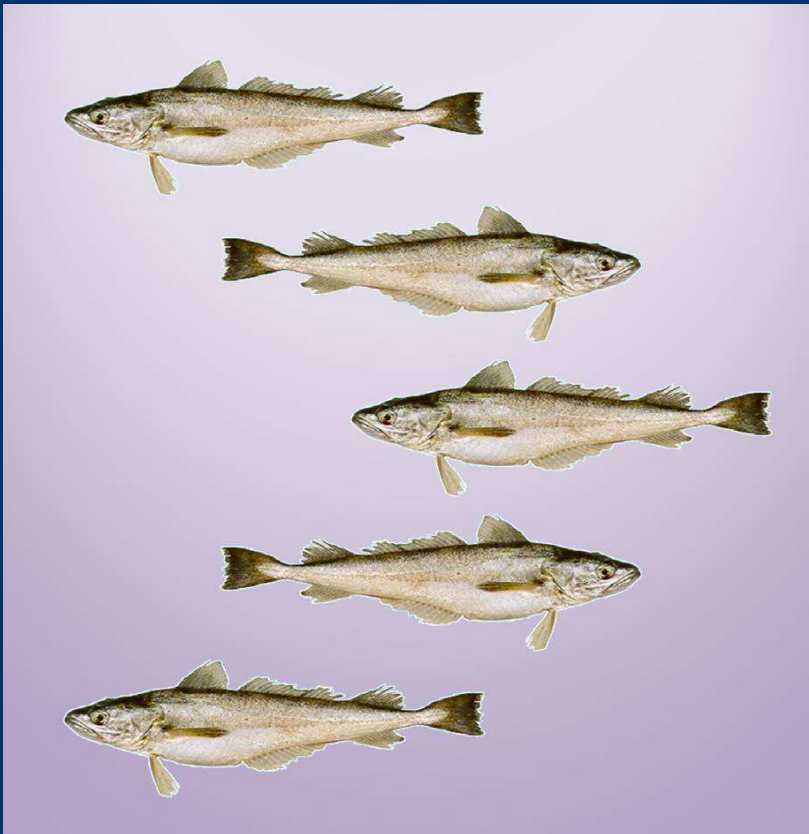


Stock Assessment Common Hake

Merluccius hubbsi



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Natural Resources - Fisheries
Falkland Islands Government
Stanley, Falkland Islands

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Stock assessment of common hake (*Merluccius hubbsi*) in the Falkland Islands

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Summary

Merluccius hubbsi commercial catches in Falkland Islands licenced fisheries were 43,246.2 tonnes in 2020; after 2019 the second-highest annual reported catch total since 1988. Following recommendations of the MacAlister Elliott & Partners external review, total allowable catch (TAC) was calculated according to the ICES category 5 advice rule: three-year average, for a species with landings data but not reliable indices from surveys or catch-per-unit-effort. The *M. hubbsi* TAC for 2022 is recommended at 41,137.9 tonnes.

Two parallel *D. gahi* and groundfish trawl surveys were conducted in July 2017 and 2020, around the time when *M. hubbsi* reaches its highest annual presence in Falkland Islands waters. Estimated *M. hubbsi* biomass in July 2017 was 109,069.2 tonnes, and estimated *M. hubbsi* biomass in July 2020 was 364,613.4 tonnes. The survey biomass increase from 2017 to 2020 is roughly equivalent to the ratio of total commercial catches in either year.

