Falkland Islands Fisheries Department

Vessel Units

Allowable Effort

Allowable Catch

2021

Summary and Recommendations

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Contents

1. Foreword

The 2021 Licensing Advice document (Vessel Units, Allowable Effort, and Allowable Catch) summarizes licensing advice for all regulated fisheries in Falkland Islands Conservation Zones for 2021 apart from the B-licensed *Illex* fishery. Current licencing advices are based on data through the end of 2019 for finfish, toothfish and skates, and through the end of first season 2020 for calamari. Summary tables of the licencing advice are presented at the end of the report.

Stock assessments and survey data that inform the licencing advice standards are published as separate reports and available on the Falkland Islands Fisheries Department website: https://www.fig.gov.fk/fisheries/ (publications).

Falkland calamari *Doryteuthis* (*Loligo*) *gahi* obtained lower catches over the past two seasons compared to the exceptional totals in 2017, 2018 and first season 2019. Second season 2019 was closed early by emergency order, for the first time since 2015. First season 2020 ended with the lowest catch total for a first season since 2016. During the middle of this season catches were periodically low enough to cause warning, but late immigrations brought stock projections back up and the full season was fished. With stock levels continuing to show a robust status overall, allowable effort is set with the expectation of full seasons in 2021, and vessel units were calculated as the average of the past three years: 27.01.

Rock cod (*Patagonotothen ramsayi*) is currently maintained as the finfish index species for allowable effort. Estimated total rock cod biomass from the February 2020 parallel finfish / calamari surveys was the lowest of the eight parallel surveys conducted since 2010. However, surplus production modelling suggests that the rock cod biomass decrease has levelled off over the past two to three years. Since 2016, the FIFD has superimposed total allowable catches (TAC) on the rock cod-indexed allowable effort; these TACs have been lowered from 30,000 t for 2017 to 20,000 t in 2018 and 2019, to 11,112 t in 2020 and 2021. However, no fishing year since 2016 has approached its total allowable catch for rock cod anyway. While rock cod catches have decreased, hake (*Merluccius hubbsi*) and hoki (*Macruronus magellanicus*) commercial finfish catches increased substantially from 2018 to 2019, red cod (*Salilota australis*) and kingclip (*Genypterus blacodes*) catches increased slightly, and southern blue whiting (*Micromesistius australis*) and grenadier (*Macrourus carinatus*) catches decreased.

Patagonian toothfish (*Dissostichus eleginoides*) catch in the target longline fishery obtained 1047.6 tonnes in 2019; the full quota plus a small amount of overage from the year before, while bycatches in finfish and calamari trawls continued lower than their peaks in 2017 and 2016. The current stock assessment estimates a spawning stock biomass (SSB) of 10,637 t toothfish – a small increase from last year's estimate – and a ratio of 2019 SSB to unfished SSB of 0.440. This spawning stock ratio follows a trend that is anticipated to continue downward until 2023 before reversing. However, at a level >0.4 the SSB ratio meets the target reference point of the harvest control measures, and therefore TAC for toothfish is maintained at 1040 tonnes.

Skate (Rajiformes) catch in 2019 (1676 tonnes) was the lowest since 1998 and skate-license effort (27 days) was the lowest since the start of skate licencing, with effort less than half of the year before and a quarter of two years ago. Just over 2% of total skate catch was taken under skate (F) licence. Given the low commercial activity in skate fishing, stock assessment for skates was not updated and the same biomass as the 2018 estimate was used

as the basis for licencing allocation. As in previous years, allocations were equalized among GT categories.

Southern blue whiting (*Micromesistius australis*) commercial catches in Falkland waters were in 2019 the lowest annual total on record for the second straight year, at 509 tonnes. Of this total 98.6% were taken by finfish licence (primarily W licence) and the rest by calamari licence. Additionally, 14 tonnes were taken under experimental trawl licenses for finfish and calamari. S (surimi) license was not fished in 2019, as it was not fished in 2017, and only by one vessel for 4 days last year. With last year's stock assessment showing a low but relatively stable estimate, the statutory TAC of 2,000 metric tonnes under S licence was maintained for blue whiting.

We are grateful to the scientific observers of the FIFD for data collection and to data management staff for processing catch reports from fishing vessels. We also thank our local and foreign-partner fishing companies for their cooperation in providing timely and reliable fisheries data.

2. *Doryteuthis gahi* (*Loligo*) – Falkland calamari

2.1. Management and stock trends.

The targeted fishery for Falkland calamari (*Doryteuthis gahi* – colloquially *Loligo*) is managed through two levels of control: 1) season schedule and 2) total biomass to a minimum escapement threshold per season. Season schedules are currently set as: 1st season (C licence), 64/65 days opening from February 24th to April 28th; 2nd season (X licence), 64 days from July 29th to September 30th. Since 2013 a flexible option also allows vessels to start and end either season as much as 6 days later with deferrals for bad weather or mechanical breakdown. In either 1st or 2nd season the minimum escapement threshold is set at 10,000 tonnes biomass (Barton 2002, Arkhipkin et al. 2008). If in-season depletion models project that calamari biomass will fall below 10,000 tonnes, the fishery may be suspended or stopped before the scheduled end date of the season.

