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New Zealand Hake, Hoki, Ling and Southern Blue Whiting

Surveillance Report

December 2019

Conformity Assessment Body (CAB)	Lloyd's Register
Assessment team	Jo Akroyd and Andre Punt
Fishery client	**Deepwater Group Limited**
Assessment Type	First Surveillance

Assessment Data Sheet

Fishery name	New Zealand Hake, Hoki, Ling and Southern Blue Whiting			
Species and Stock	Hoki (*Macruronus novaezelandiae*)	HOK 1	Eastern	
		HOK 1	Western	
	Hake (*Merluccius australis*)	HAK 1	Sub-Antarctic	
		HAK 4	Chatham Rise	
		HAK 7	West Coast South Island	
	Ling (*Genypterus blacodes*)	LIN 3	Chatham Rise (LIN 3 & 4)	
		LIN 4	Chatham Rise (LIN 3 & 4)	
		LIN 5	Sub-Antarctic (LIN 5 & 6)	
		LIN 6	Sub-Antarctic (LIN 5 & 6)	
		LIN 7	West Coast South Island (LIN 7WC)	
	Southern blue whiting (*Micromesistius australis*)	SBW 6B	Bounty Platform	
		SBW 6I	Campbell Rise	

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1 Executive Summary

This surveillance audit began as a review of information. On review, it became apparent that re-scoring was necessary for the Hake 7 UoC (UoC 5). As such, this became an offsite surveillance audit (FCP V2.1 7.28.17.1 'If the CAB has access to new information that may affect the scoring of any PI under a review of information audit, it shall undertake an off-site audit according to 7.28.15.').

In 2018, after a MSC reassessment process was undertaken for NZ Hoki, Hake, Ling and Southern Blue Whiting trawl fisheries and NZ Ling longline fisheries, using the MSC Certification Requirements (CR) version (v) 1.3 (MSC 2013) default assessment tree these fisheries were MSC certified with no conditions.

A comprehensive programme of stakeholder consultations was carried out as part of this re-assessment, complemented by a full and thorough review of relevant literature and data sources.

This first annual surveillance for these fisheries took place during November and December 2019. All fisheries with the exception of HAK 7 continue to meet the MSC Fisheries standard and continued certification is recommended.

HAK 7 was rescored and it did not meet SG60 at PI 1.1.1a and consequently it is recommended that this UOC (5) be suspended. In this case the client elected for self-suspension prior to LR issuing the suspension notice. More information is given in Section 7.4.

A rebuilding plan consistent with the New Zealand harvest strategy standard has been implemented (FNZ, 2019f). However, P.1.1.3 is not scored because P1.1.1 scores less than 60. The results of rebuilding plan are in terms of the time to rebuild in the absence of harvest T_{MIN}, while the MSC standard refers to recovery time in terms of generation length.

2 Report Details

2.1 Surveillance information

Table 1. Surveillance Information

1	Fishery name	
	New Zealand Hake, Hoki, Ling and Southern Blue Whiting	
2	Surveillance level and type	
	- Surveillance level 1 Review of Information (FCP v2.1. 7.28.1 – 7.28.6). -	
	Originally Review of Information for all species – upgraded to Offsite audit for Hake only (FCPv2.1 . 7.28.17.1)	
3	Surveillance number	
	1st Surveillance	✓
4	Proposed team leader	
	Jo Akroyd – Team Leader, Principle 2 & 3 expert Jo is a fisheries management and marine ecosystem consultant with extensive international and Pacific experience. She has worked at senior levels in both the public and private sector as a fisheries manager and marine policy expert. Jo was with the Ministry of Agriculture and Fisheries in New Zealand for 20 years. Starting as a fisheries scientist, she was promoted to senior chief fisheries scientist, then Fisheries Management Officer, and the Assistant Director, Marine Research. She was awarded a Commemoration Medal in 1990 in recognition of her pioneering work in establishing New Zealand's fisheries quota management system. Among her current contracted activities, she is involved internationally in fishery certification of offshore, inshore and shellfish fisheries as Fisheries Management Specialist and Lead Assessor for the Intertek Fisheries Certification audit team. She has carried out the Marine Stewardship Council's (MSC) certification assessment for sustainable fisheries. Examples include New Zealand (hoki, southern blue whiting, albacore, scallops), Fiji (longline albacore) Japan (pole and line tuna, flatfish, snowcrab, scallops), China (scallops), and Antarctica (Ross Sea tooth fishery). Jo has passed MSC training and has no Conflict of Interest in relation to this fishery. Full CV available upon request Leadership experience – Jo has conducted multiple MSC assessment as team leader over the last 5 years.	
5	Proposed team members	
	Andre Punt – Principle 1 expert Dr Punt is a Professor at the University of Washington and Director of the School of Aquatic and Fisheries Sciences. He is a quantitative scientist with a specialty of providing quantitative scientific advice for fisheries management, focusing on new methods for assessing fish and marine mammal populations; Bayesian assessment and risk analysis methods; and valuating the performance of existing methods for assessing and managing renewable resource populations. He uses methods for assessing fish and marine mammal populations that are tailored specifically to the situation in question. Current areas of interest are spatial models, individual-based models, and stage-structured models. He has worked as a resource population models for the Benguela Current in South Africa, a resource modeler at CSIRO in Australia, and at the University of Washington. He has a Ph.D. from the University of Cape Town in South Africa. Andre has passed MSC training and has no Conflict of Interest in relation to this fishery. Full CV available upon request	

6	Audit/review time and location
	- Time and dates of surveillance activities. Location activities will be carried out (if off site or review of new information, this could be from CAB/auditor office).
	Review of information took place week commencing the 4th November. Offsite audit of UOC HAK 7, PI 1.1.1 took place w/c December 2nd 2019
7	Assessment and review activities
	- What will be assessed/reviewed during the audit.
	All relevant data.

2.2 Background

The client Group Deepwater Group Limited (DWG) http://deepwatergroup.org was established in September 2005. This non-profit organisation is an amalgamation of EEZ fisheries quota owners in New Zealand. Species targeted by DWG are usually fished at depths between 400 and 1,200 m within the New Zealand Exclusive Economic Zone (EEZ). These include hoki, hake, ling, southern blue whiting, orange roughy, oreo dory, squid and jack mackerel. The client group catches about 95% of the recorded hoki, hake, ling and southern blue whiting landings.

The NZ hoki, hake, ling and southern blue whiting trawl fisheries along with the ling longline fishery were reassessed and recertified in 2018. These fisheries were previously assessed against the MSC standard and certified separately at different times. The re-assessment was conducted using the MSC Certification Requirements (CR) version (v) 1.3 (MSC 2013) default assessment tree with no changes made to the text of any default Performance Indicator (PI). The assessment followed CR v 2.0 process (MSC 2014). This surveillance process followed FCP v2.1 August 2018.

At reassessment, no Performance Indicators scored < 80 and so no conditions of certification were applied to the fishery. The Assessment Team also made no recommendations.

2.2.1 Changes in management system

This section applies to all UoAs.

2.1.1.1 Legal and Customary Framework

No change

2.2.1.2 Compliance and Enforcement

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 (Fisheries New Zealand) to monitor all hake/hoki/ling/southern blue whiting vessel locations at all times. This system is now being replaced by Geospatial Position 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.

Introduced in January 2019, all New Zealand vessels are transitioning in a staged implementation programme to new Electronic Reporting and Geospatial Position Reporting (replaces VMS) regulations. All New Zealand vessels now report catch daily on an event-by-event basis. These reports are validated against positional data allowing for timely interventions and compliance oversight in near real time.

MPI Fishery Officers conducted an at-sea RNZN (Royal NZ Navy) patrol covering the West Coast South Island Hoki fishery in 2018. During this operation, 10 deep water vessels and one inshore vessel were inspected. Some minor non-compliance was detected during the at-sea and in-port inspections. This included adherence to product state definitions.

These issues were followed up by Fisheries Compliance staff with each company through the post inspections being conducted.

2.2.1.3 Fisheries Plans

The National Fisheries Plan for Deepwater 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 are fisheries-specific chapters for the hake, hoki, ling and southern blue whiting fisheries within this.

The actual management measures and delivery outcomes in the Plan are specified in FNZ's Annual Operational Plan (AOP), (FNZ, 2018), which is reviewed and updated annually. In addition, an Annual Review Report assesses performance against the AOP and is publicly available.

2.2.1.4 Changes to personnel involved in science, management or industry

No changes

3 Changes to scientific base of information, including stock assessments

3.1 Stock status, projections and management changes

Table 1 summarises stock status (biomass relative to B_0) and the probability of being below the limit and target reference points.

Table 1: Summary of the stock status of the 10 UoC based on the base model runs

Stock	Most recent assessment	Depletion [Year]	P < Limit	P < Target
HOK 1 East	2019	66 (48-89) [2019]	< 1%	< 1%
HOK 1 West	2019 (model 1.17)	56 (37-78) [2019]		
	2019 (model 1.34)	29 (22-39) [2019]	40-60%	< 40%
HAK 1	2018	49 (34-67) [2018]	< 1%	0.11
HAK 4	2017	48 (40-59) [2016]	< 1%	< 40%
HAK 7	2019	17 (10-25) [2019]	0.74	1.00
LIN 3 & 4	2015	57 (45-71) [2014]	< 1%	< 1%
	2019*	57 (48-66) [2019]	< 1%	< 1%
LIN 5 & 6	2018	88 (75-101) [2018]	< 1%	< 1%
LIN 7	2017	79 (61-96) [2017]	< 1%	< 10%
SBW 6B	Managed using an HCR			
SBW 6I	2017	70 (54-86) [2016]	< 1%	<10%

* Not included in the 2019 Plenary Report.

