

Falkland
Islands
Fisheries
Department



Vessel Units

Allowable Effort

Allowable Catch

2023

Summary and Recommendations

© Crown Copyright 2022

No part of this publication may be reproduced without prior permission from the Falkland Islands Government Fisheries Department.

For citation purposes this publication should be referenced as follows:

FIFD. 2022. Vessel Units, Allowable Effort, and Allowable Catch 2023. Summary and Recommendations. Fisheries Department, Directorate of Natural Resources, Falkland Islands Government.

Contents

1. FOREWORD	3
2. <i>DORYTEUTHIS GAHI (LOLIGO)</i> – FALKLAND CALAMARI	5
<i>Andreas Winter</i>	
2.1. MANAGEMENT AND STOCK TRENDS.....	5
2.2. VESSEL UNITS AND Q-VALUES.	5
2.3. REFERENCES.....	7
3. FINFISH	8
<i>Andreas Winter</i>	
3.1. INTRODUCTION	8
3.2. VESSEL UNITS AND FISHING TIME.....	8
3.3. REFERENCES	10
4. <i>DISSOSTICHUS ELEGINOIDES</i> – PATAGONIAN TOOTHFISH	11
<i>Frane Skeljo</i>	
4.1. INTRODUCTION	11
4.2. STOCK ASSESSMENT ESTIMATES.....	12
4.3. RECOMMENDATION	12
4.4. REFERENCES	13
5. RAJIFORMES – SKATES	14
<i>Andreas Winter</i>	
5.1. MANAGEMENT AND STOCK TRENDS.....	14
5.2. ALLOWABLE EFFORT AND VESSEL UNITS	15
5.3. REFERENCES	15
6. QUICK REFERENCE GUIDE TO VUM/GT CATEGORY	17
6.1. FALKLAND CALAMARI FISHERY (C).....	17
6.2. FINFISH FISHERY (A, G, W)	17
6.3. TOOTHFISH LONGLINE FISHERY (L).....	18
6.4. SKATE FISHERY (F).....	18
6.5. RESTRICTED FINFISH PELAGIC FISHERY (S).....	18

1. Foreword

The 2023 Licensing Advice document (Vessel Units, Allowable Effort, and Allowable Catch) summarizes licensing advice for all regulated fisheries in Falkland Islands Conservation Zones for 2023 apart from the B-licensed *Illex* fishery. Current licencing advices are based on data through the end of 2021 for finfish, toothfish and skates, and through the end of first season 2022 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* was fished for the full 1st season 2022, and obtained the second-highest catch total since 1995. Four of the past five 1st seasons have totalled over 40,000 tonnes *D. gahi* catch, and three of the past five 2nd seasons have totalled over 30,000 tonnes *D. gahi* catch. With stock levels continuing to show a robust status overall, allowable effort is set with the expectation of full seasons in 2023, and vessel units were calculated as the average of the past three years: 27.01.

Finfish license allocations have been changed significantly with the retirement of the effort index based on rock cod (*Patagonotothen ramsayi*) and shift towards a Total Allowable Catch system along the guidelines of the 2020 finfish external review. Total Allowable Efforts from 2021 (the last year before implementation of the current TAE / TAC protocol) were set as a baseline for continuity, but adjusted by target proportion and TAC proportion factors calculated from updated stock assessments of individual species. Finfish license allocations for 2023 reference finfish licenses to their FIG Ordinance statuses, with A license as unrestricted finfish, G license as *Illex* squid plus restricted finfish, and W license as restricted finfish. Accordingly, A license is the only license allocated to target-fish hake (*Merluccius* spp.). Hake comprised by far the greatest percentage of finfish catches in 2021 for the fifth consecutive year, resulting in a further increase to A license allocation, but further decrease to W license.

Patagonian toothfish (*Dissostichus eleginoides*) catch in the target longline fishery obtained 1009.3 tonnes in 2021, while bycatches in calamari trawls increased slightly and bycatches in finfish trawls continued to decrease from their peaks in 2017 and 2016. The current stock assessment estimates a spawning stock biomass (SSB) of 12,432 t toothfish and a ratio of 2021 SSB to unfished SSB of 0.484 – both slightly higher than the last year’s estimate. At a level >0.45 the SSB ratio is in the *expansion range* of the harvest control rules, for the second consecutive year. Harvest control rules require at least three consecutive years within the expansion range before a TAC can be considered for increase, therefore the 2023 TAC for toothfish is maintained at 1040 tonnes.