With the use of these controls, actual vessel units (VU) play a nominal role in determining the effort allocation to the Falkland calamari fishery. As long as no significant decline in stock biomass is anticipated, all licensed vessels can expect to fish for the duration of the season (except vessels restricted to fixed proportions of the season based on their replacement categories; see below). Calamari catches and stock biomass estimates were exceptionally high in three of the past five years; 2017 (Mercopress 2017), 2018 (Mercopress 2018) and 2019 (Faro de Vigo 2019). In first seasons of both 2016 and 2020 most calamari immigration came late, resulting in low catches early in the seasons (and in 2020, a mid-season caution of potential emergency closure), but abundant biomasses remaining at the end of the seasons, reflected in nil to low risks of escapement failure (Table 2.1).

Table 2.1. Catches, estimated biomass, escapement risks, and VU allocations of Falkland calamari 1st seasons 2016-2020.

Year	1st season calamari catch (t)	1st season calamari biomass (t)[a]	Risk of <10,000 t escapement	Total VU allocation
2016	22,616	65,603	0.000	27.01
2017	39.433	113,939	0.000	27.02
2018	43,085	106,237	0.000	27.01
2019	55,586	189,577	0.000	27.01
2020	29,116	52,941	0.001	27.01

a: Biomass estimate at the end of the pre-season survey, plus in-season immigration.

2.2. Vessel units and q-values.

As in previous years (e.g., Section 2 in FIFD, 2019), the total VU allocation for 2019 was set as the average of the preceding three years (Table 2.1). As this procedure has been followed for a number of years, the total VU allocation at this point is essentially a fixed value of 27.01.

Total VU allocation was partitioned among licensed vessels in proportion to the GT category-averaged catchability coefficients (q values). Catchability coefficients represent the efficiency of a vessel at fishing (Arreguin-Sanchez 1996), and are calculated as catch per unit effort per available biomass. To smooth variations within seasons, catchability coefficients were averaged over the most recent three years 2018 to 2020 (Table 2.2). Since 2016

catchability coefficients have been calculated only on unreplaced vessels, i.e. excluding vessels that had been entered as replacements for a mechanical breakdown. Replacement vessels are less experienced in the fishery and are therefore likely to have lower catch efficiency independently of their GT category. No replacement vessels were employed in calamari 1st season 2020.

Table 2.2. Parameters for average q-value calculations. Trends were visualized for the five years 2016 - 2020; q averages were calculated for the most recent three years 2018 – 2020.

Parameter	GT cat	Year					3-year average
		2016	2017	2018	2019	2020	
Biomass		65,603	113,939	106,237	189,577	52,941	
Catch (t)	3	1,156.5	241.5	0.0	0.0	0.0	
	4	3,438.0	6603.1	8812.7	11275.0	6674.6	
	5	6,818.6	12203.7	12805.9	16712.5	8988.6	
	6	7,531.5	13950.9	13121.6	18320.0	9307.3	
	7	3,462.2	3389.4	7449.0	9225.3	4145.6	
Fishing days	3	64	7	0	0	0	
	4	178	185	239	232	251	
	5	311	314	297	294	322	
	6	322	311	292	303	318	
	7	130	62	123	124	121	
CPUE ($t\ day^{-1}$)	3	18.1	34.5				
	4	19.3	35.7	36.9	48.6	26.6	
	5	21.9	38.9	43.1	56.8	27.9	
	6	23.4	44.9	44.9	60.5	29.3	
	7	26.6	54.7	60.6	74.4	34.3	
Catchability (q)	3	2.75e-4	3.03e-4				
	4	2.94e-4	3.13e-4	3.47e-4	2.56e-4	5.02e-4	3.69e-4
	5	3.34e-4	3.41e-4	4.06e-4	3.00e-4	5.27e-4	4.11e-4
	6	3.57e-4	3.94e-4	4.23e-4	3.19e-4	5.53e-4	4.32e-4
	7	4.06e-4	4.80e-4	5.70e-4	3.92e-4	6.47e-4	5.37e-4

One category 5 vessel in the fishery is licensed to replace a category 3 vessel, and starting 1st season 2018, one category 4 vessel is licensed to replace a category 3 vessel. The standard procedure for replacement vessels has been to adjust their VU allocation to the category they are replacing based on the current calculation of averaged catchability. However, following the latest replacement there is no actual category 3 vessel left in the fishery. Thus the allocation proportions have been fixed at their previous and current values; for the replacement category 5 vessel at 83% of the allocation (FIFD 2015; 2016; 2017), and for the category 4 vessel at 92% of the allocation (based on average catchabilities in 2015, 2016, and 2017) (Table 2.3).