Horn et al. (2019) conducted alternative assessments for hoki (HOK 1 East, HOK 1 West), hake (HAK 1, HAK4, HAK7) and ling (LIN 3&4, LIN 5&6, LIN7) based on three alternative but unsubstantiated catch histories (42, 43, and 44) derived from the Sea Around Us databases. These unsubstantiated catch histories indicate generally larger catches than those used in the assessments for these species. As expected, the estimates of biomass were generally higher when the alternative catch histories were included in the assessments, but the relative stock sizes (biomass in the most recent year relative to B_0) were generally within 5% of estimates from the original assessments.

3.1.1 Hoki

The 2017-18 catch was 135,383t, 6,300t lower than the 2016-17 catch, and about 14,600t less than the TACC, with much of the reduction in the midwater spawning fishery off the west coast of the South Island (10,500t between 2016-17 and 2017-18).

Stock assessments for HOK1 were undertaken in 2018 (FNZ, 2018) and 2019 (FNZ, 2019). This review is based on the 2019 assessment because this assessment is based on the most recent information on trends in abundance. The 2019 assessment included an update of the 2018 two stock base model and alternative models that aimed to fit the eastern and western biomass data better. The assessment was again based on five time-series of biomass indices derived from

fishery-independent sources. Compared to the 2017 assessment, the 2019 assessment included a new (trawl) biomass index for the Sub-Antarctic (December 2018), a new (trawl) biomass index for the Chatham Rise (January 2018), and a new acoustic estimate of biomass for Cook Strait in winter 2017. The assessment also included new age data for the fisheries and surveys (Table 17 of FNZ, 2019a).

Dunn and Langley (2018) conducted a review of the 2017 assessment model and made recommendations related to ways to improve the assessment: (a) conduct retrospective analyses; (b) move the assessment from CASAL to CASAL2; (c) remove where possible any confounding in the selectivity-migration-YCS-M assumptions; (d) conduct further research into the assumed catchability change in the Sub-Antarctic area; (e) partition the age compositions into separate age blocks; (f) conduct likelihood profiles for the various priors; (g) further evaluate the estimation of the pE (proportion of biomass in the eastern stock) parameter; (h) investigate sources of variation in the age composition data; (i) further investigate CPUE trends; and report vulnerable biomass from the model; (j) revise the biological assumptions, including deriving sensitivity runs; and (k) further review catch history.

The direct update to the 2018 assessment (run 1.17 in FNZ, 2019a) led to poor fits to the biomass indices for the sub-Antarctic area. This led to identification of alternative models including two model runs (1.34 and 1.37 which eliminated process error to better fit the trawl biomass indices for the sub-Antarctic [1.34] and Chatham Rise [1.37]) [Table 2].

Table 2: Characteristics of the final model runs (Source: FNZ, 2019a).

Run	Short name	Main assumptions
1.17	Two stock (update)	natal fidelity *M* is age-dependent single *q* for Sub-Antarctic trawl series process error of CRsumbio and SAsumbio was estimated
1.33	Western only	Similar in assumptions to 1.17 but drop eastern areas and data process error zero for SAsumbio
1.34	Two stock (west focus)	as 1.17 but process error zero for SAsumbio
1.37	Two stock (east focus)	as 1.17 but process error zero for CRsumbio process error 0.70 for SAsumbio halve effective sample sizes for western at-age data

Biomass and recruitment

The runs show that the biomasses of both stocks were at their lowest points from about 2004 to 2006 (lowest values being at about 0.27 B_0 for the eastern stock run 1.37, and 0.26 B_0 for the western stock run 1.34) after the western stock experienced seven consecutive years of poor recruitment from 1995 to 2001 inclusive and the eastern stock had below average recruitment over the same period (Figure 1). The eastern stock has since increased to levels which exceed the target range, but the western stock remains below it for the two stock (west focus) or western only models (Figure 2 and Figure 3). Recruitment to the western stock following the 1995–2001 period of poor recruitment was estimated to have been above average for run 1.17 in 2011, 2014, and 2015, but at or below average for most years for runs 1.33 and 1.34.

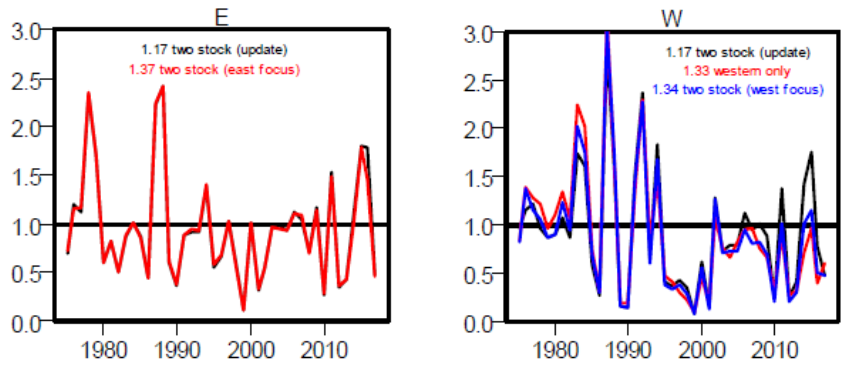

Figure 1 Year-class strengths for the eastern (left panel), and western (right panel) stocks. Plotted values are medians of marginal posterior distributions. (Source: FNZ, 2019a).

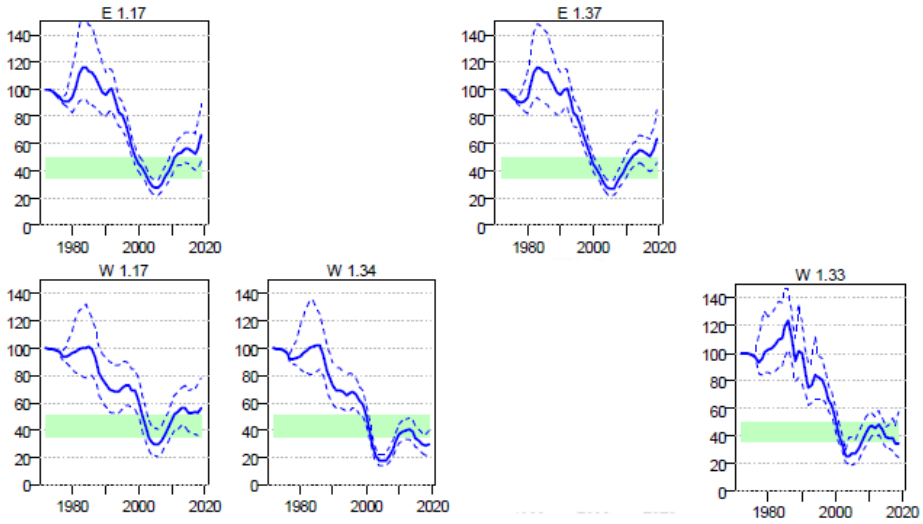

Figure 2 Estimated spawning-biomass trajectories from the MCMC runs, showing medians (solid lines) and 95% credible intervals (broken lines) by run for the eastern (upper panels) and western (lower panels) stocks. The first three columns show the two stock models (update run 1.17), west focus (run 1.34), east focus (run 1.37)). The fourth column is the western only model. The shaded green region represents the target range of 0.35-0.50 B_0. (Source: FNZ, 2019a)

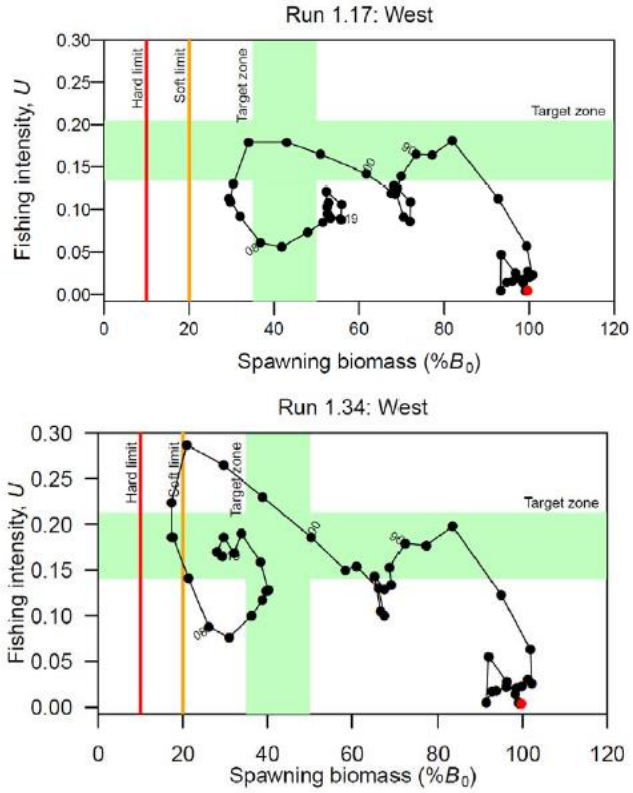

Figure 3 Trajectories over time of fishing intensity (*U*) and spawning biomass (%B_0), for two assessment models for the western hoki stock from the start of the assessment period in 1972 (represented by a red circle) to 2019 (19). The red vertical line at 0.1 B_0 represents the hard limit, the yellow line at 0.2 B_0 is the soft limit, and the shaded area represents the management target ranges in biomass and fishing intensity. Biomass and fishing intensity estimates are medians from MCMC results. (Source: FNZ, 2019a).