Introduction

Common hake *Merluccius hubbsi* is a benthopelagic species inhabiting the shelf and upper continental slope of the Southwest Atlantic Ocean, from Southern Brazil to Southern Argentina (Cohen et al. 1990, Arkhipkin et al. 2015). *M. hubbsi* migrate into western Falkland Islands waters in February, large numbers are then found to the west and north from March to May. In May, *M. hubbsi* is also found to the south and southeast, and its widest distribution occurs from July to September. Return migration from the southeast occurs in September; individuals are found to the northwest in October, and leave Falkland Islands waters in November (Arkhipkin et al. 2012, 2015). Falkland Islands waters have been identified as a feeding ground for this species (Arkhipkin et al. 2003), where post-spawning individuals occur mostly from March to June, and resting individuals from July to November (Arkhipkin et al. 2015). *M. hubbsi* is carnivorous; feeding on fish, squids, and macrozooplankton (Cohen et al. 1990). Females are larger than males, with maximum sizes in the Falkland Islands fishery at 102 cm total length for females and 90 cm total length for males; maximum age has been estimated at 18 years old (Arkhipkin et al. 2015).

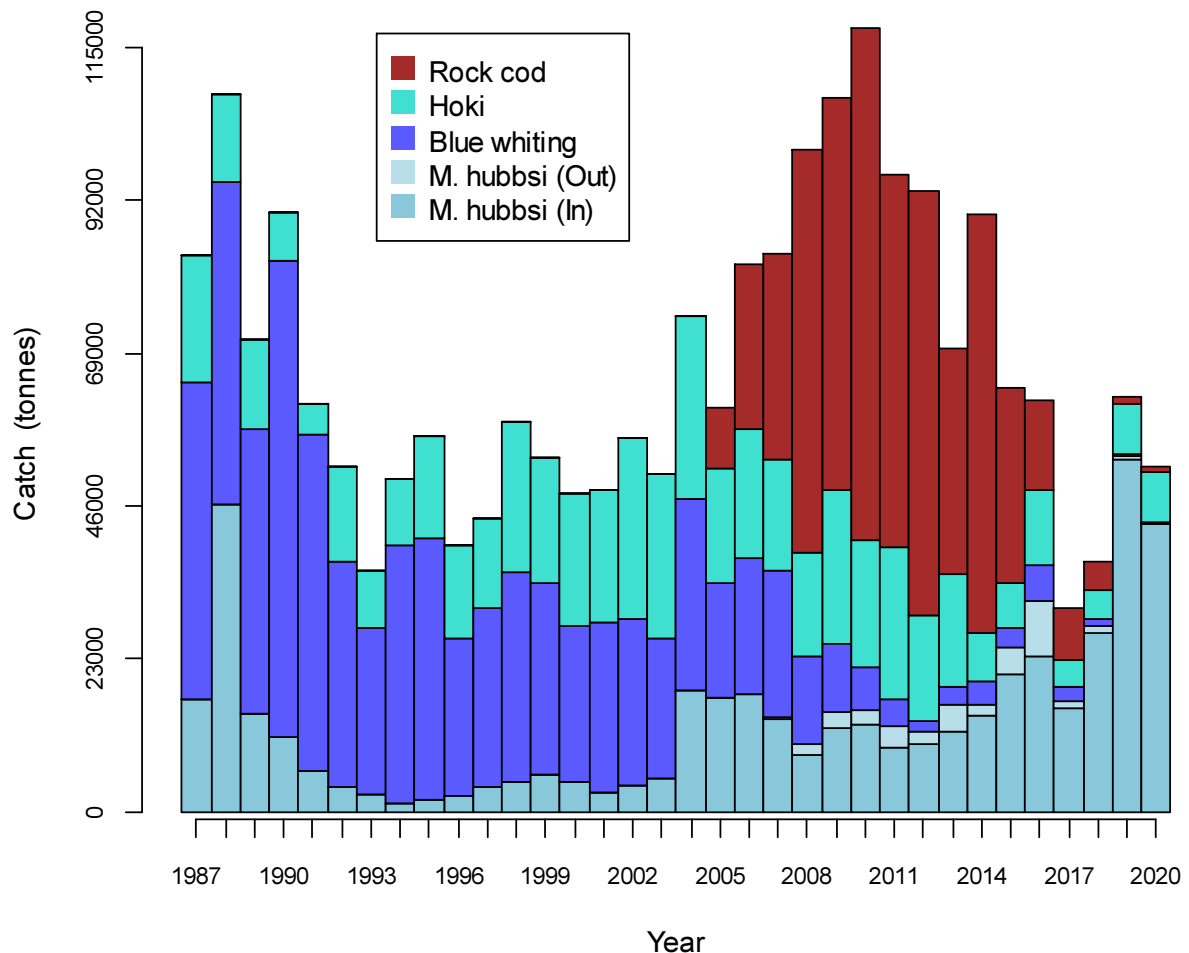


Figure 1. Annual commercial catches of *M. hubbsi* and other major groundfish target species from FIFD catch reports. *M. hubbsi* (out) are *M. hubbsi* caught outside the Falkland Islands conservation zones but reported to the FIFD (as required for Falkland-flagged vessels), and entered in the database as licence category “O”. Blue whiting, hoki, and rock cod are totalled irrespective of licence category.

M. hubbsi is commercially fished in both Falkland Islands and Argentine waters, and the migratory life cycle of this species suggests that it is the same stock: the southern or Patagonian stock. Falkland Islands fisheries have been reporting hake catches since 1987, whereby *M. hubbsi* was not always distinguished from its rarer congeneric *Merluccius australis* (FIG 1989). Except for 1988, hake was a relatively low catch compared to hoki and southern blue whiting until about 2005, just before rock cod became predominant (Figure 1). Following the decline of rock cod *M. hubbsi* has been the highest finfish catch species and since 2018, has annually totalled more finfish catch tonnage in Falkland Islands waters than all other species together (FIG 2020).

Methods

ICES advice rules

