Stock Assessment of kingclip (*Genypterus blacodes*) in the Falkland Islands

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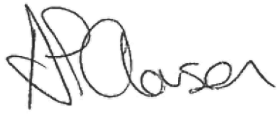

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Summary

Commercial catches of kingclip *Genypterus blacodes* in Falkland Islands licenced fisheries were 1,620 tonnes (t) in 2020; the third lowest catch over the past 10 years. Following recommendations of the MacAlister Elliott & Partners external review, Total Allowable Catch (TAC) was calculated according to the ICES category 5 assessment framework: three-year catch average, for a species with landings data but not reliable indices from surveys or catch-per-unit-effort. The kingclip TAC for 2022 is recommended at 1,587 t.

Introduction

Kingclip (*Genypterus blacodes*, Ophidiidae) is a demersal fish that occurs at 100–700 m depth in temperate waters of the shelf and slope of New Zealand, southern Australia and South America (Nyegaard et al. 2004). In South America, *Genypterus blacodes* occurs in the Southeast Pacific and the Southwest Atlantic; however, there is no evidence that this is one shared stock. In the Southwest Atlantic, kingclip starts migrating in austral autumn (April to June) from Argentine waters into Falkland Islands waters, and is most abundant in its feeding grounds to the north, northwest, and west of Falkland Islands waters during winter (July to September) and spring (October to December) (Falkland Islands Government 2021). In Falkland Islands feeding grounds, kingclip preys upon a range of species including rock cod *Patagonotothen* spp., hoki *Macruronus magellanicus*, and benthic isopods (Nyegaard et al. 2004). During summer (January to March), approximately two thirds of the kingclip adult population move out of Falkland Islands waters to spawn (Arkhipkin et al. 2012). Based on the migratory behaviour of kingclip in the region it is assumed that Falklands and Argentine fisheries catch the same stock. This species is a valuable bycatch in both nations' commercial fisheries, with most of the catch historically taken by the Argentine fishery; however, this difference has decreased since 2016 with the decline of Argentine kingclip catches (Fig. 1). For instance, during 2020 a total of 2,921 tonnes (t) were caught in Argentina (MAGYP 2021), and 1,620 t were caught in the Falkland Islands (Falkland Islands Government 2021).

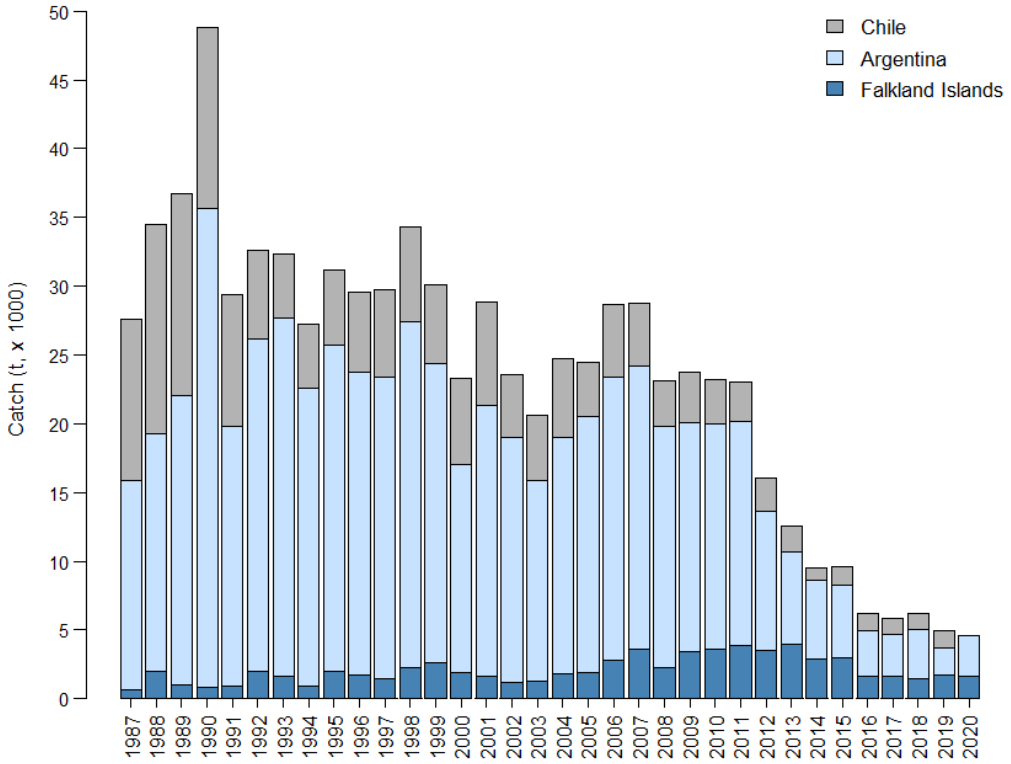

Figure 1. Annual commercial catch of kingclip *Genypterus blacodes* in Falkland Islands, Argentine and Chilean waters. Kingclip catch data from Chile were not available for 2020 at the time of producing this report.