Skate (Rajiformes) total catch in 2021 of 1597 tonnes was slightly higher than in 2020, but still the second-lowest since 1998. 2021 was also the first year on record with a complete absence of skate target (F license) effort, in parallel to a new regulatory minimum trawl mesh of 400 mm for F-license fishing. To evaluate the potential for reactivating the skate fishery, four trawl surveys from 2013 to 2021 were analysed, with the results indicating that skate biomass in Falkland Islands waters may have decreased by 45% to 70% over that period. Given the hiatus in skate target fishing, and the change in regulatory mesh, the existing Vessel Unit protocol for F license cannot presently be maintained. Results of the survey analysis instead provided the recommendation that a skate TAC of 500 tonnes may be allocated, with use of

the new regulatory mesh, an approved fishing plan, and continuance of the exclusion zone to skate target fishing south of 51°S latitude.

Southern blue whiting (*Micromesistius australis*) commercial catches in Falkland Islands waters were in 2021 the lowest annual total on record for the fourth straight year, at 23 tonnes. Two tonnes were taken by W license, and 21 tonnes by X license. Additionally, 63 tonnes were taken under experimental license, of which 45.3 tonnes on one day of a survey that had actually been designated for skate. That opportunistic finding of southern blue whiting abundance instigated a preliminary survey for southern blue whiting, in September 2022, that suggested a substantial abundance. Licencing Advice for S (surimi) licence, which would specifically target southern blue whiting, is therefore maintained at the statutory TAC of 2,000 metric tonnes, but may be augmented by an FIFD-approved joint exploratory survey to estimate the southern blue whiting biomass fishable under commercial conditions.

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 late February; 2nd season (X licence), 64 days from late July. Since 2013 a flexible option also allows vessels to start and end either season as much as 6 days later, including compensatory days for deferred fishing days in-season. 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). Vessel allocations are calculated from 1st seasons, given the schedule for publishing licencing advice. Four of the last five 1st seasons were among the five highest for CPUE since at least 2004, when catch management was assumed by the FIFD (Winter and Skeljo 2022). Concurrently abundant biomasses are reflected in nil to low risks of season-end escapement failure (Table 2.1).

Table 2.1. Catches, estimated biomass, escapement risks, and VU allocations of Falkland calamari 1st seasons 2018-2022.

Year	1 st season calamari catch (t)	1 st season calamari biomass (t) ^a	Risk of <10,000 t escapement	Total VU allocation
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
2021	59,587	145,482	0.000	27.01
2022	59,587	242,913	0.000	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 2021), the total VU allocation for 2022 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 2020 to 2022 (Table 2.2). Since 2016 catchability coefficients have been calculated only on unsubstituted vessels, i.e. excluding vessels that had been entered as short-term substitutes for logistic or mechanical reasons.

Substitute vessels may be less experienced in the fishery and therefore have lower catch efficiency independently of their GT category.

Table 2.2. Parameters for average q-value calculations. Trends were visualized for the five years 2018 - 2022; q averages were calculated for the most recent three years 2020 – 2022.

Parameter	GT Cat	Year					3-year average
		2018	2019	2020	2021	2022	
Biomass		106,237	189,577	52,941	145,482	242,913	
Catch (t)	4	8812.7	11275.0	6674.6	15946.3	15864.5	
	5	12805.9	16712.5	8988.6	15570.2	14902.5	
	6	13121.6	18320.0	9307.3	19196.3	17752.6	
	7	7449.0	9225.3	4145.6	8450.5	7561.0	
Fishing days	4	239	232	251	283	299	
	5	297	294	322	217	242	
	6	292	303	318	273	307	
	7	123	124	121	110	115	
CPUE (t day ⁻¹)	4	36.9	48.6	26.6	56.3	53.1	
	5	43.1	56.8	27.9	71.8	61.6	
	6	44.9	60.5	29.3	70.3	57.8	
	7	60.6	74.4	34.3	76.8	65.7	
Catchability (q)	4	3.47e-4	2.56e-4	5.02e-4	3.87e-4	2.18e-4	3.69e-4
	5	4.06e-4	3.00e-4	5.27e-4	4.93e-4	2.54e-4	4.25e-4
	6	4.23e-4	3.19e-4	5.53e-4	4.83e-4	2.38e-4	4.25e-4
	7	5.70e-4	3.92e-4	6.47e-4	5.28e-4	2.71e-4	4.82e-4

Table 2.3. VU allocations per vessel.

Vessel Callsign	GT category	GT avg. q	VU allocation
ZDLC1	4	3.69e-4	1.53
ZDLC4	4	3.69e-4	1.53
ZDL D4	5	4.25e-4	1.75
ZDLE1	6	4.25e-4	1.76
ZDLF2	5	4.25e-4	1.75
ZDLM3 ^a	4	3.40e-4	^a 1.40
ZDLO1	6	4.25e-4	1.76
ZDLP1	5	4.25e-4	1.75
ZDLR1	6	4.25e-4	1.76
ZDLS3	5	4.25e-4	1.75
ZDLT1	4	3.69e-4	1.53
ZDLU1	6	4.25e-4	1.76
ZDLW3	4	3.69e-4	1.53
ZDLY ^b	7	4.14e-4	^b 1.71
ZDLZ	7	4.82e-4	1.99
ZDLZ1	6	4.25e-4	1.76
			27.01

^a Replacing a category 3 vessel, restricted to 92% of the season.