In 2020, hake was included in the Falkland Islands Government finfish stock assessment and management review conducted by MacAlister Elliott & Partners Ltd, UK (MEP 2020). The MEP report recommended stock assessments for most commercial finfish species to be based on the ICES advice rules (ICES 2012, 2018), referencing applicable categories of data availability and quality.

In relation to its annual cycle, *M. hubbsi* is mostly absent from Falkland Islands waters during February (Arkhipkin et al. 2012). A biomass index of the February surveys (Ramos and Winter 2020) would therefore be likely to reflect migratory timing rather than abundance. Commercially, the Falkland Islands hake fishery is a relatively small proportion compared to the Argentine hake fishery (Figure 2), and a catch-per-unit-effort index of the Falkland Islands fishery alone cannot be implemented. Stock assessment using a data-poor method (CMSY) produced high margins of uncertainty (Winter and Ramos 2020). For these reasons *M. hubbsi* was advised at category 5, as a species for which landings data are available, but not reliable indices from surveys or catch-per-unit-effort.

Under category 5 the recommended assessment framework is based on the average catches^a from the last 3 years (MEP 2020). Year-to-year change is further limited to an ‘uncertainty cap’ of $\pm 20\%$ (ICES 2018). Falkland Islands-licensed catches for any species are available routinely from the Fisheries Department database. However, Falkland Islands commercial fisheries were not required to separately report *M. hubbsi* and *M. australis* catches before 2015 (A. Blake, Falkland Islands Fisheries Department [FIFD], pers. comm.), and the two species remain difficult to distinguish (Cousseau and Cotrina 1980). Hake catches were therefore first combined between the two species and then proportioned according to a LOESS smooth (degree = 2, span = 0.90) of observer catch composition samples^b. For comparison, Argentine commercial *M. hubbsi* catches of the stock south of 41°S^c were summarized from Sánchez et al. 2012, Navarro et al. 2014, 2019, and the website of the Ministerio de Agricultura, Ganadería y Pesca^d (Table A2).

Surveys

^a It is not explicitly stated in the reference but inferred that ‘average’ catches signifies the ‘mean’ of the annual total catches, by weight.

^b As observer coverage is variable from year to year, it is understood that this approach introduces a certain amount of stochasticity into the estimation.

^c Which is the stock that migrates to Falkland Islands waters (Arkhipkin et al. 2015).