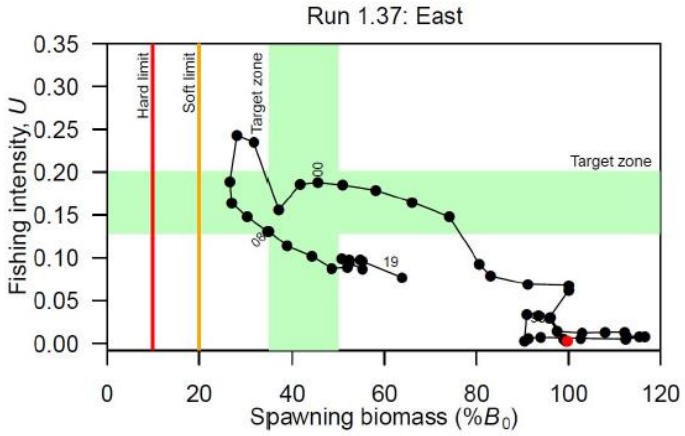

Figure 4 Trajectories over time of fishing intensity (*U*) and spawning biomass (%B_0), for the eastern hoki stock from the start of the assessment period in 1972 (represented by a red circle) to 2019 (19). The red vertical line at 0.1 B_0 represents the hard limit, the yellow line at 0.2 B_0 is the soft limit, and the shaded area represents the management target ranges in biomass and fishing intensity. Biomass and fishing intensity estimates are medians from MCMC results. (Source: FNZ, 2019a).

The western stock estimates of biomass relative to B_0 are reported in Figure 3. The eastern stock is estimated to be within the management target range (Figure 4) and this is also the case for the western stock under the standard two stock model (run 1.17). In contrast, run 1.34 (two stock model with a west focus) estimated the stock to below the lower end of the target range, with the lower 95% credibility interval just above the soft limit (Table 3). The stock assessment plenary concluded that model 1.17 is considered to overestimate stock status while model 1.34 may underestimate stock status (FNZ, 2019a).

Table 3 Estimates of spawning biomass (medians of marginal posterior, with 95% credibility intervals in parentheses). B_{2019} is the biomass in mid-season 2019. See Table 2 for the associated run numbers. For the two stock models, where the focus is on one of the stocks, biomass estimates are shown just for that stock. (Source: FNZ, 2019a).

Run	B_0 (000t)		B_{2019} (000t)		B_{2019} (%B_0)	
	E	W	E	W	E	W
Two stock (update)	550 (438-717)	990 (805-1355)	365 (235-566)	550 (309-999)	66 (48-89)	56 (37-78)
Western only		948 (806-1188)		325 (210-629)		34 (25-58)
Two stock (west focus)		823 (716-939)		239 (163-353)		29 (22-39)
Two stock (east focus)	566 (475-705)		358 (243-531)		64 (46-85)	

Projections and revised TACC

Projections were undertaken for the models in Table 2. Recruitment was sampled randomly from either the 2008-2017 (recent recruitment) or 1975-2017 (long-term recruitment) periods. The total catch was assumed to be same as that for 2019 (135,500t split 64,000t and 71,500t for the eastern and western stocks respectively). The biomass of the eastern stock is predicted to increase slightly over the next five years. The biomass of the western stock is also predicted to increase under model 1.17 but to be stable under models 1.33 and 1.34. The probability of dropping below the soft limit of 0.2B_0 in five years exceeded 10% for models 1.34 and 1.37.

The Minister of Fisheries was provided with two options for revising the TACC for HOK1 and particularly the limit for the western stock (Table 4). FNZ (2019b) notes that under option 2 the western stock will either increase from 0.56 B_0 to 0.62 B_0 (two stock update), or remain at around 0.29-0.30 B_0 (two stock, western focus) and that projections using the west stock-focused model estimate a 13% probability of the stock being below 0.2 B_0 in 2024. Under option 2, the western stock will either increase from 0.56 B_0 to 0.62 B_0 (two stock update) or from 0.29 B_0 to 0.35 B_0 (western stock-focused model). Projections using the western stock-focused model estimate a 4% probability of the stock being below the 0.2 B_0 in 2024. The Minister opted for a more conservative approach, reducing the TACC for HOK 1 to 115,000t (60,000t eastern stock limit; 55,000t western stock limit) and noted that a comprehensive review of the hoki stock assessment model would be undertaken (Nash, 2019).

Table 4 Proposed TACs, TACCs and allowance for source of fishing related mortality (in tonnes) for HOK1 (source: FNZ, 2019b).

Option	TAC (t)	TACC (t)	Eastern stock limit	Western stock limit	Customary Maori	Recreational	Other sources of fishing related mortality
Current status	151,540	150,000	60,000	90,000	20	20	1,500
Option 1	131,340	130,000	60,000	70,000	20	20	1,300
Option 2	121,340	120,000	60,000	60,000	20	20	1,300

3.1.2 Hake

3.1.2.1 HAK1

A new stock assessment of the Sub-Antarctic area (HAK 1) was conducted during 2018 (Dunn, 2019), which updated the last assessment conducted in 2014. The assessment, which now includes data up to the 2016-17 fishing year, was again conducted using CASAL (Bull et al., 2012). This assessment included new indices of biomass (for 2015 and 2017). The model fitted the data well, although it overpredicted the last two biomass indices (Figure 5).

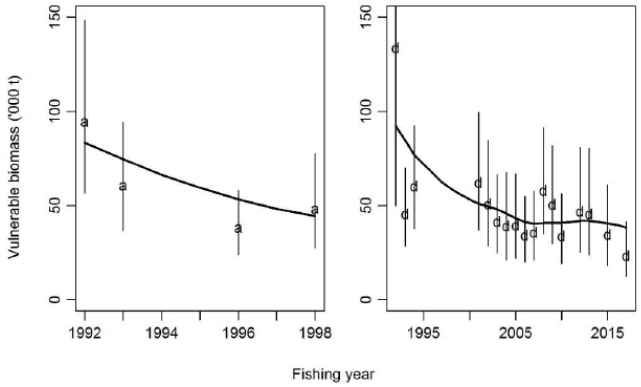

Figure 5 Fits of the base model for the Sub-Antarctic area (solid lines) to the April-May (left) and November-December (right) research trawl indices. Vertical lines the 95% CI. (Source: FNZ, 2019a).

Biomass and recruitment

Estimated recruitment to the HAK1 stock is similar to that from the previous assessment, with high values in the late 1970s, a very strong year class in 1980, less than average recruitment from 1981 to 2004, higher than average recruitment from 2005-2007, followed by another period of below average recruitment (Figure 6).

The base model estimate of B_0 is lower in the 2018 compared to the 2014 assessment (posterior median 54,600t compared to 59,290t), with a 2018 depletion (biomass relative to B_0) of 0.49 (95% credibility interval; 0.34-0.67) (Figure 7). The probability of being below 0.40 B_0 in 2019 is estimated to be 0.11, with a negligible (<1%) probability of being below the soft limit of 0.2B_0 (Table 5). Exploitation rate has consistently been less than that corresponding to the target biomass of 0.4B_0 (Figure 8).

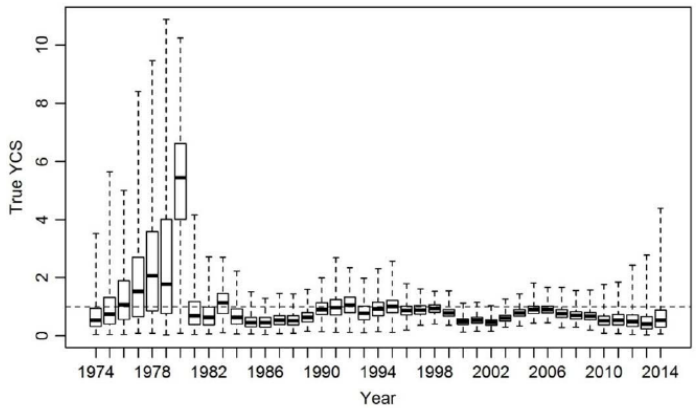

Figure 6 Estimated posterior distributions of year class strengths for the base case model for the Sub-Antarctic area. The dashed horizontal line indicates a year class strength of one. Individual distributions show the marginal posterior distribution, with horizontal lines indicating the median. (Source: FNZ, 2019a).

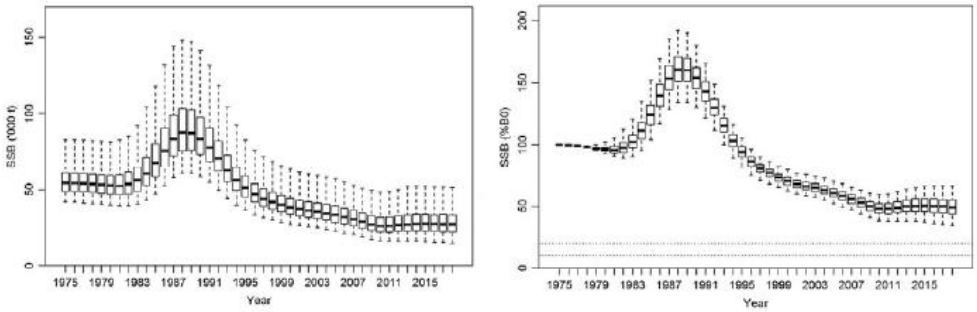

Figure 7 Estimated median trajectories (with 95% credible intervals shown as dashed lines) for the Sub-Antarctic area base model for absolute biomass and biomass as a percentage of B_0. The management target (0.4B_0, solid horizontal line) and soft limit (0.2 B_0, dotted horizontal line) are shown on the right-hand panel. (Source: FNZ, 2019a).