^b Three-way replacement between category 5 and 7 vessels, restricted to 86% of the season.

In 2022 1st season opened on February 23rd, and closed on schedule April 27th, with 19 compensatory days taken as late as May 1st. One vessel test-fished north of the Loligo Box for three days, and these catches were included with the regular season total (Winter and Skeljo 2022).

One category 4 vessel has been licensed to replace a category 3 vessel since 2019 (FIFD 2019), and is restricted to 92% of the season to offset its higher fishing capacity. One category 7 vessel had part of its allocation transferred to a newer category 5 vessel, and the allocation restriction was calculated at 86% (Table 2.3). By agreement in the Fisheries Advisory Committee (Winter and Ross 2022a, b), allocation restrictions for inter-category vessel replacements are kept to fixed percentages going forward.

2.3. References

- Arkhipkin, A.I., Middleton, D.A.J., Barton, J. 2008. Management and conservation of a short-lived fishery resource: *Loligo gahi* around the Falkland Islands. American Fisheries Society Symposium 49:1243-1252.
- Arreguin-Sanchez, F. 1996. Catchability: a key parameter for fish stock assessment. Reviews in Fish Biology and Fisheries 6:221-242.
- Barton, J. 2002. Fisheries and fisheries management in Falkland Islands Conservation Zones. Aquatic Conservation: Marine and Freshwater Ecosystems 12:127-135.
- FIFD. 2019. Vessel Units, Allowable Effort, and Allowable Catch 2020. Part I. Summary and recommendations. Fisheries Dept., Directorate of Natural Resources, Falkland Islands Government, 21 p.
- FIFD. 2021. Vessel Units, Allowable Effort, and Allowable Catch 2022. Summary and Recommendations. Fisheries Dept., Directorate of Natural Resources, Falkland Islands Government, 19 p.
- Winter, A., Ross, S. 2022a. VU options for permanent vessel replacement in the Falkland Islands calamari (*Doryteuthis gahi*) fishery. Fisheries Advisory Committee paper, June 2022, 3 p.
- Winter, A., Ross, S. 2022b. VU options for permanent vessel replacement in the Falkland Islands calamari (*Doryteuthis gahi*) fishery. Fisheries Advisory Committee paper, September 2022, 3 p.
- Winter, A., Skeljo, F. 2022. Stock assessment –Falkland calamari *Doryteuthis gahi* 1st season 2022. Technical Document, Falkland Islands Fisheries Department. 30 p.

3. Finfish

3.1. Introduction

Finfish trawl catch in the Falkland Islands is allocated by three licences: A (unrestricted finfish), G (*Illex* squid and restricted finfish), and W (restricted finfish). Specialized fisheries for toothfish, skates and surimi are separately allocated by L, F and S licences. In 2021, catch of major commercial species by A, G and W licences totalled 68,119 tonnes (Table 3.1).

Table 3.1. Catches in 2021 of commercial species targeted by finfish licences.

Species	Catch by Licence (tonnes)			
	A	G	W	
Common hake	30504.7	12102.5	16127.4	58734.5
Southern hake	0.0	0.3	3.6	3.9
<i>Illex</i> squid	78.0	4287.8	103.9	4469.7
Blue whiting	0.3	0.3	1.7	2.4
Hoki	13.7	275.5	1593.0	1882.2
Red cod	321.9	313.8	524.6	1160.2
Kingclip	694.8	434.3	562.6	1691.8
Rock cod	57.5	56.4	60.4	174.4
	31671.0	17470.8	18977.3	68119.1

Finfish licence allocations have, since last year, been set by Total Allowable Effort (TAE) adjusted by target proportion and TAC proportion factors (Winter et al. 2021, Winter 2022). One particular issue informing proportionality has been the predominant catch of hake (*Merluccius*) over the past few years by all three finfish licences (Table 3.1 in FIFD 2021), even though hake is allocated as a target species only to A licence under the Fisheries (Management and Conservation) Ordinance (FIG 2011). Also since last year, A licence has been reverted to the status of unrestricted finfish licence as originally established in the Ordinance (FIG 2011). All finfish effort allocations following in this document reference A licence as the unrestricted finfish licence.

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 species. VUs are then used to apportion the total VU allocation into fishing time.

The VUs from 2021 per finfish licence were multiplied by each of the proportion factors calculated by Winter (2022) to give the 2023 VUs. Note that VUs from 2021 were taken as the baseline; i.e., the last year prior to implementation of the current TAE / TAC protocol, not 2022; the first year of the current TAE / TAC protocol. If 2022 was taken as the baseline, then relative penalties / advantages among licences that were already effected last year would be compounded again (Winter 2022).