Table 2.3. VU allocations per vessel.

Vessel Callsign	GT category	GT avg. q	VU allocation
MSPL9	5	4.11e-4	1.67
ZDLC1	4	3.69e-4	1.50
ZDLE1	6	4.32e-4	1.75
ZDLF2	5	4.11e-4	1.67
ZDLM3 [a]	4	3.35e-4	[a] 1.36
ZDLO1	6	4.32e-4	1.75
ZDLP1	5	4.11e-4	1.67
ZDLR1	6	4.32e-4	1.75
ZDLS3	5	4.11e-4	1.67
ZDLT1	4	3.69e-4	1.50
ZDLU1	6	4.32e-4	1.75
ZDLV [b]	5	3.41e-4	[b] 1.38
ZDLW3	4	3.69e-4	1.50
ZDLY	7	5.37e-4	2.18
ZDLZ	7	5.37e-4	2.18
ZDLZ1	6	4.32e-4	1.75
			27.01

a: ZDLM3 replaced a category 3 vessel, and is restricted to 92% of the season to offset its higher fishing capacity. Last season this switch was allocated to ZDLT1.
b: ZDLV replaced a category 3 vessel, and is restricted to 83% of the season to offset its higher fishing capacity.

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3. Finfish

3.1. Introduction

Finfish trawl catch in the Falkland Islands is allocated by three licenses: A (unrestricted finfish), G (*Illex* squid and restricted finfish), and W (restricted finfish). Specialized fisheries for skates and surimi are separately allocated by F and S licenses. In 2019, catch of major commercial species by A, G and W licenses totalled 66,201 tonnes, as shown in Table 3.1.

Table 3.1. Catches in 2019 of commercial species targeted by finfish licences.

Species	Catch by Licence (tonnes)			
	A	G	W	
Illex squid	12.4	1171.8	130.5	1314.7
Blue whiting	4.7	3.7	494.1	502.5
Hoki	175.9	929.2	6221.8	7326.9
Red cod	298.3	408.9	959.7	1667.0
Common hake	27225.0	11214.6	14263.0	52702.5
Southern hake	8.0	16.8	69.0	93.8
Kingclip	630.8	442.1	601.1	1674.0
Rock cod	107.2	207.6	274.0	588.8
Grenadier	33.4	51.9	245.7	331.0
	28495.7	14446.6	23258.9	66201.2

Finfish license allocations are set by Total Allowable Effort (TAE). The effort allocations are calculated as a function of the catchability of an index species. The index species is designated to represent the main target of the fishery, which can be assumed to characterize consistent relationships among catch, effort, and biomass. Previously, the index species for finfish TAE was blue whiting. With declining catches of blue whiting and concurrently increasing rock cod, the licensing index species was switched to rock cod starting in 2011 (Payá et al. 2010). In the years since, catches of rock cod have decreased from their peak in 2010 (FIG 2019), but no other single species has taken a similar consistent level of predominance. The estimated biomass of rock cod in 2019 was 37,793 metric tonnes from the groundfish + calamari surveys (Ramos and Winter 2020), and 155,149 metric tonnes from a modified surplus production model (Winter 2020).

For 2021, rock cod continues to be used as the finfish licensing index species by default. Given the uncertainties of rock cod biomass and distribution, precautionary total allowable catches (TAC) have been superimposed on the TAE: 20,000 metric tonnes for 2018 and 2019 (FIFD 2017, FIFD 2018), and 11,112 tonnes for 2020 (FIFD 2019). The TAC of 11,112 tonnes is retained for 2021 but in fact, no annual rock cod catches have been close to even 10,000 tonnes since 2015 (FIG 2019).

3.2. Vessel units and fishing time.

TAE is expressed by Vessel Units (VU), a metric of the fishing effort expected to yield a standard level of catch of the target index species. VUs are then used to apportion the total VU allocation into fishing time, expressed as vessel-months. VUs and fishing times are

calculated according to the catchability of the index species averaged over a preceding range of years. For each licence A, G, or W, catchability was averaged over the three most recent completed years, 2017 to 2019.

To maintain continuity, the total VU allocations for 2020 (FIFD 2019) had been calculated as equivalent to the VU allocations for 2019 (FIFD 2018) adjusted by the proportionality of rock cod biomass over its own 3-year average (2016 – 2018). The same adjustment is set for 2021, with rock cod biomass (from Table 3 in Winter (2020)) in the most recent assessed year (2019) divided by the average that is now extended to 4 years (2016 – 2019), to maintain connection with the same baseline:

$$\text{V-month adjustment} = \frac{\text{biomass}_{2019}}{\text{avg.}(\text{biomass}_{2016,\ 2017,\ 2018,\ 2019})} - 1$$

$$= \frac{155149.0}{\text{avg.}(248664.8,\ 185895.3,\ 154080.0,\ 155149.0)} - 1 \quad = -16.6\%$$