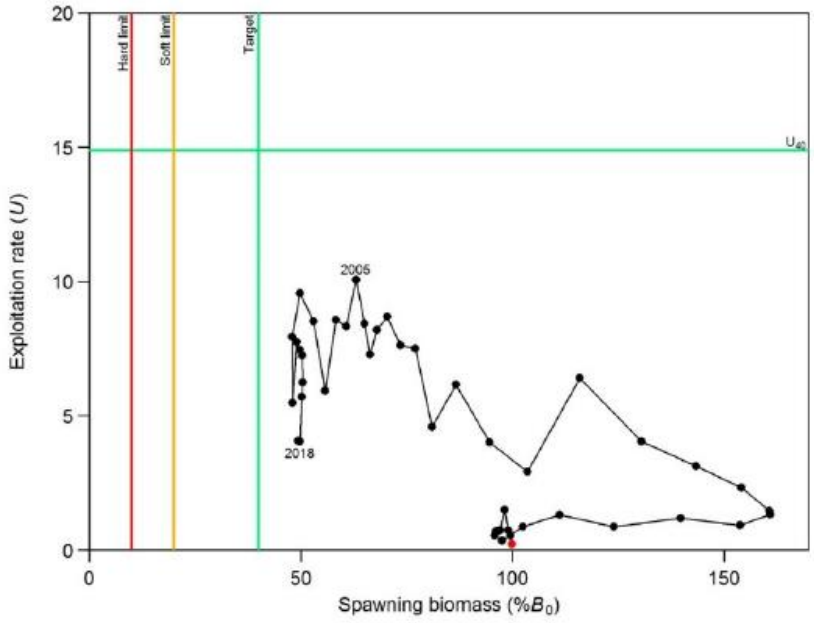

Figure 8 Trajectory over time of exploitation rate (U) and spawning biomass (% B_0), for the HAK 1 stock base model from the start of the assessment period in 1974 (represented by a red point), to 2018. The red vertical line at 0.1 B_0 represents the hard limit, the orange line at 0.2 B_0 is the soft limit, and green lines are the %B_0 target (0.4 B_0) and the corresponding exploitation rate (U_{40}). Biomass and exploitation rate estimates are medians from MCMC results. (Source: FNZ, 2019a).

Table 5 Bayesian median (95% credible intervals) (MCMC) of B_0, B_{2018}, B_{2018} as a percentage of B_0, and the probability of B_{2018} being below the target (0.4B_0), for the Sub-Antarctic base model and sensitivity runs.

Case	B_0	B_{2018}	B_{2018} (%B_0)	P(B_{2018} < 0.4B_0)
Base	54,600 (41,500–83,200)	27,200 (14 800–51,300)	49 (34–67)	0.11
Previous	54,400 (40,100–85,400)	31,700 (16 900-61,200)	57 (40–78)	0.03

Projections

Catches from HAK1 have been consistently less than the TACC. Five-year projections based on the base model suggest that a catch equal to the average catch over the last three years (1,366t) has a negligible probability of dropping the biomass below 0.2 B_0 in 2023. The probability of dropping between 0.2 B_0 in 2023 under the current TACC (3,701t) is

5% if 1974-2012 recruitment is representative of future recruitment and 12% if 2003-2012 recruitment is representative of future recruitment.

3.1.2.2 HAK4

No assessment of the Chatham Rise area (HAK4 plus HAK 1 north of Otago) has been undertaken since the 2017 recertification. The next stock assessment for HAK4 may take place in 2020 (FNZ, 2019a).

3.1.2.3 HAK7

The 2017 re-certification noted that "*The most recent assessment (2017) deemed two models (survey & CPUE) equally plausible. The survey model estimates that 2016 spawning stock biomass (25.7% B0) is above the limit reference point (20% B0) with the lower 95% credible interval just below the limit reference point (95% CI 19.1 – 36.5 B0). The CPUE model estimates that 2016 spawning stock biomass (50.3% B0) is above the limit reference point (20% B0) with the lower 95% credible interval above the limit reference point (95% CI 34.6 – 73.6 B0). Projections to 2021 are highly dependent on recruitment and catch assumptions with those based on current catch (4,100 t) indicating modest change in stock status with the Survey model projections being more pessimistic. Given the results of the two models, it is highly likely (80%) that biomass is currently above the limit reference point. SIa scores SG60 and 80. However, given the conflict in status between the two models and the results of the projections to 2021, this can't be stated with greater certainty*"

A new stock assessment of HAK 7 was conducted during 2018 (Kienzle et al., 2019; McGregor et al., 2019; FNZ, 2019a), which updated the 2017 assessment. The 2017 assessment (Horn, 2017) estimated the biomass of HAK7 to be 0.26 or 0.50 B_0 (posterior medians; "survey" or "CPUE" model runs) and projections indicated that the stock would be stable given recent catches and would decline under the TACC of 7,700t. The 2019 assessment, which includes data up to the 2017-18 fishing year, was again conducted using CASAL (Bull et al., 2012). This assessment includes a new biomass index for 2018 and revised trawl fishery CPUE data, which now extend to the 2017-18 fishing year. The base model from the 2019 assessment used the survey indices, with the CPUE data treated as a sensitivity test. The assessment considered sensitivity tests with different survey indices, a different assumed level of variation in year-class strength, and the use of the CPUE data. The first two sensitivity tests led to similar outcomes but the sensitivity test using the CPUE data led to a much more optimistic outcome (Table 6). However, the CPUE index was considered to be a less reliable index than the research survey (FNZ, 2019a).

Table 6 Bayesian median (95% credible intervals) (MCMC) of B_0, B_{2019}, B_{2019} as a percentage of B_0. (Source: FNZ, 2019a).

Case	B_0	B_{2019}	B_{2019} (%B_0)
Survey all	70,046 (65,945-75,588)	11,904 (6,636-20,977)	17.0 (9.7–28.5)
Survey core	70,430 (65,930-72,218)	13,068 (6 082-24,929)	18.5 (8.9-33.0)
YCS c.v	70,586 (66,425-76,419)	13,442 (7 632-23,569)	19.1 (11.2-31.6)
CPUE	84,743 (76,058-99,139)	52,595 (31,309-88,696)	62.0 (40.5-90.8)

Biomass and recruitment

Estimated recruitment (year-class strength) to the HAK7 stock exhibits a declining trend from the mid-1990s to the early 2000s (Figure 9), with evidence for increased (but highly uncertain) recruitment in the last year of the assessment. The base model ("survey all") estimated that spawning stock biomass declined throughout the late 1970s (Figure 10) when there were relatively high catches. The biomass then increased through the mid-1980s, after which it steadily declined further owing to higher levels of exploitation and below-average recruitment since 2000. The exploitation rate has exceeded that consistent with a target biomass of 0.4 B_0 since the 1986-87 fishing year (Figure 11). The stock is assessed to be below the soft limit of 0.2 B_0 and so is considered depleted under the New Zealand harvest policy and in need of a rebuilding plan.

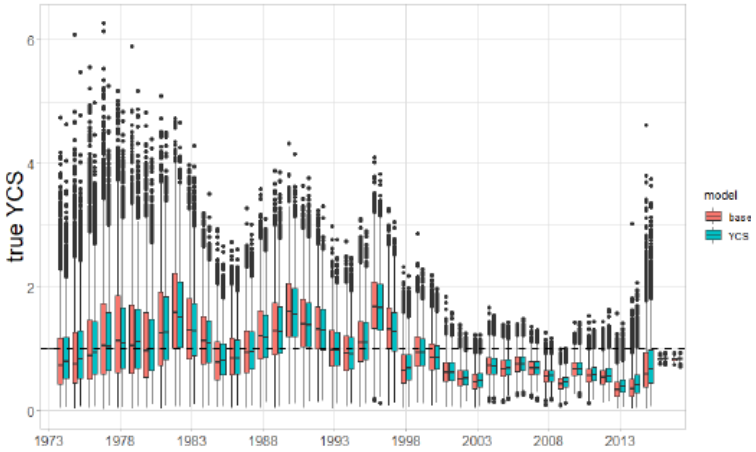

Figure 9 MCMC estimates of year class strength for the base model and the sensitivity model investigating a narrower prior distribution (YCS c.v.=0.8 instead of 1.1). (Source: FNZ, 2019a).

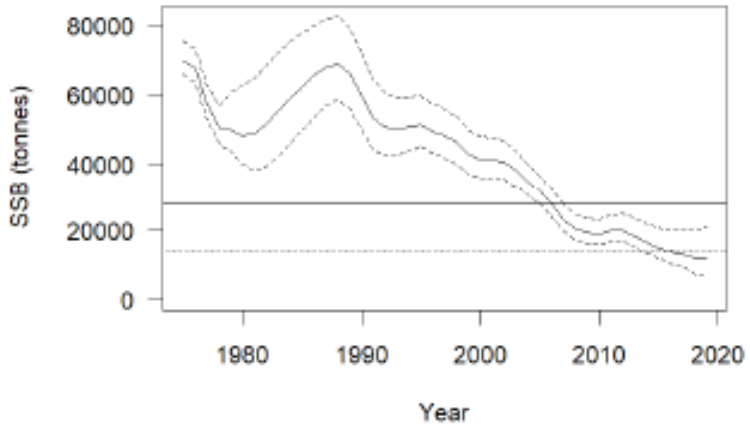

Figure 10 Estimated median trajectories (with 95% credible intervals shown as dashed lines) for the west coast South Island area base model. The management target (0.4 B_0, solid horizontal line) and soft limit (0.2B_0, dotted horizontal line) are shown as horizontal solid and dotted lines respectively. (Source: FNZ, 2019a).