Table 3.2. 2023 VU allocation calculated from 2021 VU allocations.

Licence	2021 VU		target proportion		TAC proportion		2023 VU
A	12.20	×	1.000	×	1.961	=	23.93
G	12.77	×	0.677	×	1.303	=	11.26
W	14.27	×	0.338	×	0.745	=	3.60

VUs are translated to fishing time (vessel-days or vessel-months) by the vessel-units per month (VUMs), which are a function of catchability and available fish biomass. For 2023 VUMs are again considered constant since the year before, as catchability may be assumed to have not fundamentally changed, and available fish biomass is accounted for by the TAC proportion. Differences in fishing time allocated for 2023 are therefore directly proportional to differences in VU (Table 3.2), from 2021:

Table 3.3. Fishing effort VUM and allocated fishing time in vessel-months by GT category, for A licence, 2014 to 2023.

GT category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Fishing effort VUM										
3	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46
4	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46
5	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46
6	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46
7						0.46	0.46	0.46	0.46	0.46
Fishing time vessel-months										
3	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	48.7	52.0
4	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	48.7	52.0
5	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	48.7	52.0
6	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	48.7	52.0
7						26.6	26.6	26.6	48.7	52.0

Table 3.4. Fishing effort VUM and allocated fishing time in vessel-months by GT category, for G licence, 2014 to 2023.

GT category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Fishing effort VUM										
3	0.49	0.37	0.40	0.40	0.40	0.38	0.38	0.38	0.38	0.38
4	0.75	0.72	0.68	0.68	0.68	0.73	0.73	0.73	0.73	0.73
5	1.01	1.06	0.96	0.96	0.96	1.07	1.07	1.07	1.07	1.07
6	1.27	1.40	1.25	1.25	1.25	1.42	1.42	1.42	1.42	1.42
7						1.76	1.76	1.76	1.76	1.76
Fishing time vessel-months										
3	40.7	53.8	49.7	44.8	38.1	40.0	35.2	33.4	19.3	29.6
4	26.6	27.9	29.3	26.3	22.4	21.0	18.5	17.5	10.1	15.4
5	18.9	18.9	20.7	18.7	15.9	14.3	12.6	11.9	6.9	10.5
6	14.4	14.2	16.1	14.5	12.3	10.8	9.5	9.0	5.2	7.9
7						8.7	7.7	7.3	4.2	6.4

Table 3.5. Fishing effort VUM and allocated fishing time in vessel-months by GT category, for W licence, 2014 to 2023.

GT category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Fishing effort VUM										
3	0.23	0.27	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40
4	0.48	0.47	0.49	0.49	0.49	0.56	0.56	0.56	0.56	0.56
5	0.74	0.67	0.66	0.66	0.66	0.72	0.72	0.72	0.72	0.72
6	1.00	0.87	0.84	0.84	0.84	0.88	0.88	0.88	0.88	0.88
7						1.03	1.03	1.03	1.03	1.03
Fishing time vessel-months										
3	97.1	81.2	71.0	64.0	54.4	42.5	37.4	35.5	10.0	9.0
4	46.5	47.0	45.7	41.2	35.0	30.5	26.9	25.4	7.2	6.4
5	30.2	33.1	33.7	30.3	25.8	23.8	21.0	19.9	5.6	5.0
6	22.3	25.5	26.7	24.0	20.4	19.5	17.2	16.3	4.6	4.1
7						16.5	14.5	13.8	3.9	3.5

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 (not additive) total outcomes, for example, the W-licence fishery could be taken by Category 3 vessels fishing a total of 9.0 vessel-months or by Category 4 vessels fishing a total of 6.4 vessel-months or by Category 5 vessels fishing a total of 5.0 vessel months, etc.; or any fractional combination of these categories.

3.3. References

- Falkland Islands Fisheries Department (FIFD). 2018. Vessel Units, Allowable Effort, and Allowable Catch 2019. Summary and recommendations. Fisheries Dept., Directorate of Natural Resources, Falkland Islands Government, 21 p.
- Falkland Islands Fisheries Department (FIFD). 2021. Vessel Units, Allowable Effort, and Allowable Catch 2022. Summary and recommendations. Fisheries Dept., Directorate of Natural Resources, Falkland Islands Government, 19 p.
- Falkland Islands Government (FIG). 2011. Notices No. 84, 85, 87. Falkland Islands Gazette, Vol.20, No. 19, 30 September 2011.
- Winter, A., Clausen, A.P., Blake, A., Arkhipkin, A., Costelloe, T., Ross, S. 2021. Licencing advice and management proposals for Falkland Islands finfish for 2022. Part II. Fisheries Advisory Committee paper, September 2021, 19 p.
- Winter, A. 2022. Finfish licencing advice 2023. Fisheries Advisory Committee paper, June 2022, 11 p.