^d www.magyp.gob.ar/sitio/areas/pesca_maritima/desembarques/

In two recent years groundfish trawl surveys have been conducted during July for the primary purpose of apprehending hake (Gras et al. 2017, Randhawa et al. 2020). Like the February surveys, these July surveys were also paralleled with *D. gahi* pre-season surveys (Winter et al. 2017, 2020) for a complete inventory of the Falkland Islands fishing zone. *M. hubbsi* biomass estimates were calculated from these survey data according to the inverse distance weighting methods described in Ramos and Winter (2020). While two sets of data cannot serve as a time series index, they provide a baseline for the recent biomass of *M. hubbsi* in Falkland Islands waters.

Results

Catch

The annual commercial *M. hubbsi* catch tonnage had a statistically significant negative linear correlation between the Falkland Islands and Argentina ($p = 0.043$, $R^2 = 12.2\%$; Figure 2, Tables A1 and A2).

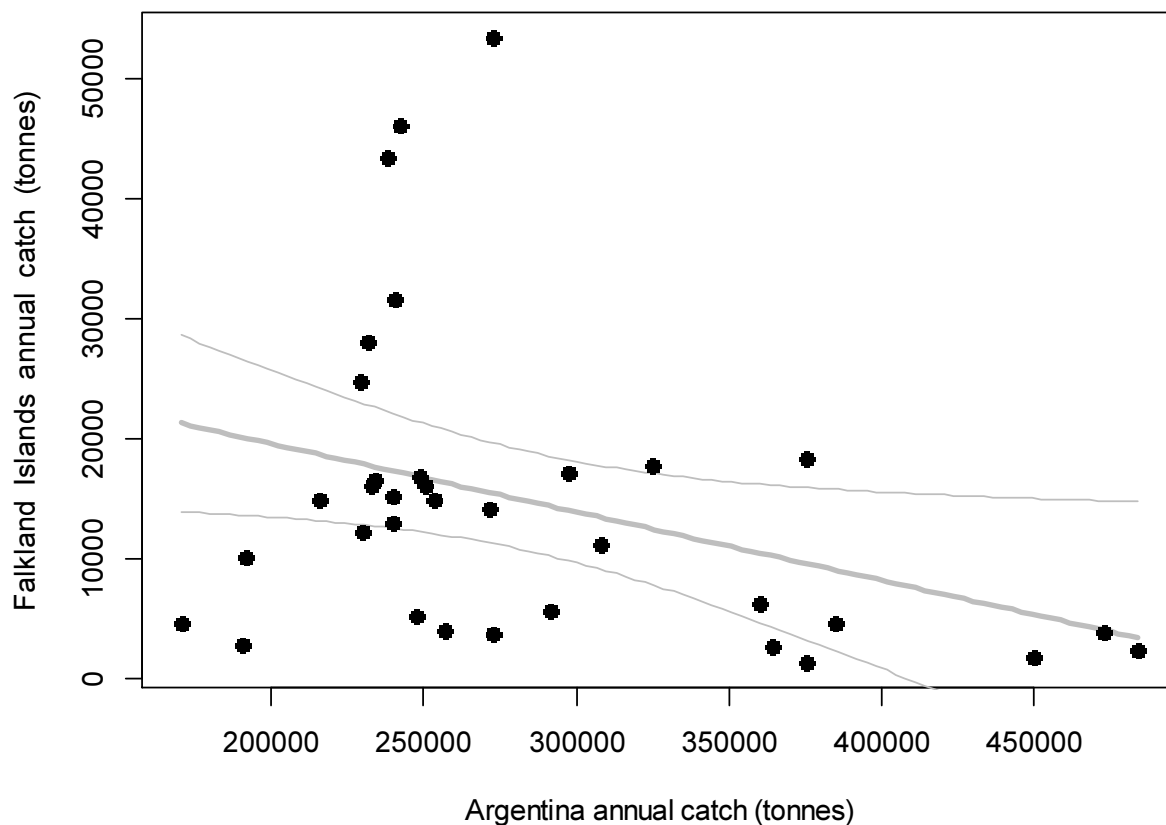


Figure 2. Annual commercial *M. hubbsi* catches of Argentina vs. the Falkland Islands (in-zone + out-zone), 1987 to 2020, with linear regression and 95% confidence intervals.