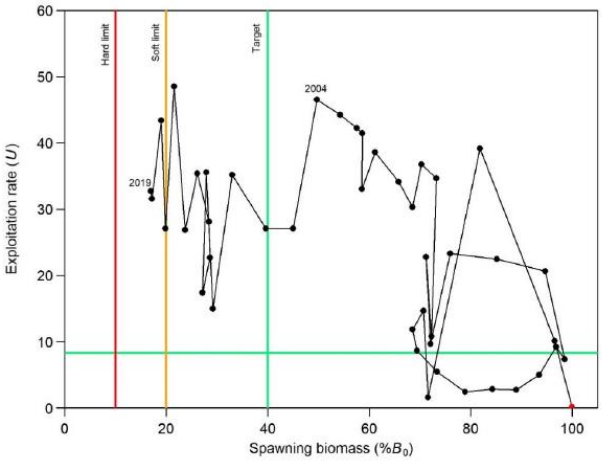

Figure 11 Trajectory over time of exploitation rate (*U*) and spawning biomass (% B_0), for the HAK 7 base model fitted to the survey biomass index, from the start of the assessment period in 1974 (represented by a red point), to 2018. The red vertical line at 0.1 B_0 represents the hard limit, the orange line at 0.2 B_0 is the soft limit, and green lines are the % B_0 target (0.4 B_0) and the corresponding exploitation rate (U_{40}). Biomass and exploitation rate estimates are medians from MCMC results. (Source: FNZ, 2019a).

Projections and rebuilding plan

Projections with the base model using the 2000-2015 recruitment series, which is below average, indicated that spawning biomass will remain below 0.2 B_0 with catches equal to 2,968 t (Figure 12). If catches were to increase to the current TACC, the spawning biomass in 2024 would drop further. When projections are made assuming average recruitment (1974-2015), spawning biomass is expected to increase at current level of catches and stay at a similar level if the TACC were to be caught.

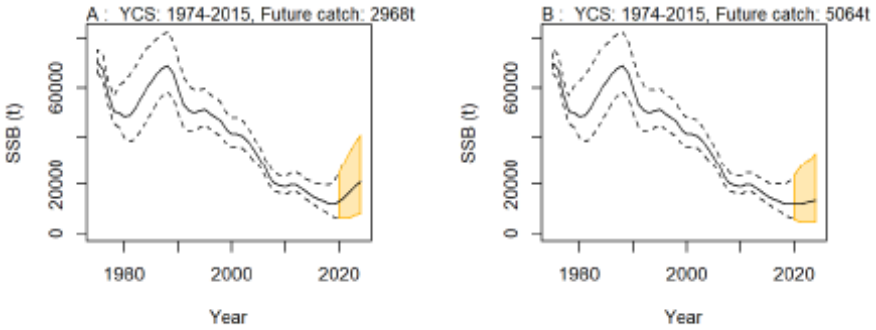

Figure 12 Spawning Stock Biomass (SSB) trajectories including projections from 2020–2024 for the base model (Survey all), projected with catch of 2,968 t (A) or TACC catch (B), with YCS sampled from all years. (source: FNZ, 2019a).

Under the New Zealand Harvest Strategy Standard (MPI, 2008), a formal, time-constrained rebuilding plan is required to be developed for stocks assessed to be below the soft limit of 0.2 B_0 to rebuild the stock to at least the target level of biomass (0.4 B_0). The stock should be rebuilt to at least the target level of biomass within a timeframe of between T_{min}, and 2*T_{min} with an acceptable level of probability. T_{min} is defined as the number of years required to rebuild a stock to the target, in the absence of fishing. For the HAK 7 stock, T_{min} has been estimated using the base model under two recruitment assumptions (Table 7).

Table 7 Outputs from the base model for rebuild time periods. (Source: FNZ, 2019c).

Recruitment assumption	Rebuild time period	
	T_{MIN}	2* T_{MIN}
Below average recruitment	8 years	16 years
Average recruitment	5 years	10 years

Projections using the 2019 stock assessment were undertaken to determine the catch levels that would rebuild the stock to the target level, within the timeframe required under the New Zealand Harvest Strategy Standard. Projections used two recruitment assumptions; one that is below average (2006-2015), and one that is average (1973-2015). The outputs are presented in Table 8.

Table 8 Proposed TACs, TACCs and allowance for source of fishing related mortality (in tonnes for HAK7 (Source: FNZ, 2019c).

Option	TAC (t)	TACC (t)	Other sources of fishing-related mortality (t)	Rebuild time (below average recruitment assumption)	Rebuild time (average recruitment assumption)
Current setting	5,120	5,064	51	N/a	N/a
Option 1	3,200	3,163	32	N/a	10 years
Option 2	2,300	2,272	23	N/a	7 years
Option 3	1,400	1,382	14	16 years	5-7 years

The management response has been to reduce the TACC from 5,064 t to 2,272 t from 1 October 2019 (option 2 in Table 8). This will serve to reduce the annual catch by ~700 t and is expected to rebuild the stock to the target level in seven years if recruitment is average but not if recruitment remains below average (FNZ, 2019c; Table 8). The Minister selected option 2 given the indications of improved recruitment and the economic impacts of TAC reductions (Nash, 2019). The next stock assessment is scheduled for 2021.

3.1.3 Ling

3.1.3.1 LIN3 & LIN 4 (Chatham Rise)

The stock assessment for which results are reported in the 2019 Fisheries Assessment Plenary was conducted in 2015 (FNZ, 2019a). The 2015 assessment estimated that B_0 was 126,600t (95% credibility intervals: 110,700-161,100t), B_{2014} was 71,800t (50,500-115,200t), resulting in a current depletion of 57% (45-71%) (FNZ, 2019a). Holmes (2019) presented an assessment of LIN 3&4 to the Deepwater Working Group. This assessment was not included in the report of the 2019 Fisheries Assessment Plenary, but the base model results indicate the biomass was 0.55 B_0 in 2018. Various sensitivities suggest that including CPUE data has the largest impact on the results of the assessment (a reduction of %B_0 from 55 to 32%). All of the sensitivity tests led to similar fits to the trawl survey index data and good fits to the survey and fishery composition data. Table 9 lists the estimates from the base model and the CPUE sensitivity model run.

Table 9 Bayesian median (95% credible intervals) (MCMC) of B_0, B_{2019}, B_{2019} as a percentage of B_0, and the probability of B_{2018} being below the target (0.4 B_0) for the base model and sensitivity runs. (Source: Holmes, 2019).

Model	B_0	B_{2019}	B_{2019} (%B_0)	P(B_{2019} < 0.4B_0)
Base	111,067 (102,260-126,828)	62,800 (49,641-82.913)	56.5 (48.2-65.5)	0.0001
CPUE	92,630 (87,605-100.986)	32,075 (24,627-46,258)	34.8 (26.8-46.9)	0.782

3.1.3.2 LIN5 & LIN6 (Sub-Antarctic excluding the Bounty Plateau)

A new stock assessment of LIN 5 & 6 was conducted during 2018 (Masi, 2019; FNZ, 2019a), which updated the last assessment conducted in 2015. The 2018 assessment includes two new biomass indices for 2015 and 2017 and associated survey proportion-at-age data as well as CPUE data for 2012-17 and associated longline proportion-at-age data.

Biomass and recruitment

Estimated recruitment (year-class strength) to the LIN5 & 6 stock was generally weak from 1982 to 1992, strong from 1994 to 1996, 2005 to 2006, 2008 and 2010, and average since then (Figure 13). Biomass estimates for the stock are healthy (Figure 14; Table 10). Annual exploitation rates (catch over vulnerable biomass) were low (less than 0.05) (Figure 15).

Table 10 Bayesian median and 95% credible intervals (in parentheses) of B_0 and B_{2018} (in tonnes), and B_{2018} as a percentage of B_0, and the probability that B_{2018} is below 0.4 B_0 from the base model, Reference model and base model with nuisance q's. (Source: FNZ, 2019a)

Model Run	B_0	B_{2018}	B_{2018} (%B_0)	P(B_{2018} < 0.4B_0)
Base case	205,306 (206,165-568-452)	271,900 (164,127-498,668)	88 (75-101)	<1%
Reference	278,469 (185,556-207,129)	253,822 (124,119-508,076)	90 (74-105)	<1%
Nuisance q	373,544 (233,061-657,266)	339,627 (190,132-638,935)	91 (79-103)	<1%

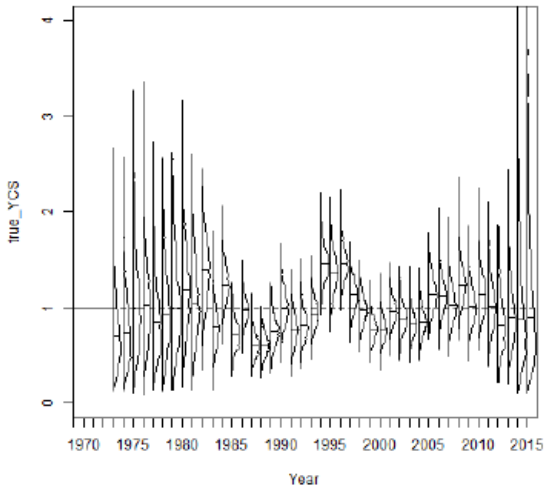

Figure 13 Estimated posterior distributions of year class strength from the base model. The horizontal line indicates a year class strength of one. Individual distributions show the marginal posterior distribution, with horizontal lines indicating the median. (Source: FNZ, 2019a).