The adjustment of –16.6% was applied to G and W licences (Table 3.2). Note that the adjustment of –16.6% is relative to 2 years ago, and corresponds to a difference of 12% – 16.6% = –4.6% from last year. This adjustment is precautionary as a number of finfish species have continued to show decreasing trends in the survey program (Ramos and Winter 2020). For A licence, the outcome was obtained that last year >95% of catch taken under this licence had been hake (Table 3.1), which correlates negatively with rock cod catch (Winter 2020). Like last year, A licence was therefore exempted from the –16.6% adjustment, but for 2021 was again switched from the status of unrestricted finfish licence to the status of hake licence, with any species other than *Merluccius hubbsi* and *Merluccius australis* caught under A licence subject to bycatch regulation. Further, in relation to the seasonal distribution of hake in Falkland Islands waters (Arkhipkin et al. 2012), A licence in 2021 will be valid only from March 1st to October 15th.

Table 3.2. VU allocation comparing 2019, 2020 and 2021.

Licence	2019 VU	2020 VU	2021 VU
A	12.20	12.20	12.20
G	15.30	13.46	12.77
W	17.10	15.05	14.27

With the same vessel-units per month (VUM) maintained from the year before, vessel-months were decreased by 16.6% on G and W licences, and kept the same on A licence:

Table 3.3. Fishing effort VUM and allocated fishing time in vessel-months by GT category, for A licence, 2012 to 2021.

GT category	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Fishing effort VUM										
3	0.46	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46
4	0.46	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46
5	0.46	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46
6	0.46	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46
7								0.46	0.46	0.46

Fishing time vessel-months										
3	28.3	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	26.6
4	28.3	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	26.6
5	28.3	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	26.6
6	28.3	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	26.6
7								26.6	26.6	26.6

Table 3.4. Fishing effort VUM and allocated fishing time in vessel-months by GT category, for G licence, 2012 to 2021.

GT category	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Fishing effort VUM										
3	0.39	0.42	0.49	0.37	0.40	0.40	0.40	0.38	0.38	0.38
4	0.73	0.79	0.75	0.72	0.68	0.68	0.68	0.73	0.73	0.73
5	1.07	1.17	1.01	1.06	0.96	0.96	0.96	1.07	1.07	1.07
6	1.41	1.54	1.27	1.40	1.25	1.25	1.25	1.42	1.42	1.42
7								1.76	1.76	1.76
Fishing time vessel-months										
3	54.4	52.6	40.7	53.8	49.7	44.8	38.1	40.0	35.2	33.4
4	29.0	28.0	26.6	27.9	29.3	26.3	22.4	21.0	18.5	17.5
5	19.8	18.9	18.9	18.9	20.7	18.7	15.9	14.3	12.6	11.9
6	15.0	14.4	14.4	14.2	16.1	14.5	12.3	10.8	9.5	9.0
7								8.7	7.7	7.3

Table 3.5. Fishing effort VUM and allocated fishing time in vessel-months by GT category, for W licence, 2012 to 2021.

GT category	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Fishing effort VUM										
3	0.24	0.24	0.23	0.27	0.31	0.31	0.31	0.40	0.40	0.40
4	0.48	0.51	0.48	0.47	0.49	0.49	0.49	0.56	0.56	0.56
5	0.73	0.78	0.74	0.67	0.66	0.66	0.66	0.72	0.72	0.72
6	0.98	1.04	1.00	0.87	0.84	0.84	0.84	0.88	0.88	0.88
7								1.03	1.03	1.03
Fishing time vessel-months										
3	98.8	102.9	97.1	81.2	71.0	64.0	54.4	42.5	37.4	35.5
4	48.9	48.4	46.5	47.0	45.7	41.2	35.0	30.5	26.9	25.4
5	32.5	31.7	30.2	33.1	33.7	30.3	25.8	23.8	21.0	19.9
6	24.2	23.8	22.3	25.5	26.7	24.0	20.4	19.5	17.2	16.3
7								16.5	14.5	13.8

Note that GT categories are equalized for A licence only, as previous analyses (FIFD 2018) showed no statistically significant correlation between GT and VU of individual vessels under A licence. Also note that VUM and vessel-months per category are alternate total outcomes, for example, the W-licence fishery could be taken by Cat 3 vessels fishing a total of 35.5 vessel-months or by Cat 4 vessels fishing a total of 25.4 vessel-months or by Cat 5 vessels fishing a total of 19.9 vessel-months, etc.; or any proportioned combination of these categories.

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4. *Dissostichus eleginoides* – Patagonian toothfish

4.1. Introduction

The targeted longline fishery for Patagonian toothfish (*Dissostichus eleginoides*) is listed under L-licence, and managed through total allowable catch (TAC). In addition to longline, notable quantities of toothfish are taken as bycatch in finfish and calamari trawl fisheries. In the finfish fishery toothfish is a commercially valuable bycatch, while in the calamari fishery it is usually discarded, due to the small size of the specimens.