During 2020 a total of 43,503.3 tonnes *M. hubbsi* were reported caught in the Falkland Islands fisheries, with catch by licence distributions shown in Table 1. Nearly half of all Falkland Islands *M. hubbsi* catch was under A licence; the designated target licence for this

species. Together, the three finfish licences A, G and W accounted for 97.3% of the *M. hubbsi* catch. Among 748 A-licence catch reports in 2020, *M. hubbsi* was the highest catch species on 741 and the second-highest on 6 catch reports (91.4% of total A-licence catch). Among 506 G licence catch reports in 2020, *M. hubbsi* was the highest catch species on 260 and the second highest catch species on 93 catch reports (62.0% of total G-licence catch). Among 735 W-licence catch reports in 2020, *M. hubbsi* was the highest catch species on 433 and the second-highest on 24 catch reports (58.0% of total W-licence catch). And among 59 F-licence catch reports in 2020, *M. hubbsi* was the highest catch species on 47 and the second-highest on 5 catch reports (73.2% of total F-licence catch).

Table 1. Falkland Islands *M. hubbsi* catches by licence in 2020.

Code	Licence Type	<i>M. hubbsi</i> catch	
		Tonnes	%
A	Unrestricted finfish	20863.1	47.9
G	Restricted finfish + <i>Illex</i>	8254.1	19.0
W	Restricted finfish	13236.1	30.4
F	Skate	493.6	1.1
C	Calamari 1 st season	117.5	0.3
X	Calamari 2 nd season	255.7	0.6
B	<i>Illex</i> squid	^e 26.1	0.1
L	Toothfish longline	0.0	0.0
E	Experimental	83.4	0.2
O	Other (outside)	198.8	0.5
Total		^f 43503.3	100.0

Category 5

M. hubbsi catches for calculating the last three years' average are the in-zone catches summarized in Table A1, as these are the catches subject to licencing:

$$\begin{aligned} \text{TAC-5}_{2022} &= \overline{\text{Catches}_{2018 \text{ to } 2020}} \\ &= \frac{26847.7, 53054.3, 43221.2}{3} = 41,041.1 \text{ tonnes.} \end{aligned}$$

Note that the year jumps from 2020 to 2022. Standard procedure is to inform *next* year's allowable catch with data up to the last completed year, i.e., the *previous* year, as licencing advice must be issued while the *current* year is still in progress.

TAC-5₂₀₂₂ is a less than 20% reduction from the total *M. hubbsi* in-zone catch in 2020 (which was still allocated by total allowable effort), and therefore should represent the effective total allowable catch (without need of an uncertainty cap).

Surveys

^e B-licence hake catch was taken by trawling only, not jigging.

^f The difference between this total and the sum of 2020 licenced catches in Table A1 (in-zone + out-of-zone) is the E-licence catches.

Trawl effort and *M. hubbsi* catches of the July 2017 and 2020 surveys are summarized in Table 2. The estimated survey biomass of *M. hubbsi* was 3× greater in July 2020 than July 2017, a similar ratio compared with the survey catches (Table 2: 85,652.1 vs. 26,653.1 kg ≈ 3.2×) and the annual commercial catches (Figure 1: 43,451.3 vs. 16,563.8 t ≈ 2.6×). In contrast February survey biomass estimates were 3.7× lower in 2020 than 2017 (Table III in Ramos and Winter 2020), a difference which may relate to the timing of *M. hubbsi*'s movement. In both July 2017 and July 2020, *M. hubbsi* was mainly distributed to the north-west and west of West Falkland Island, in particular near the limit of the FICZ. In July 2020, the second area of high concentration due west was more strongly defined than in July 2017 (Figure A1).