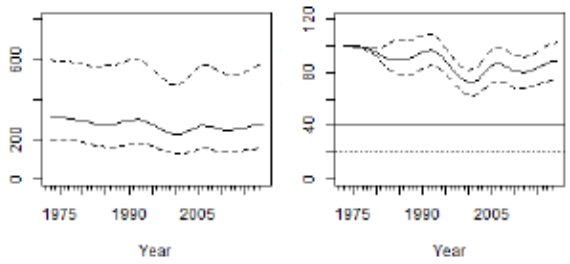

Figure 14 Estimated median trajectories (with 95% credible intervals shown as dashed lines) for absolute biomass and biomass as a percentage of B_0 for the base model. The management target of 0.4 B_0 is represented as a solid line and the dashed line is the soft limit (0.2 B_0). (Source: FNZ, 2019a).

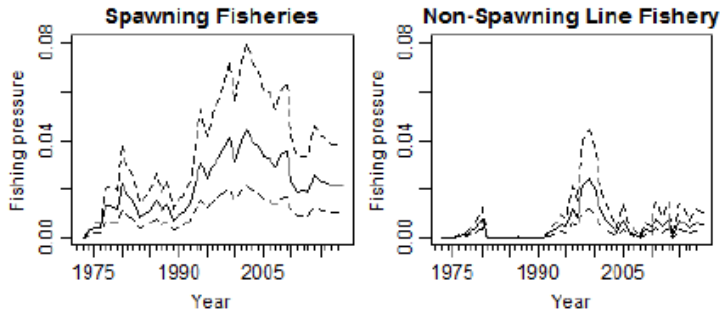

Figure 15 Exploitation rates (catch over vulnerable biomass) with 95% credible intervals shown as dashed lines. (source: FNZ, 2019a).

Projections

Projections conducted by Masi (2019) confirm that the stock will remain above the target and limit levels under a range of catch levels (Figure 16).

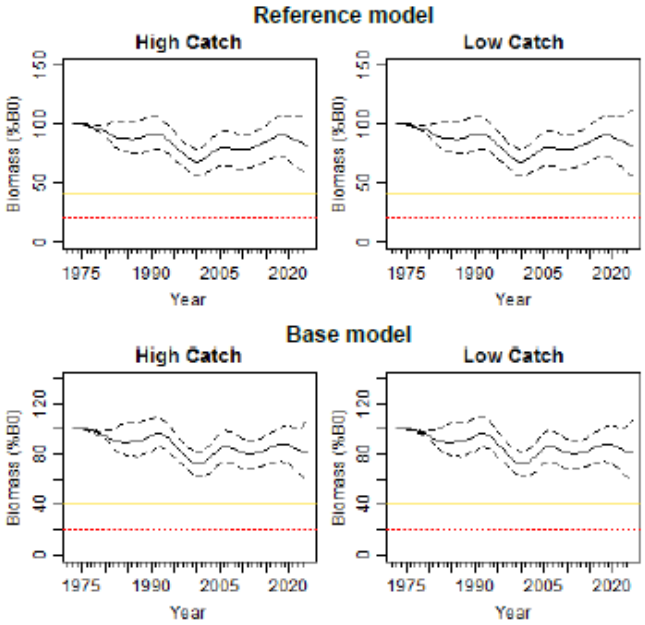

Figure 16 Estimated median trajectories (with 95% credible intervals shown as dashed lines) for biomass as a percentage of B_0, projected to 2023 under the reference and base models, with future catches assumed to be 12,100 t ("High"; left panel) or 6,650 t ("Low"; right panel) annually.

3.1.3.3 LIN7 (east coast South Island)

No assessment of the east coast South Island area (LIN7WC) has been undertaken since the 2017 recertification (Dunn and Ballara, 2019; FNZ, 2019a). The TACC for this stock has been slightly overcaught for the last five fishing years (FNZ, 2019a). The Minister was provided with three two options for increasing the TACC for LIN 7 (by 10% and by 20%) (FNZ, 2019d). The Minister increased the TACC by 10% based on the conclusion from the 2016-17 assessment that the biomass is estimated to be very likely to be above the management target of 0.4B_0 (Nash, 2019). The next stock assessment for LIN7WC may take place in 2020 (FNZ, 2019a).

3.1.4 Southern blue whiting

3.1.4.1 SBW 6B (Bounty Platform)

No assessment of the Bounty Platform area has been undertaken since the 2017 recertification. The TACC for the SBW 6B is based on a harvest control rule (Doonan, 2017). The TACC for SBW 6B was increased from 2,960t to 3,145t in 2017-18 based on the application of the HCR (Doonan, 2018), but catches have been well below the TACC since the 2017-18 fishing year. The acoustic estimates of biomass for SBW6B are imprecise, and the estimates for the last three years (2015, 2016 and 2017) are below average. Acoustic data collected in 2018 could not be used for estimates of abundance as aggregations seen later in August had dispersed before an acoustic snapshot could be made (FNZ, 2019e). The next stock assessment for SBW 6B may take place in 2020 (FNZ, 2019e).

3.1.4.2 SBW 6I (Campbell Island Rise)

No assessment of the Campbell Island Rise area has been undertaken since the 2017 recertification (Roberts and Hanchet, 2019; FNZ, 2019e). Spawning biomass in 2016 was estimated to be 70% B_0 and Very Likely (>90%) to be at or above the target of 40% B_0.

4. Environmental Overview

4.1 Principle 2

4.1.1 Retained and bycatch

HOK HAK LIN trawl

No change

Hoki, hake and ling have accounted for, on average, 91% of the total estimated catch weight recorded by observers in these target fisheries.

SBW trawl

No change.

Bycatch comprises <1%

Ling Longline

Ling accounts for ~ 66% of the total reported catch from ling targeted longliners.The trend in total bycatch has been relatively constant over the period 2002-03 to 2018-19, while for discards there has been a slight decrease (Finucci & Anderson, 2019).

4.1.2 ETP and non fish species

HOK HAK LIN trawl

No significant changes.

Seabirds

The proportion of birds released alive has increased in recent years as the main type of interaction has shifted from warp strikes (all fatal) to net captures (varying degrees of mortality annually but rarely less than 30% released alive. The seabird mitigation strategy applied by the hoki/hake/ling trawl fisheries has a high probability of ensuring the UoAs do not hinder nor threaten the recovery of any seabird populations.

NZ Sea Lion

There has been only one reported incidental capture of a New Zealand (NZ) sea lion in the hoki/hake/ling trawl fisheries in the last five years (2013-14 to 2017-18).

NZ Fur seal

On average over the last five years, there have been around 40 observed and 290 estimated incidental captures of New Zealand fur seals per year in the hoki trawl fishery, with a small fraction being released alive. NZ fur seal captures by the hake and ling trawl fisheries are negligible by comparison. The Department of Conservation's threat classification status for NZ Fur Seal is 'Not Threatened' and the population size is believed to be increasing (Baker et al., 2019).

Other species e.g. basking shark, Whales and dolphins Corals

No significant changes.

SBW trawl

No significant changes.

New Zealand sea lions

Fisheries New Zealand's Operational Plan (OP) to Manage the Incidental Capture of New Zealand Sea Lions in the Southern Blue Whiting Fishery, Campbell Islands, sets out the stringent requirements for vessels in the fishery including:

- Requirement to carry two SLEDs built and approved by certified manufacturer
- Carrying of observers at all times
- Prior notification of vessel departures.

The OP requires the fleet to leave the fishery should the following occur:

- A limit of 12 female sea lion mortalities is reached, or
- 25 total sea lion mortalities occurs.

In the 2017-18 fishing season, 10 vessels undertook a total of 204 tows in the fishery. Two male sea lions were observed captured. The population size of the endemic New Zealand sea lion is estimated to be around 12,000 animals and their conservation status was downgraded from 'Nationally Critical' in 2013 (Baker et al., 2016), to 'Nationally Vulnerable' in 2019 because the overall rate of decline has slowed and populations are stable or increasing at most breeding locations (Baker et al., 2019).

New Zealand fur seals

In the 2017-18 fishing year, there were 17 observed captures of New Zealand fur seal in southern blue whiting trawl fisheries.

Seabirds

In the 2017-18 fishing year there were six observed captures of seabirds in the southern blue whiting trawl fisheries.

LIN Longline

Seabirds

Between 2013-14 and 2017-18, there were between 16 and 89 observed, and between 496 and 857 estimated, incidental seabird captures per annum in ling longline fisheries. In 2017/18, 23 observed and between 315-786 estimated

The DWG Ling Longline Operational Procedures prescribe a range of mitigation measures to be followed to mitigate seabird capture

The existing seabird mitigation strategies applied by DWG and FNZ for ling longline fisheries, in combination with FNZ's seabird risk assessment and management approach, serve to ensure that the UoAs do not hinder recovery of any seabird populations.