Toothfish stock assessment is calculated as an age-structured production model in CASAL software (Bull et al. 2012), and integrates the catch and effort data reported by fisheries with toothfish age, length and maturity data collected by observers during commercial trips. The main observations used to inform the model are: catch-at-age data for Spanish-system longline, umbrella-system longline, finfish trawl and calamari trawl fisheries, and CPUE data for Spanish- and umbrella-system longline. CPUE is estimated in kg per 1,000 hooks, and standardized across several covariates (individual vessel, month, soak-time, depth, fishing region, umbrella-spacing, and number of hooks-per-umbrella).

Reported toothfish catch in 2019 totalled 1318.0 tonnes, of which 79% was caught by longline (1047.6 t in 206 vessel-days), 19.9% by finfish trawl (262.3 t in 2397 vessel-days), and 0.6% by calamari trawl (8.1 t in 1637 vessel-days) (Figure 4.1). Toothfish bycatch in the finfish trawl fishery remained roughly the same as in the previous year, but toothfish bycatch further decreased in the calamari trawl fishery.

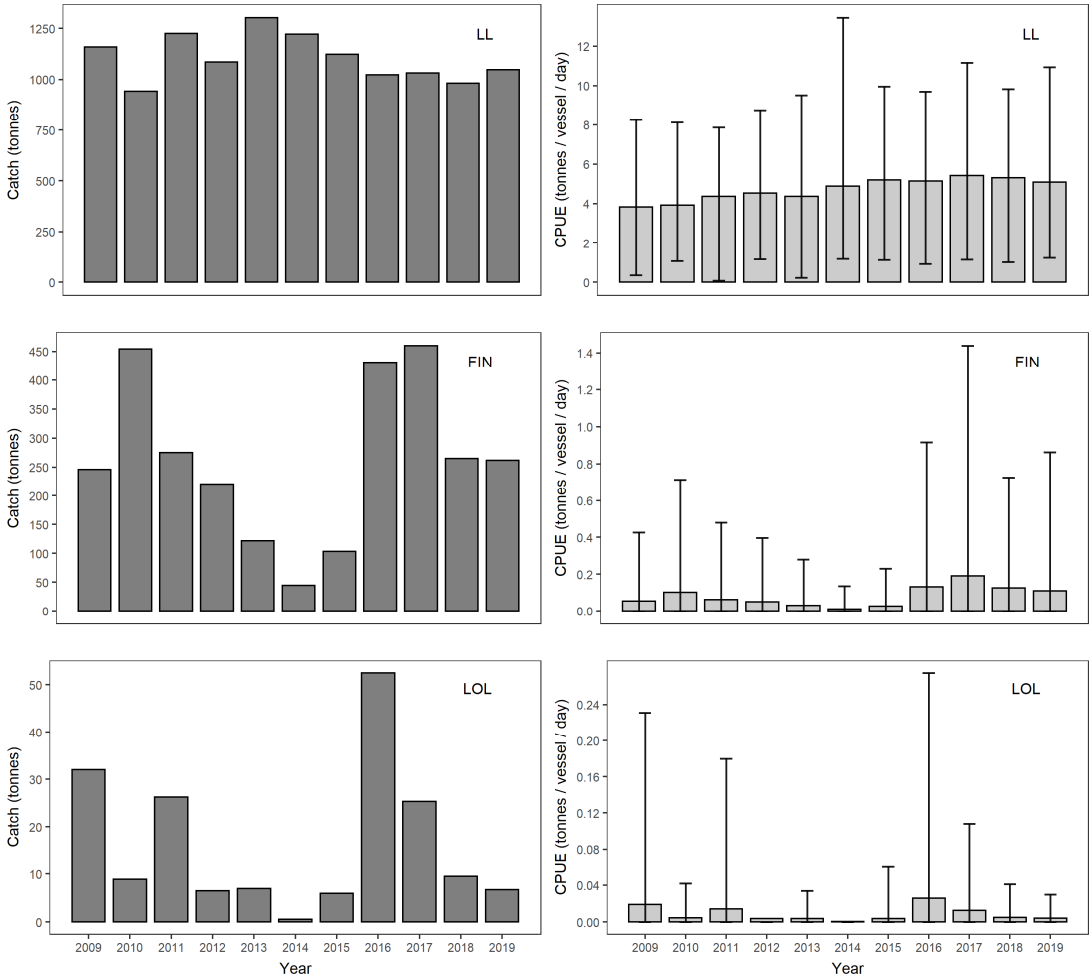

Figure 4.1 [previous page]. Time series of toothfish catches (left) and unstandardized CPUE (right) for longline (LL), finfish trawl (FIN) and calamari trawl (LOL) fisheries. Error bars are 95% quantiles of observed CPUE.

4.2. Stock assessment estimates

The key output parameters estimated in 2019 toothfish stock assessment are summarised in Table 4.1.