Table 2. July survey trawl effort, *M. hubbsi* catches, and *M. hubbsi* Falkland Islands zone biomass estimates ± 95% confidence intervals.

Year	Survey	Trawls	Catch (kg)	Biomass (t)
2017	groundfish	74	18323.6	109069.2 (92295.3 – 142922.4)
	<i>D. gahi</i>	^g 59	8329.5	
2020	groundfish	^h 33	19907.1	364613.4 (238247.1 – 502733.4)
	<i>D. gahi</i>	55	65744.9	

Conclusion

Because of the current high volume of hake catches, A licence has been redirected from the status of unrestricted finfish licence to *de facto* hake licence over the past two years (FIFD 2019, 2020). The redirected status obtained that A licence was exempt from effort adjustments in relation to the finfish index species (rock cod), but also that any species caught under A licence other than *M. hubbsi* and *M. australis* would be subject to regulation as bycatch. For restricted finfish and skate licences hakes remain ostensibly categorized as bycatch, although also representing the highest catches in the past few years (FIFD 2019, 2020). Accordingly, hakes are suitable species for management by total allowable catch, subject to partitioning among licences.

TAC-5₂₀₂₂ = 41,041.1 tonnes is recommended as the total allowable catch for *M. hubbsi*. TAC-5₂₀₂₂ represents a decrease of 5.04% from the catch in 2020, thus corresponding to a conservative catch limit.

^g An additional one-day transect of four trawls was taken in shallow inshore waters to sample for juvenile toothfish. These four trawls were not included in analyses as their locations were not relevant to the distribution of *M. hubbsi*.

^h Twelve additional trawls were conducted on the high seas (out-of-zone) during the July 2020 survey; these high seas survey trawls were not included in the analyses.

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Appendix

Table A1. Falkland Islands commercial *M. hubbsi* catches (excluding E licences) by year. Equivalent to the *M. hubbsi* (out) and *M. hubbsi* (in) bars in Figure 1.

Year	<i>M. hubbsi</i> catch (tonnes)		Year	<i>M. hubbsi</i> catch (tonnes)	
	Out-of-zone	In-zone		Out-of-zone	In-zone
1987	0.0	16774.8	2004	0.0	18362.3
1988	0.0	46138.3	2005	0.0	17175.0
1989	0.0	14825.7	2006	0.0	17689.3
1990	0.0	11131.7	2007	126.3	13983.1
1991	0.0	6245.9	2008	1417.9	8668.7
1992	0.0	3628.9	2009	2434.1	12507.5
1993	0.0	2704.5	2010	2117.2	13118.2
1994	0.0	1275.9	2011	3328.7	9571.1
1995	0.0	1806.5	2012	1997.5	10136.6
1996	0.0	2413.8	2013	4050.8	12070.2
1997	0.0	3783.7	2014	1572.7	14516.4
1998	0.0	4521.1	2015	4001.9	20762.4
1999	0.0	5666.5	2016	8183.0	23491.0
2000	0.0	4511.8	2017	1039.1	15553.4
2001	0.0	2797.0	2018	1113.1	26847.7
2002	0.0	4005.5	2019	358.6	53054.3
2003	0.0	5133.4	2020	198.8	43221.2

Table A2. Argentine commercial *M. hubbsi* catches by year, of the stock south of 41°. From Sánchez et al. 2012, Navarro et al. 2014, 2019, and the Ministerio de Agricultura, Ganadería y Pesca website.