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 integrated statistical catch-at-age 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 the commercial trips and research surveys. 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, catch-at-age data for groundfish survey and calamari pre-season survey, and CPUE data for Spanish- and umbrella-system longline. CPUE is estimated in kg-per-umbrella, and standardized across a wide set of covariates (individual vessel, month, soak-time, depth, fishing region and number of hooks-per-umbrella).

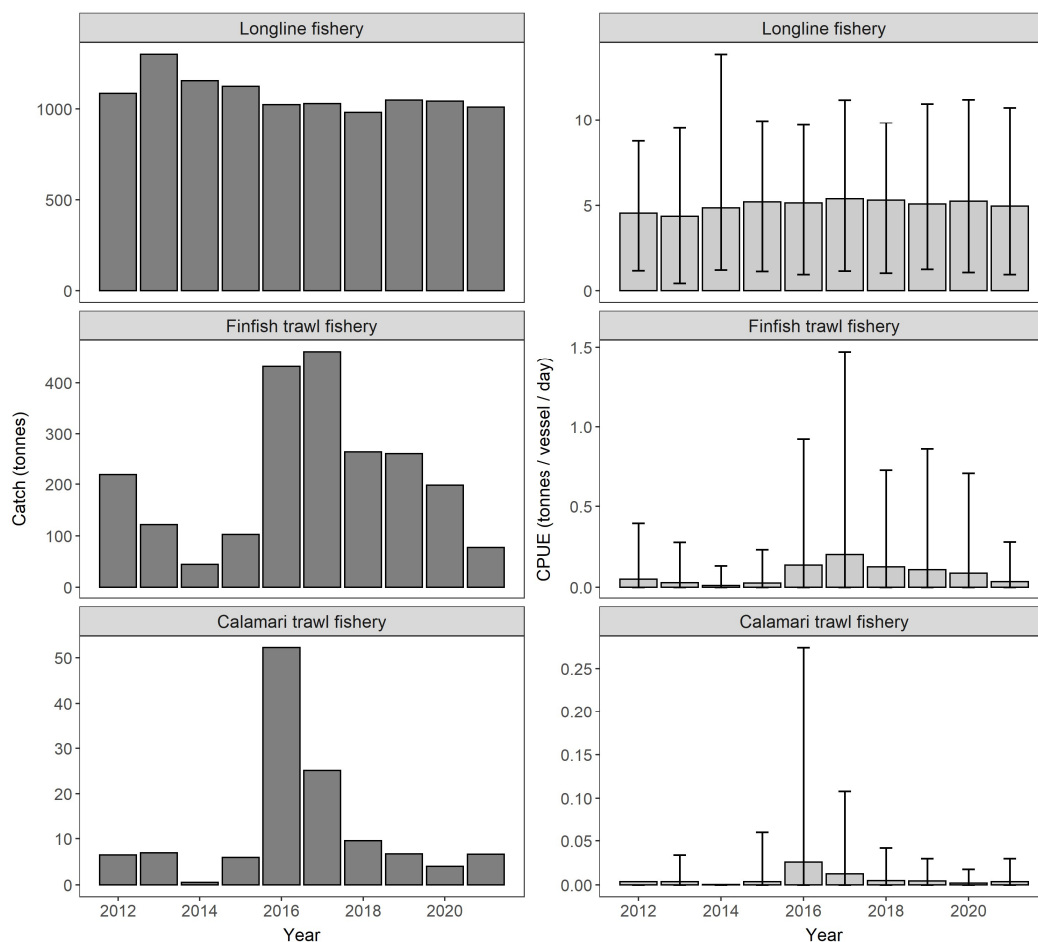


Figure 4.1. Time series of toothfish catches (left) and observed CPUE (right) for longline, finfish trawl and calamari trawl fisheries. Error bars are 95% quantiles of observed CPUE.

Reported toothfish catch in 2021 totalled 1094.6 tonnes, of which 92.2% was caught by longline (1009.3 t in 202 vessel-days), 7.1% by finfish trawl (77.3 t in 2106 vessel-days) and 0.6% by calamari trawl (6.6 t in 1870 vessel-days) (Figure 4.1). The remaining 0.1% (1.4 t) was caught under experimental licence. Combined toothfish bycatch in finfish and calamari trawl fisheries decreased compared to the previous year.

4.2. Stock assessment estimates

Key output parameters estimated by the 2021 toothfish stock assessment are summarised in Table 4.1.

Table 4.1. Key output parameters of the 2021 toothfish stock assessment model; Maximum Posterior Density estimates with corresponding Markov chain Monte Carlo credible intervals.