The current spawning stock biomass (SSB_{2019}) was estimated at 10,637 t, slightly higher than in the previous year. However, the ratio of current spawning stock biomass to initial spawning stock biomass (SSB_{2019}/SSB_0) estimate was lower than the last year's (SSB_{2019}/SSB_0 = 0.440 vs. SSB_{2018}/SSB_0 = 0.467). This decline was anticipated by the previous assessment, and although minor, it places the SSB_{2019}/SSB_0 ratio below the 0.45 threshold, i.e. under the target range of harvest control rules (HCR), as defined by Farrugia and Winter (2018, 2019). The future trend of SSB/SSB_0 was projected based on the constant future annual catches (longline 1,040 t, finfish trawl 300 t, calamari trawl 30 t), and showed that further decline can be expected, until reaching the minimum point of 0.424 in 2023. However, this is still within the HCR target range, and the median SSB/SSB_0 ratio is expected to slowly start increasing afterwards, reaching 0.45 by 2029.

The model-estimated natural mortality of M = 0.186 is similar to the natural mortality used for toothfish in South Georgia (Hillary et al. 2006), and previously in the Falkland Islands as a composite average (Payne et al. 2005).

Maximum sustainable yield (MSY) is the maximum constant annual catch that can be sustained under deterministic recruitment and the assumed constant catch partition. MSY was determined to be 1,890 t. Deducting from MSY 300 t for finfish trawl and 30 t for calamari trawl fishery leaves 1,560 t available for the longline toothfish fishery. As a precautionary measure, TAC should be set below the MSY to provide a buffer to account for undetected whale depredation, uncertainties in the model, and variability in the toothfish stock and the environmental conditions.

Table 4.1. Key output parameters estimated by the 2019 toothfish stock assessment model. 95% confidence intervals of the maximum posterior distribution (MPD) were calculated using the Markov Chain Monte Carlo (MCMC) method.

Parameter	MPD value	MCMC 95% CI
SSB_0	24,199 t	21,316 - 92,249 t
SSB_{2019}	10,637 t	7,877 - 78,504 t
SSB_{2019}/SSB_0	0.440	0.364 - 0.875
MSY	1,890 t	1,665 - 7,205 t
M	0.186 y^{-1}	0.171 - 0.241 y^{-1}

4.3. Recommendation

Current management advice is based on a set of harvest control rules (HCR) established to manage the Falkland Islands toothfish longline fishery (Farrugia and Winter 2018, 2019). The estimated SSB_{2019}/SSB_0 ratio of 0.440 is below the upper target reference point (0.45) and above the trigger reference point (0.40), i.e. in the target range. Although the model projects a further decrease in SSB_{2019}/SSB_0 ratio in the next few years, it is nevertheless expected to

stay above 0.40 (in the target range). While the stock is at this level, the total allowed catch (TAC) should not be increased, but more restrictive conservation measures are not required either. Therefore, the recommendation for the toothfish longline fishery is to maintain the annual TAC at its current level of 1,040 tonnes.

A second recommendation is to maintain the existing '1.5% toothfish bycatch limit', as toothfish bycatch in both finfish and calamari trawls decreased in 2018/2019 compared to 2016/2017, coinciding with the introduction of this regulation. A longer time period is needed to ascertain the effectiveness of the bycatch limit, as the recent bycatch decline could be a consequence of natural variability in toothfish recruitment (i.e., weak recruitment in the last two years). Therefore, close monitoring of toothfish bycatch, especially in the finfish trawl fishery where larger quantities are taken, needs to be continued.

4.4. References

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5. Rajiformes – Skates

5.1. Management and stock trends

Skate (Rajiformes) are since 1994 licensed separately from other groundfish trawl fisheries in the Falkland Islands (F license). The skate fishery is regulated by total allowable effort (TAE) of licensed vessels. However, a large proportion of skate catch is routinely taken in finfish trawls, while skate-licensed vessels may take large amounts of groundfish other than skate. In 2019, 35.6 tonnes of skate were caught under skate target license, together with 213.6 t hake, 0.1 t rock cod, 5.2 t kingclip, 2.4 t red cod, and 1.3 t hoki. Conversely, 1640.1 t skate were caught in 2019 under licenses other than skate target license.

Target catch of skate has decreased strongly, concurrently with a strong decrease in effort. Both total catch and target catch of skate in 2019 were the lowest since 1998 and decreasing continually since 2015 (Figure 5.1). Recent stock assessments (e.g., Winter 2018) have shown stable trends of the skate stock, and reviews of the skate assemblage (Arkhipkin et al. 2012, Winter et al. 2015) have noted high population abundance, species diversity, and habitat structure. Therefore, a new stock assessment was not calculated in 2020. The same biomass as the last two years is used as a baseline: 43,342.6 metric tonnes (Winter 2018).