Marine mammals

There have been no reported incidental captures of New Zealand sea lions, New Zealand fur seals, whales or dolphins in the ling longline fisheries subsequent to the 2004-05 fishing year

4.1.3 Benthic Impacts

HOK HAK LIN trawl

The trawl footprint of these fisheries is monitored to assess the extent of their interactions with the benthic habitat and has been calculated for each year since 1989-90 for all targeted tows for each Tier 1 deep water species. The trawl footprints for hoki, hake and ling during the 2015-16 fishing year (the most recent year for which published information is available), range from 4.5% of the main fished depth range (i.e. 400-800 m) and 1.8% of the fishable area in the EEZ and Territorial Sea (TS) (i.e. depths less than 1,600 m) for hoki, to 0.14% of the main fished depth range and 0.1% of the fishable area for hake. For all Tier 1 deep water fisheries combined, the trawl footprint in 2015-16 was 5.5% of the main depth range and 2.9% of the fishable area

SBW trawl
For the 2016–17 fishing year, 307 southern blue whiting bottom tows had an estimated footprint of 748 km^2 which represented coverage of < 0.1% of the EEZ and Territorial Sea combined, and 0.1% of the fishable area shallower than 1,600 m outside of area closures).

LIN longline
Bottom longline fishing has minimal interactions with the benthic habitat.

5. Traceability

Developments or changes within the fishery which impact traceability or the ability to segregate between fish from the Unit of Certification (UoC) and fish from outside the UoC (non-certified fish).

New Zealand has excellent traceability systems in place.

If HAK 7 is suspended then there will be a need for the client to ensure that HAK 7 does not get mixed with any certified hake. Where there is potential for mixing, these risks will be managed by the operators who have their own protocols in place to separate these catches. They are legally required to record in catch and effort logbooks catch weight by position, and method, as well as on the official catch landing form. Further, the operators have their own internal reporting systems that record the date and time of fishing activities against the packaged product (if processed)

At-sea processing occurs on all the major factory ships participating in this fishery. At-sea processing includes the sorting, heading and gutting, filleting, freezing, and packaging of hoki, hake and ling.
There are two levels of process technology in the fleet:

1. Fully integrated weighing labelling systems which barcode every carton on production and before storage in the ship's hold. This data is downloaded on arrival, reconciled on landing figures and thus final inventory is arrived at. This system allows the tagging of product lines which is non-certified so that it is barcoded as non-certified and trackable and separable ever after simply by scanning. Onshore systems in load-out audit exports.

2. The rest of the fleet practice standard practice where all product (by carton) is labelled as per MPI and NZFSA requirements. The outer markings are used to separate and inventory all product on landing.

Under MPI regulations every container in which fish is packaged on a licensed fish receiver's premise shall be marked with species name, date, licensed fish receivers name, processed state, area fished. Therefore, the risk of substitution is considered to be well managed and therefore negligible.

6 Version Details

Table 11 Fisheries program documents versions

Document	Version number
MSC Fisheries Certification Process	**Version 2.1**
MSC Fisheries Standard	**Version 1.3**
MSC General Certification Requirements	**Version 2.4.1**
MSC Surveillance Reporting Template	**Version 2.01**

7 Results

7.1 Surveillance results overview

No new conditions were raised. However, HAK 7 does not meet the SG60 at PI 1.1.1a and therefore fails. This UoC will be removed from the certificate for this fishery. The client elected for self-suspension prior to the finalizing of this report. The intent to suspend notice was published on 23rd December 2019 and the actual suspension date is the 22nd January 2019.

7.2 Stock status, TACC & catches

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

TACC 2019-20	115,000 t (agreed catch limit split East 60,000 t; West 55,000 t)
TACC 2018-19	150,000 t (agreed catch limit split East 60,000 t; West 90,000 t)
TACC 2017-18	150,000 t (agreed catch limit split East 60,000 t; West 90,000 t)
TACC 2016-17	150,000 t (agreed catch limit split East 60,000 t; West 90,000 t)
UoA share of TACC	93%
UoC share of TACC	100%
HOK 1 catch 2017-18	135,397 t (HOK 1 East 59,668 t, HOK 1 West 73,736 t)
HOK 1 catch 2016-17	141,567 t (HOK 1 East 55,616 t, HOK 1 West 64,077 t)[1]

UoC 3 – HAK 1

TACC 2017-18	3,701 t
TACC 2016-17	3,701 t
TACC 2015-16	3,701 t
UoA share of TACC	100%
UoC share of TACC	94%
HAK 1 catch 2017-18	1,350 t
HAK 1 catch 2016-17	1,175 t

UoC 4 – HAK 4

TACC 2017-18	1,800 t
TACC 2016-17	1,800 t
TACC 2015-16	1,800 t

[1] The sum of the HOK 1 East & West sub-area catches from FishServe amounts to slightly less than the total hoki catch because operators who balance with HOK ACE less than 275 t are not required to report by sub-area.

UoA share of TACC UoC share of TACC	100% 94%
HAK 4 catch 2017-18 HAK 4 catch 2016-17	267 t 268 t

UoC 5 – HAK 7

TACC 2019-20 TACC 2018-19 TACC 2017-18 TACC 2016-17	2,272 t 5,064 t 5,064 t 7,700 t
UoA share of TACC UoC share of TACC	100% 94%
HAK 7 catch 2017-18 HAK 7 catch 2016-17	3,086 t 4,071 t

UoC 6 – LIN 3 Trawl and Longline

TACC 2017-18 TACC 2016-17 TACC 2015-16	2,060 t 2,060 t 2,060 t
LIN 3 catch 2017-18 LIN 3 catch 2016-17 	2,171 t (Total reported catch) 621 t (Estimated catch trawl)[2] 676 t (Estimated catch bottom longline)[8] 764 t (Estimated catch other methods)[8] 1,808 t (Total reported catch) 708 t (Estimated catch trawl)[8] 672 t (Estimated catch bottom longline)[8] 290 t (Estimated catch other methods)[8]
UoA share of TACC and total LIN catch UoC share of TACC and total LIN catch	100% of TACC and 34% of total LIN catch (based on average estimated longline catch over the last two years) 93% of TACC and 32% of total LIN catch (based on average estimated longline catch over the last two years)

2 There are typically differences between estimated and reported catches. "Estimated catch" is an at-sea estimate of the top 5-8 species per fishing event, whereas "reported catch" is the landings as reported against the TACC and balanced with ACE.

UoC 7 – LIN 4

TACC 2017-18	4,200 t
TACC 2016-17	4,200 t
TACC 2015-16	4,200 t
UoA share of TACC and total LIN catch	100% of TACC and 26% of total LIN catch (based on average estimated trawl catch over the last two years)
UoC share of TACC and total LIN catch	94% of TACC and 25% of total LIN catch (based on average estimated trawl catch over the last two years)
LIN 4 catch 2017-18	2,636 t (Total reported catch) 698 t (Estimated catch for all target trawl) 1,603 t (Estimated catch for bottom longline) 73 t (Estimated catch other methods).
LIN 4 catch 2016-17	2,565 t (Total reported catch) 666 t (Estimated catch for all target trawl) 1,542 t (Estimated catch for bottom longline) 2 t (Estimated catch other methods).

UoC 8 – LIN 5 Trawl and Longline

TACC 2017-18	3,955 t
TACC 2016-17	3,955 t
TACC 2015-16	3,955 t
UoA share of TACC and total LIN catch	100% of TACC and 84% of total LIN catch (based on average estimated trawl catch over the last two years)
UoC share of TACC and total LIN catch	95% of TACC and 80% of total LIN catch (based on average estimated trawl catch over the last two years)
LIN 5 catch 2017-18	4,034 t (Total reported catch) 3,421 t (Estimated catch for all target trawl) 502 t (Estimated catch for bottom longline) 21 t (Estimated catch for other methods)
LIN 5 catch 2016-17	4,051 t (Total reported catch) 3,391 t (Estimated catch trawl) 575 t (Estimated catch bottom longline) 2 t (Estimated catch other methods)

UoC 9 – LIN 6 Trawl and Longline

TACC 2017-18	8,505 t

TACC 2016-17 TACC 2015-16	8,505 t 8,505 t
UoA share of TACC and total LIN catch UoC share of TACC and total LIN catch	100% of TACC and 61% of total LIN catch (based on average estimated trawl catch over the last two years) 61% of TACC and 57% of total LIN catch (based on average estimated trawl catch over the last two years)
LIN 6 catch 2017-18 LIN 6 catch 2016-17 	4,845 t (Total reported catch) 3,656 t (Estimated catch trawl) 545 t (Estimated catch bottom longline) 2 t (Estimated catch other methods. 228 t (Estimated catch LIN 6B bottom longline)[3] 3,323 t (Total reported catch) 1,315 t (Estimated catch trawl) 351 t (Estimated catch bottom longline) 0 t (Estimated catch other methods) 932 t (Estimated catch for LIN 6B bottom longline)

UoC 10 – LIN 7 Trawl and Longline

TACC 2017-18 TACC 2016-17 TACC 2015-16	3,080 t 3,080 t 3,080 t
UoA share of TACC and total LIN catch UoC share of TACC and total LIN catch	100% of TACC and 52% of total LIN catch (based on average estimated trawl catch over the last two years) 73% of TACC and 38% of total LIN catch (based on average estimated trawl catch over the last two years)
LIN 7 catch 2017-18 LIN 7 catch 2016-17 	3,487 t (Total reported catch) 1,732 t (Estimated catch trawl) 822 t (Estimated catch bottom longline) 117 t (Estimated catch other methods) 3,428 t (Total reported catch) 1,891 t (Estimated catch trawl) 757 t (Estimated catch bottom longline) 26 t (Estimated catch other methods)

UoC 11 – SBW 6B Trawl

[3] LIN 6B catches are included in the reported and estimated totals for LIN 6, but have also been separated out here for ease of assessing the LIN 6B fishery.

