aquatic Environment and Biodiversity Annual Review 2021. Compiled by the Aquatic Environment Team, Fisheries Science and Information, Fisheries New Zealand, Wellington New Zealand. 779 p. https://www.mpi.govt.nz/dmsdocument/51472-Aquatic-Environment-and-Biodiversity-Annual-Review-AEBAR-2021-A-summary-of-environmental-interactions-between-the-seafood-sector-and-the-aquatic-environment

FNZ (2023). Mahere Takahuritanga Ahumahi Hao Ika Fisheries Industry Transformation Plan – Draft for consultation. 59 p. https://www.mpi.govt.nz/dmsdocument/56572/direct

FNZ & DOC (2022). Managing the effects of bottom trawling in the Exclusive Economic Zone Forum – Terms of Reference. 5 p. https://www.mpi.govt.nz/dmsdocument/52099-Managing-the-effects-of-bottom-trawling-in-the-Exclusive-Economic-Zone-Forum-Terms-of-Reference

Helson, J., Leslie, S., Clement, G., Wells, R. and Wood, R. (2010). Private rights, public benefits: Industry-driven seabed protection. Marine Policy 34, 557–566. https://deepwatergroup.org/wp-content/uploads/2021/11/Helson-et-al-2010-Private-Rights-Public-Benefits-Industry-driven-seabed-protection.pdf

IQANZ (2018). Deepwater Fisheries Management Independent Quality Assurance Review Report. Prepared for Ministry for Primary Industries by Independent Quality Assurance New Zealand (IQANZ). 13 p. https://www.mpi.govt.nz/dmsdocument/27609-Ministry-for-Primary-Industries-

Deepwater-Fisheries-Management-Independent-Quality-Assurance-review-report-31-January-2018-signed

MFish (2009). Fisheries 2030: New Zealanders maximising the benefits from the use of fisheries within environmental limits. Ministry of Fisheries, Wellington. https://www.mpi.govt.nz/dmsdocument/5032-fisheries-2030-new-zealanders-maximising-benefits-from-the-use-of-fisheries-within-environmental-limits

MFish (2011). Research and Science Information Standard for New Zealand Fisheries. Ministry of Fisheries, April 2011. 31 p. https://fs.fish.govt.nz/NR/rdonlyres/D1158D67-505F-4B9D-9A87-13E5DE0A3ABC/0/ResearchandScienceInformationStandard2011.pdf

MPI (2008). Harvest Strategy Standard for New Zealand Fisheries. Ministry for Primary Industries. 25 p. https://fs.fish.govt.nz/Doc/16543/harveststrategyfinal.pdf.ashx

MPI (2010). Memorandum of Understanding: Continuing a partnership between the Ministry of Fisheries and the deepwater fishing industry for the management of New Zealand's deepwater fisheries. 12 p. https://www.mpi.govt.nz/dmsdocument/19715-memorandum-of-understanding-2010

MPI (2010a). Hoki Fisheries Plan Chapter: National Fisheries Plan for Deepwater and Middle-depth Fisheries Part 1B. 51 p. https://www.mpi.govt.nz/dmsdocument/3974-national-fisheries-plan-for-deepwater-and-middle-depth-fisheries-part-1b-hoki-fishery-chapter

MPI (2011). Ling Fisheries Plan Chapter: National Fisheries Plan for Deepwater and Middle-depth Fisheries Part 1B. 50 p. https://www.mpi.govt.nz/dmsdocument/3973-national-fisheries-plan-for-deepwater-and-middle-depth-fisheries-part-1b-ling-chapter

MPI (2013). Hake Fisheries Plan Chapter: National Fisheries Plan for Deepwater and Middle-depth Fisheries Part 1B. 29 p. https://www.mpi.govt.nz/dmsdocument/3972-national-fisheries-plan-for-deepwater-and-middle-depth-fisheries-part-1b-hake-chapter

MPI (2019). Fisheries Compliance: DW Operators Meeting – Nelson 5th March 2019. PowerPoint presentation prepared by Ministry for Primary Industries. https://deepwatergroup.org/wp-content/uploads/2019/10/MPI-2019-Compliance-Overview-Commercial-Operators-5-March.pdf

MPI (2020). Risk Management and Compliance HOK and SBW. Ministry for Primary Industries memo to deepwater operators, June 2020. 2 p. https://deepwatergroup.org/wp-content/uploads/2021/04/MPI-2020-Risk-Management-and-Compliance-HOK-and-SBW-Memo.pdf

MPI (2023). Risk Management and Compliance for the Hoki & and SBW Fisheries. Ministry for Primary Industries memo to deepwater operators, June 2023. 2 p. https://deepwatergroup.org/wp-content/uploads/2024/09/Risk-mgmt-and-compliance-HOKI-and-SBW-memo-2023.pdf