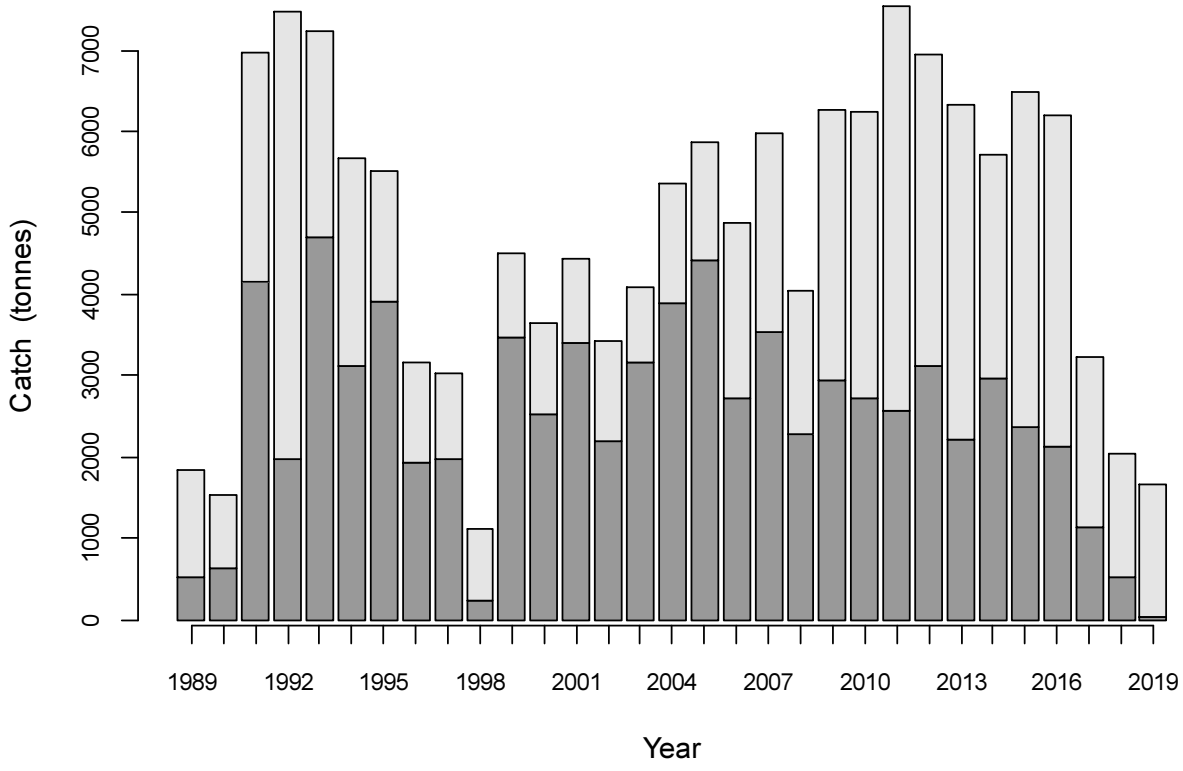

Figure 5.1. Target-licence catches (dark) and all catches (light grey) of skates, 1989 to 2019.

5.2. Allowable effort and vessel units

The recommendation for 2020 is to aim for skate target catch under F license at a level corresponding to this same baseline biomass. Effort allocations were updated by calculating

Vessel Units based on catchability per GT category, averaged over the preceding three years. Catchability coefficients (q-values) per GT category were calculated as:

$$Q_i = \left. \overline{\frac{\text{catch}_i\ (t)}{\text{effort}_i\ (hrs) \times \text{biomass}\ (t)}} \right|_{2017}^{2019}$$

where catch and effort of the *i*th GT category are obtained from vessel reports, and biomass in each year 2017 to 2019 is the north biomass estimate (Table 5.1). Vessel units per month per GT category were calculated as:

$$VUM_i = Q_i \times \text{biomass}_{2018} \times \left. \overline{\frac{\text{fish hrs}_i}{\frac{\text{fish days}_i}{30.5}}} \right|_{2017}^{2019} / 100$$

where fishing hours and fishing days of the *i*th GT category are obtained from vessel reports, 30.5 converts month/day, and 100 is a scaling factor of the vessel units. Vessel unit allocations per GT category were calculated as:

$$VU_i = \frac{VUM_i \times \text{licensed days}_{i\,2019}}{30.5}$$

Table 5.1. Skate-licence fishery parameters 2017 – 2019, used for calculating the 3-year averaged Vessel Unit allocations.

Parameter	GT category	Year		
		2017	2018	2019
Biomass		43,343	43,343	43,343
Catch	3	1,119	462	15
	4	1	0	7
	5	10	54	13
	7	6	0	0
	8	0	0	0
Effort Hours	3	2144	798	182
	4	13	0	40
	5	43	311	113
	7	23	0	0
	8	0	0	0
Licensed Days	3	205	174	50
	4	6	0	14
	5	10	84	50
	7	2	0	0
	8	0	0	0
Fishing Days	3	126	45	14
	4	1	0	3
	5	4	19	10
	7	2	0	0
	8	0	0	0

Fishery parameters for the past three years are summarized in Table 5.1, and the recommended Vessel Unit allocations are summarized in Table 5.2. As in previous years (since FIFD 2014) the vessel units per month were equalized between GT categories. Equalization was implemented because the small scale of this fishery (3 vessels in 2019; one in each GT category 3, 4 and 5) would confound differences between GT categories. Despite category 4 being occupied again in 2019, total skate skate-licensed-effort decreased further from 2018 to 2019 (Table 5.1). 2019 was also the first year since the start of licencing that saw no effort by Korean vessels.