Parameter	MPD value	MCMC 95% CI
SSB ₀	25,691 t	22,729 - 35,422 t
SSB ₂₀₂₁	12,432 t	9,485 - 21,947 t
SSB ₂₀₂₁ /SSB ₀	0.484	0.416 - 0.626
MSY	1,728 t	1,529 - 2,383 t

The estimates of the initial spawning stock biomass (SSB₀) and the current spawning stock biomass (SSB₂₀₂₁) were 10.9% and 12.4% higher than in the previous year's assessment (SSB_{0 in 2020} = 23,169 t, SSB₂₀₂₀ = 11,056 t), while the SSB ratio in the final year (SSB₂₀₂₁/SSB₀) remained almost the same (SSB₂₀₂₀/SSB_{0 in 2020} = 0.477). According to the existing harvest control rules (HCR) (Farrugia and Winter 2018, 2019), the current SSB₂₀₂₁/SSB₀ of 0.484 places the stock in the expansion range. The future trend of SSB/SSB₀ ratio was projected based on the constant future annual catches (longline 1,040 t, finfish trawl 300 t, calamari trawl 30 t), and indicated that the ratio will remain in the HCR expansion range, on a levelled-off trend throughout the projection period.

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 1,728 t. Deducting from the MSY 300 t for finfish trawl and 30 t for calamari trawl fishery leaves 1,398 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.

4.3. Recommendation

Management advice is based on harvest control rules (HCR) established for the Falkland Islands toothfish longline fishery (Farrugia and Winter 2018, 2019). The estimated SSB₂₀₂₁/SSB₀ ratio of 0.484 is above upper target reference point (0.45), i.e. in the expansion range, and the projection suggests it will remain above 0.45 in the future. This is the second consecutive year with SSB ratio within the expansion range; at least three consecutive years within the expansion range are required before considering TAC alterations, therefore no action is anticipated by HCR at this point.

The recommendation for the toothfish longline fishery is to maintain the annual total allowable catch (TAC) at its current level of 1,040 tonnes.

4.4. References

Bull, B., Francis, R.I.C.C., Dunn, A., McKenzie, A., Gilbert, D.J., Smith, M.H., Bian, R., Fu, D. 2012. CASAL (C++ algorithmic stock assessment laboratory): CASAL User Manual v2.30-2012/03/21. NIWA Technical Report 135, 275 p.

Farrugia, T.J., Winter, A. 2018. 2017 Stock Assessment Report for Patagonian toothfish, Fisheries Report SA-2017-TOO. Fisheries Department, Directorate of Natural Resources, Falkland Islands Government, 35 p.

Farrugia, T.J., Winter, A. 2019. 2018 Stock Assessment Report for Patagonian toothfish, Fisheries Report SA-2018-TOO. Fisheries Department, Directorate of Natural Resources, Falkland Islands Government, 38 p.

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 has been regulated by total allowable effort (TAE) of licensed vessels. 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.

Total catch of skate in 2021 was slightly higher than in 2020, but still the second-lowest since 1998 (Figure 5.1). 2021 was also the first year on record with a complete absence of skate catch under target (F) license, which has been decreasing continually since 2014 (Figure 5.1). Therefore, a new catch / effort-based stock assessment was not calculated in 2022. Most skate in 2021 was caught under finfish (A, G and W) licenses, but representing no more than low single-digit percentages of the total commercial catches of these licenses (Table 5.1). The most recent stock assessment (Winter 2018) showed stable trends of the skate stock, while reviews of the skate assemblage (Arkhipkin et al. 2012, Winter et al. 2015) noted high population abundance, species diversity, and habitat structure. In contrast, an analysis of skate surveys indicated that since 2013 (the latest year examined by Winter et al. 2015) skate biomass in Falkland Islands waters may have decreased by 45% to 70% overall, with most individual species showing declines (Winter 2022).