TACC 2018-19	3,145 t
TACC 2017-18	2,377 t
TACC 2016-17	2,940 t
TACC 2015-16	2,940 t
UoA share of TACC	100%
UoC share of TACC	87%
SBW 6B catch 2017/18	2,423 t
SBW 6B catch 2016-17	2,569 t
SBW 6B catch 2015-16	2,405 t

UoC 12– SBW 6I Trawl

TACC 2018-19	39,200 t
TACC 2017-18	39,200 t
TACC 2016-17	39,200 t
UoA share of TACC	100%
UoC share of TACC	87%
SBW 6I catch 2017-18	18,334 t
SBW 6I catch 2016-17	19,875 t
SBW 6I catch 2015-16	22,100 t

7.3 Conditions

No conditions were raised

7.4 Re-scoring Performance Indicators

7.4.1 Rescoring of P.1.1.1 for HAK7

The 2017 recertification of HAK7 was based on the 2017 assessment, which estimated the 2016 biomass to be 0.257 B_0 (95% CI 0.191-0.365) [survey model] or 0.503 B_0 (95% CI 0.346-0.736). The 2018 assessment indicates a much more pessimistic appraisal of stock status (Table 12) necessitating a rescoring of P.1.1.1. for this UoC. A rebuilding plan consistent with the New Zealand harvest strategy standard has been implemented (FNZ, 2019f). However, P.1.1.3 is not scored because P1.1.1 scores less than 60. The results of the rebuilding plan are in terms of the time to rebuild in the absence of harvest T_{MIN}, while the MSC standard refers to recovery time in terms of generation length.

Cordue (2019) conducted analyses to compute the probability that recruitment is impaired (defined for that analysis as expected recruitment less than 75% of that expected in unexploited conditions).

A. Analysis based on a stock-recruitment relationship

The choice of 0.84 made for steepness for the 2019 assessment is higher than the choice of 0.8 made for the 2017 assessment. Earlier assessments assumed a value for steepness of 0.9 and this value of steepness is consistent with values assumed (and estimated) for steepness in assessments of other hake stocks. Figure 17 does not provide strong evidence for a dome-shaped stock-recruitment relationship, justifying the choice of the Beverton-Holt form. However, the estimates of recruitment for stock sizes below 0.55 B_0 do not follow a Beverton-Holt stock-recruitment relationship with either h=0.75 or h=0.84. This is because recruitment has been below average since 1997. Cordue (2019) estimates the probability of expected recruitment being above 75% of unfished recruitment given a prior on steepness with a mode of 0.84 and a 10% probability of being below 0.74 (Figure 18). This probability is 0.705.

B. Analysis based on stock and recruitment estimates

A second way to assess whether recruitment is impaired is using the actual estimates of recruitment plotted against stock biomass (Figure 17). These are the estimates that are determined by the data for the HAK7 stock and which then determine biomass trajectories. Direct estimates of recruitment are preferred as a basis to assess whether recruitment is below the PRI rather stock-recruitment relationships that do not appear to fit the data. Recruitment is lower than average for stock sizes below about 65% of B_0 and independent of stock size for stock sizes from 20-35% B_0 (Figure 17;Table 13), with mean recruitment less than 75% R_0 for stock sizes of 55% B_0 and lower.

There are indications that recent recruitment may be average and the period of low recruitment caused by temporally correlated environmental factors. However, the evidence for the latter scenario is insufficient to conclude that the stock is likely above the PRI at present. New Zealand's Medium Term Research Plan for Deep Water Species 2020/21 - 2024/25 schedules a multi-species trawl survey of West Coast South Island, which incorporates the HAK 7 fishery area, every three years. The next survey is scheduled in 2021. Stock assessments are undertaken after the surveys and so the next stock assessment for HAK 7 will occur in 2022 when the situation can be re-evaluated.

Table 12 Bayesian median (95% credible intervals) (MCMC) of B_0, B_{2019}, B_{2019} as a percentage of B_0. (source; FNZ, 2019a).

Case	B_0	B_{2019}	B_{2019} (%B_0)
Survey all	70,046 (65,945-75,588)	11,904 (6,636-20,977)	17.0 (9.7–28.5)
Survey core	70,430 (65,930-72,218)	13,068 (6 082-24,929)	18.5 (8.9-33.0)
YCS c.v	70,586 (66,425-76,419)	13,442 (7 632-23,569)	19.1 (11.2-31.6)

CPUE	84,743 (76,058-99,139)	52,595 (31,309-88,696)	62.0 (40.5-90.8)

Table 13 Estimates of mean relative recruitment (R/R_0) for different levels of estimated stock status based on MCMC (source: Cordue, 2019).

Stock Status (%B_0)	Mean relative recruitment
≤ 25	0.54
25-35	0.55
35-45	0.72
45-55	0.67
55-65	0.90
65-75	1.25
> 75	1.16

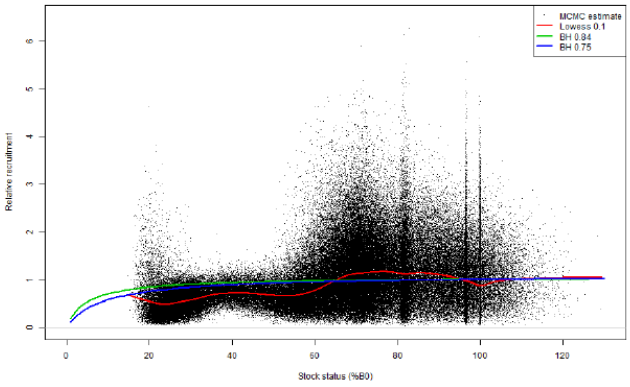

Figure 17 Relative recruitment estimates (as a proportion of virgin recruitment) plotted against estimated stock status for HAK 7 from the 2019 base model. Each point is from a single MCMC sample from the joint posterior distribution. The red line is a lowess fit (f = 0.1) and the green and blue lines are Beverton-Holt stock recruitment curves (steepness = 0.84 from the base model and the default assumption of steepness = 0.75 – see Francis 1992). (Source: Cordue [2019]).

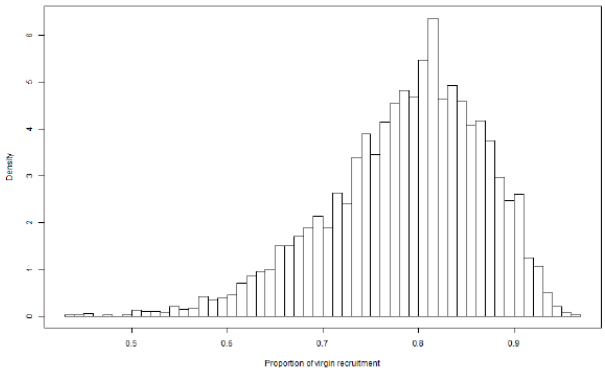

Figure 18 Posterior distribution for the expected proportion of virgin recruitment given 2019 estimated stock status for the HAK 7 base model and a prior distribution for steepness. A Beverton-Holt stock recruitment relationship was assumed. (Source: Cordue [2019]).

7.4.2 Revised scoring for P.1.1.1

PI 1.1.1		**The stock is at a level which maintains high productivity and has a low probability of recruitment overfishing**		
Scoring Issue		SG 60	SG 80	SG 100
a		It is **likely** that the stock is above the point where recruitment would be impaired (PRI).	It is **highly likely** that the stock is above the PRI.	There is a **high degree of certainty** that the stock is above the PRI.
Met		No		
	Justification	The analysis based on the stock-recruitment relationship indicates a 70.5% probability that expected recruitment at current stock levels is greater than 75% of the unfished recruitment (R_0) when account is taken of the value of the steepness parameter of the stock-recruitment relationship. The probability is larger (86%) when steepness is assumed to equal the value on which the assessment is based. However, the Beverton-Holt stock-recruitment relationship does not fit the data well. The empirical estimates of recruitment from the MCMC sample suggest that recruitment has averaged less than 60% of R_0 since the stock dropped below 35% B_0. Inferred based on estimates of recruitment from the assessment and represented using the MCMC samples is stronger evidence than inference based on an assumed stock-recruitment relationship. There are indications that recent recruitment may be average and the period of low recruitment caused by temporally correlated environmental factors. However, the evidence for the latter scenario is insufficient to conclude that the stock is likely above the PRI at present.		
b			The stock is at or fluctuating around a level consistent with MSY.	There is a **high degree of certainty** that the stock has been fluctuating around a level consistent with MSY or has been above this level over
Met				

	Justification	
References		FNZ (2019a)
Stock Status relative to Reference Points		
	Type of reference point	**Value of reference point**	**Current stock status relative to reference point**
Reference point used in scoring stock relative to PRI (SIa)	Recruitment	75% of R_0	Expected recruitment is < 60% R_0 at current stock levels.

8 Appendices

8.1 Evaluation processes and techniques

Site visits

This was an offsite review/audit.

Stakeholder input

No stakeholder reports were received

8.2 Revised surveillance program

No change

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