Year	<i>M. hubbsi</i> catch (tonnes)	Year	<i>M. hubbsi</i> catch (tonnes)
1987	248641.5	2004	375525.8
1988	242057.4	2005	297527.6
1989	253357.5	2006	324886.9
1990	308040.8	2007	271760.9
1991	360026.0	2008	191777.2
1992	272907.0	2009	215638.6
1993	364149.8	2010	239699.0
1994	375532.0	2011	240115.1
1995	449947.1	2012	230153.8
1996	483769.2	2013	250227.1
1997	472834.0	2014	232946.6
1998	384615.3	2015	229318.3
1999	291690.0	2016	240127.0
2000	170435.3	2017	234180.7
2001	190786.4	2018	231655.7
2002	256674.6	2019	272453.7
2003	247343.2	2020	238296.9

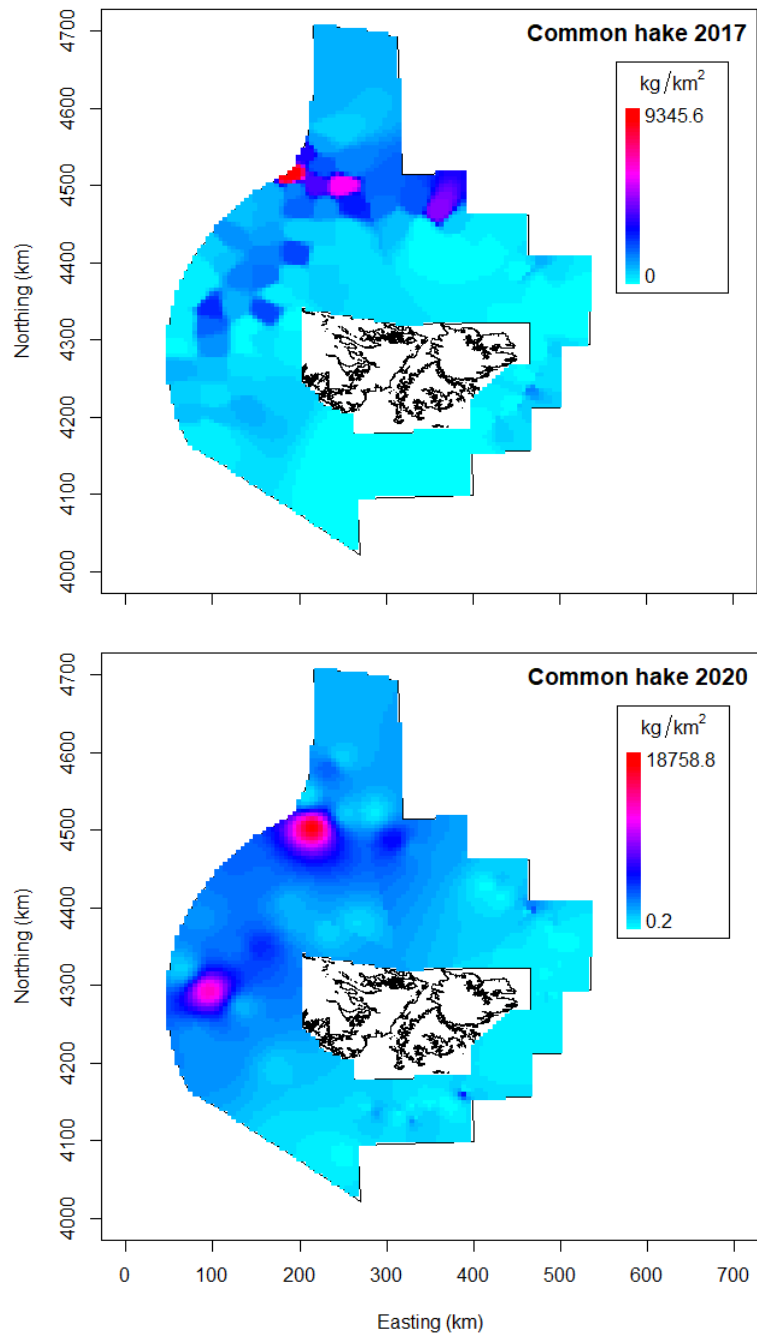


Figure A1. Densities of *M. hubbsi* modelled by inverse distance weighting throughout the Falkland Islands fishing zone, in July 2017 and July 2020.