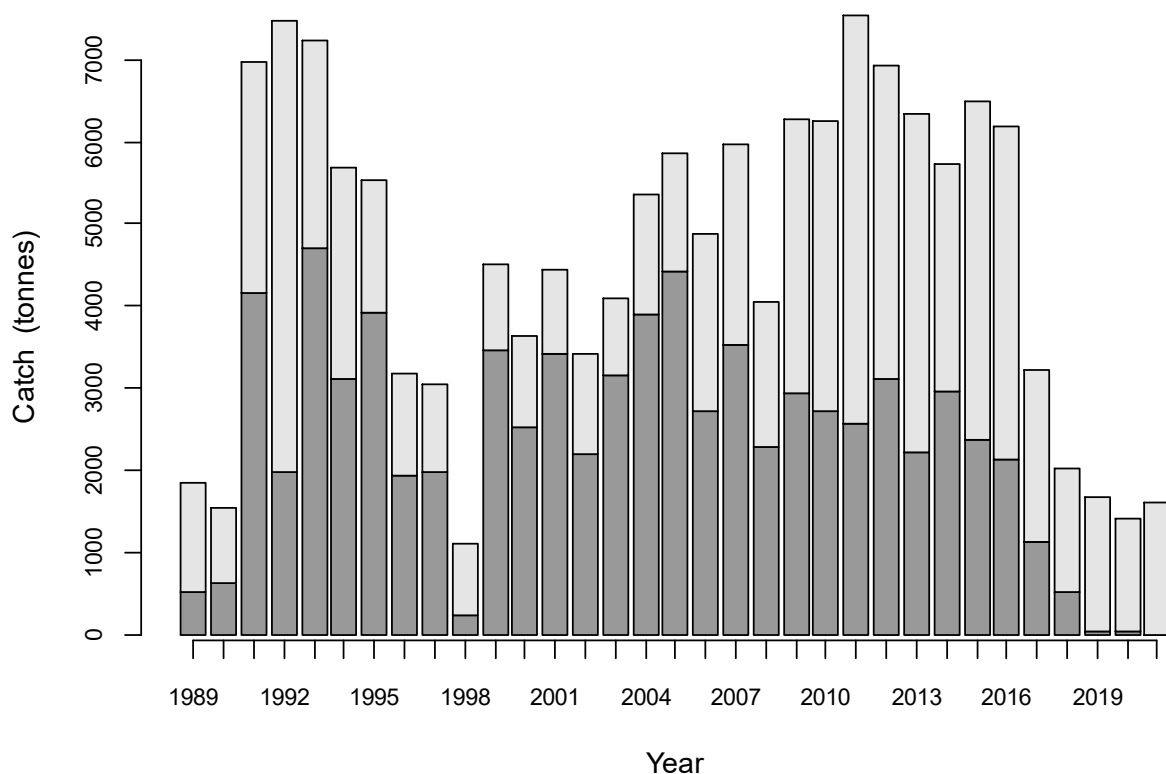


Figure 5.1. Target-licence catches (dark) and all catches (light grey) of skates, 1989 to 2021.

Table 5.1 [below]. Skate catch by fishing licence in 2021, and percentage that skate represented of each licence's total commercial catch.

Licence	Tonnes	% of commercial species catch
A	638.6	2.0
B*	3.5	0.3
C	7.5	< 0.1
E	10.7	0.7
G	261.9	1.5
L	33.7	3.1
O*	28.3	0.6
W	601.3	3.0
X	11.0	< 0.1
Total	1596.6	0.9

* Excluding jig fishing.

5.2. Allowable effort and catch

The general aim of Licencing Advice is to maintain fisheries at sustainable catch levels while mitigating year-to-year fluctuations in allocated effort. Vessel Units (VU) are therefore calculated over three-year rolling averages (FIFD 2021). However, the speculative use of F license in recent years has made the VU protocol impractical. Before ceasing completely in 2021, 59 fishing days under F license were recorded in 2020, of which only 2 reported >50% skate in the catch and only 12 reported even >10% skate in the catch. The year before, in 2019, 27 fishing days were recorded under F license, of which 9 reported >50% skate in the catch and 13 reported >10% skate in the catch. Furthermore, a regulatory minimum codend mesh size of 400 mm for skate target trawling, established in 2021 (Arkhipkin et al. 2021) (and thus never used commercially) would prevent any straightforward catch-per-unit-effort comparison with previous years.

The skate survey analysis recommended that with as much as 70% reduction of biomass, a precautionary limit on catch should be 30% of the most recent calculated MSY, which after deduction of bycatch, would leave approximately 500 tonnes TAC for F license (Winter 2022). Fishing this 500 tonne TAC should require use of the regulatory 400 mm mesh trawl codend, and a FIFD-approved fishing plan including the embarkation of a scientific observer. The fishing plan may also set other conditions pending the development of a National Plan of Action for Elasmobranchs. All F license fishing will continue to be excluded from south of 51°S latitude, established as a skate conservation area since 1996 (Agnew et al. 1999).

As noted above, setting a fishing days allocation corresponding to the TAC is impeded by the lack of comparability with previous skate trawl effort using smaller mesh. Under existing VU protocol, 158 F license days were technically available for 2022, and 114 F license days were technically available for 2021 (S. Ross, FIFD, personal communication). The 2018 and 2021 surveys with 400 mm mesh obtained skate catch rates in the range of 100 – 300 kg / hour (Arkhipkin et al. 2018, Parkyn et al. 2022). As F-licensed vessels often trawled 20+ hours per day (unpublished catch reports), these data suggest that the 2021 allocation of 114 license days would suffice to catch 500 tonnes of skate. A reprise of 114 F license days for 2023 is therefore recommended, subject to review as the commercial fishery progresses.

5.3. References

Agnew, D.J., Nolan, C.P., Pompert, J. 1999. Management of the Falkland Islands skate and ray fishery. In: Case studies of the Management of Elasmobranch Fisheries (R. Shotton, ed.), FAO, Rome, pp. 268-284.