The total allocation is 4.50 VU (Table 5.2), corresponding to a nominally expected skate catch of 450 tonnes. The considerable reduction in VU from last year (FIFD 2019) reflects both the reduction in licenced days (Table 5.1) and the lower catchability, as much of the skate licence effort was evidently employed for exploratory purposes.

Table 5.2. Mean catchability coefficients Q and recommended equalized vessel unit allocations by GT category. Note that the Q multiplier is 10^{-6}, not 10^{-5} like last year.

GT category	Q ($\times 10^{-6}$)	Vessel Units per month	Vessel Unit allocation
3	9.11	1.20	4.50
4	3.12	1.20	
5	4.00	1.20	
7	6.06	1.20	

5.3. References

Arkhipkin, A., Brickle, P., Laptikhovsky, V., Pompert, J., Winter, A. 2012. Skate assemblage on the eastern Patagonian Shelf and Slope: structure, diversity and abundance. Journal of Fish Biology 80:1704-1726.

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6. Quick reference guide to VUM/GT Categories

6.1. Falkland calamari fishery (C)

VU = 27.01 – allows for a standard fleet of 16 vessels.

6.2. Finfish fishery (A, G, W)

VU allocation in 2019, and 2020, and 2021.

Licence	2019 VU	2020 VU	2021 VU
A	12.20	12.20	12.20
G	15.30	13.46	12.77
W	17.10	15.05	14.27

A licence. Fishing effort VUM and fishing time vessel-months.

GT category	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Fishing effort VUM										
3	0.46	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46
4	0.46	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46
5	0.46	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46
6	0.46	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46
7								0.46	0.46	0.46
Fishing time vessel-months										
3	28.3	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	26.6
4	28.3	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	26.6
5	28.3	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	26.6
6	28.3	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	26.6
7								26.6	26.6	26.6

G licence. Fishing effort VUM and fishing time vessel-months.

GT category	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Fishing effort VUM										
3	0.39	0.42	0.49	0.37	0.40	0.40	0.40	0.38	0.38	0.38
4	0.73	0.79	0.75	0.72	0.68	0.68	0.68	0.73	0.73	0.73
5	1.07	1.17	1.01	1.06	0.96	0.96	0.96	1.07	1.07	1.07
6	1.41	1.54	1.27	1.40	1.25	1.25	1.25	1.42	1.42	1.42
7								1.76	1.76	1.76
Fishing time vessel-months										
3	54.4	52.6	40.7	53.8	49.7	44.8	38.1	40.0	35.2	33.4
4	29.0	28.0	26.6	27.9	29.3	26.3	22.4	21.0	18.5	17.5
5	19.8	18.9	18.9	18.9	20.7	18.7	15.9	14.3	12.6	11.9
6	15.0	14.4	14.4	14.2	16.1	14.5	12.3	10.8	9.5	9.0
7								8.7	7.7	7.3

W licence. Fishing effort VUM and fishing time vessel-months.

GT category	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Fishing effort VUM										
3	0.24	0.24	0.23	0.27	0.31	0.31	0.31	0.40	0.40	0.40
4	0.48	0.51	0.48	0.47	0.49	0.49	0.49	0.56	0.56	0.56
5	0.73	0.78	0.74	0.67	0.66	0.66	0.66	0.72	0.72	0.72
6	0.98	1.04	1.00	0.87	0.84	0.84	0.84	0.88	0.88	0.88
7								1.03	1.03	1.03
Fishing time vessel-months										
3	98.8	102.9	97.1	81.2	71.0	64.0	54.4	42.5	37.4	35.5
4	48.9	48.4	46.5	47.0	45.7	41.2	35.0	30.5	26.9	25.4
5	32.5	31.7	30.2	33.1	33.7	30.3	25.8	23.8	21.0	19.9
6	24.2	23.8	22.3	25.5	26.7	24.0	20.4	19.5	17.2	16.3
7								16.5	14.5	13.8

6.3. Skate fishery (F)

GT category	Q ($\times 10^{-6}$)	Vessel Units per month	Vessel Unit allocation
3	9.11	1.20	4.50
4	3.12	1.20	
5	4.00	1.20	
7	6.06	1.20	

6.4. Toothfish longline fishery (L)

TAC – 1,040 tonnes.

6.5. Restricted finfish – Pelagic fishery (S)

TAC for southern blue whiting – 2,000 tonnes.