- 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.
- Arkhipkin, A., Goyot, L., Trevizan, T., Derbyshire, C., Hall, J. 2018. Skate mesh trial survey, Fisheries Cruise ZDLV-10-2018. Falkland Islands Fisheries Department. Stanley, Falkland Islands, 31 p.
- Arkhipkin, A., Skeljo, F., Wallace, J., Derbyshire, C., Goyot, L., Trevizan, T., Winter, A. 2021. Industry-collaborative mesh trials to reduce bycatch in the Falkland Islands skate trawl fishery (Southwest Atlantic). *ICES Journal of Marine Science* /doi.org/10.1093/icesjms/fsab259.
- FIFD. 2021. Vessel Units, Allowable Effort, and Allowable Catch 2022. Summary and recommendations. Fisheries Dept., Directorate of Natural Resources, Falkland Islands Government, 19 p.
- Parkyn, D. C., Arkhipkin, A.I., Trevizan, T., Büring, T. 2022. Skate Survey and Mesh Trial. Fisheries Cruise ZDLV-10-2021. Falkland Islands Fisheries Department. Stanley, Falkland Islands, 35 p.
- Winter, A. 2018. Stock assessment – skates (Rajidae). Technical Report, Falkland Islands Fisheries Department. 14 p.
- Winter, A. 2022. Survey estimation of skate biomass. Fisheries Advisory Committee paper, September 2022, 15 p.
- Winter, A., Pompert, J., Arkhipkin, A., Brewin, P. 2015. Interannual variability in the skate assemblage on the South Patagonian shelf and slope. *Journal of Fish Biology* 87: 1449-1468.

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 allocations for 2021 to 2023.

Licence	2021 VU	2022 VU	2023 VU
A	12.20	22.39	23.93
G	12.77	7.34	11.26
W	14.27	4.01	3.60

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

GT category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Fishing effort VUM										
3	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46
4	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46
5	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46
6	0.46	0.46	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46
7						0.46	0.46	0.46	0.46	0.46
Fishing time vessel-months										
3	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	48.7	52.0
4	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	48.7	52.0
5	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	48.7	52.0
6	29.3	29.3	26.5	26.6	26.6	26.6	26.6	26.6	48.7	52.0
7						26.6	26.6	26.6	48.7	52.0

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

GT category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Fishing effort VUM										
3	0.49	0.37	0.40	0.40	0.40	0.38	0.38	0.38	0.38	0.38
4	0.75	0.72	0.68	0.68	0.68	0.73	0.73	0.73	0.73	0.73
5	1.01	1.06	0.96	0.96	0.96	1.07	1.07	1.07	1.07	1.07
6	1.27	1.40	1.25	1.25	1.25	1.42	1.42	1.42	1.42	1.42
7						1.76	1.76	1.76	1.76	1.76
Fishing time vessel-months										
3	40.7	53.8	49.7	44.8	38.1	40.0	35.2	33.4	19.3	29.6
4	26.6	27.9	29.3	26.3	22.4	21.0	18.5	17.5	10.1	15.4
5	18.9	18.9	20.7	18.7	15.9	14.3	12.6	11.9	6.9	10.5
6	14.4	14.2	16.1	14.5	12.3	10.8	9.5	9.0	5.2	7.9
7						8.7	7.7	7.3	4.2	6.4

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

GT category	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Fishing effort VUM										
3	0.23	0.27	0.31	0.31	0.31	0.40	0.40	0.40	0.40	0.40
4	0.48	0.47	0.49	0.49	0.49	0.56	0.56	0.56	0.56	0.56
5	0.74	0.67	0.66	0.66	0.66	0.72	0.72	0.72	0.72	0.72
6	1.00	0.87	0.84	0.84	0.84	0.88	0.88	0.88	0.88	0.88
7						1.03	1.03	1.03	1.03	1.03
Fishing time vessel-months										
3	97.1	81.2	71.0	64.0	54.4	42.5	37.4	35.5	10.0	9.0
4	46.5	47.0	45.7	41.2	35.0	30.5	26.9	25.4	7.2	6.4
5	30.2	33.1	33.7	30.3	25.8	23.8	21.0	19.9	5.6	5.0
6	22.3	25.5	26.7	24.0	20.4	19.5	17.2	16.3	4.6	4.1
7						16.5	14.5	13.8	3.9	3.5

6.3. Toothfish longline fishery (L)

TAC – 1,040 tonnes.

6.4. Skate fishery (F)

TAC – 500 tonnes, maximum 114 vessel-days pursuant to an approved fishing plan.

6.5. Restricted finfish – Pelagic fishery (S)

TAC for southern blue whiting – 2,000 tonnes plus FIFD-approved exploratory fishing.