Methods

ICES advice rules

In 2020, kingclip 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.

Kingclip research survey and commercial catch data from Falkland Islands waters are available but may not be appropriate for biomass estimates. Demersal research surveys are conducted every February through the north, west and southwest of Falkland Islands waters; however, approximately two thirds of the kingclip adult population carry out a reproductive migration out of Falkland Islands waters in summer (Arkhipkin et al. 2012). A biomass index estimated from the February research surveys (Ramos & Winter 2020) would thus be inaccurate. Since 1987, the Falkland Islands fishery has contributed only a small proportion (~16%) to the kingclip annual production in the Southwest Atlantic (Fig. 1), and a catch-per-unit-effort index for this bycatch species in the Falkland Islands fishery alone is not appropriate. In addition, stock assessment using data-poor methods (OCOM and CMSY) produced high margins of uncertainty (Ramos & Winter 2019).

For these reasons, a category 5 assessment framework was recommended for kingclip (MEP 2020), as a species for which landings data are available but with no reliable abundance indices from surveys or the fishery. The category 5 assessment framework is based on the average catches from the 3 previous years (MEP 2020). Therefore, Total Allowable Catch (TAC) for the year 2022 was estimated based on the in-zone average catch from 2018 to 2020, excluding experimental (E–licence) and out-of-zone catches (O–licence), although no kingclip catches were reported out-of-zone during those years (Table AI). Standard procedure is to inform next year's TAC 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:

$$TAC_{2022} = \frac{Catch_{2018} + Catch_{2019} + Catch_{2020}}{n_{years\ (2018-2020)}}$$

Year-to-year change is further limited to an 'uncertainty cap' of ±20% (ICES 2018). Kingclip catch data from Falkland Islands waters were retrieved from the Falkland Islands Fisheries Department database.

For catch comparison, Argentine commercial kingclip catches were summarized from Sánchez et al. (2012), Navarro et al. (2014, 2019), and MAGYP (2021) (Table AI). LOESS (span = 0.75, degree = 2) was implemented to examine the pattern of the association between Falkland Islands and Argentine commercial annual catches of kingclip from 1987 to 2020. Chilean commercial kingclip catches were summarized from SERNAPESCA (1990, 2000, 2011, 2021).

Demersal research surveys were also conducted through the north, west and southwest of Falkland Islands waters during July 2017 and July 2020 (Gras et al. 2017; Randhawa et al. 2020), at the time of the year when kingclip abundance is relatively high. Like the February surveys, these July surveys were paralleled with the *Doryteuthis gahi* pre-season surveys (Winter et al. 2017, 2020) to cover the fishing zone. Kingclip biomass estimates were calculated from these survey data according to the inverse distance weighting method

described in Ramos & Winter (2020). While two sets of data cannot serve as a time series index, they provide a baseline for the recent biomass of kingclip in Falkland Islands waters.

Results

Catch

Kingclip catches in Falkland Islands waters have been on average 2,074 t per year since 1987, representing approximately 16% of the Falkland Islands and Argentina combined annual catch. However, this proportion has increased to an average of 36% since 2016 due to the decline of Argentine catches. During 2020 a total of 1,625 t of kingclip were reported caught in Falkland Islands waters, of which 1,620 t were caught under commercial licences, i.e. excluding the experimental E–licence. Nearly 40% of all Falkland Islands kingclip catch was under A–licence, and 35% was under W–licence. The three finfish licences (A–, G– and W–licences) together accounted for 94.5% of the total kingclip catch (Table I).

Table I. Catches by licence of kingclip *Genypterus blacodes* in Falkland Islands during 2020.

Licence		Catch	
Code	Type	Tonnes	%
A	Unrestricted finfish	635	39.08
W	Restricted finfish	572	35.20
G	Restricted finfish and *Illex*	328	20.18
F	Skates and rays	77	4.74
E	Experimental	5	0.31
X	Calamari 2nd season	4	0.25
C	Calamari 1st season	2	0.12
B	*Illex* squid	2	0.12
L	Toothfish (longline)	0	0.00
S	Southern blue whiting and hoki	0	0.00
O	Outside Falkland Islands waters	0	0.00
Total		1625	100.00

Two phases were observed in the association between Falkland Islands and Argentine kingclip catches. There was an increasing trend in Falkland Islands catches when Argentine catches were low, and a declining trend in Falkland Islands catches when Argentine catches were higher (Fig. 2; Table AI). The contrast was statistically significant at $p < 0.05$.

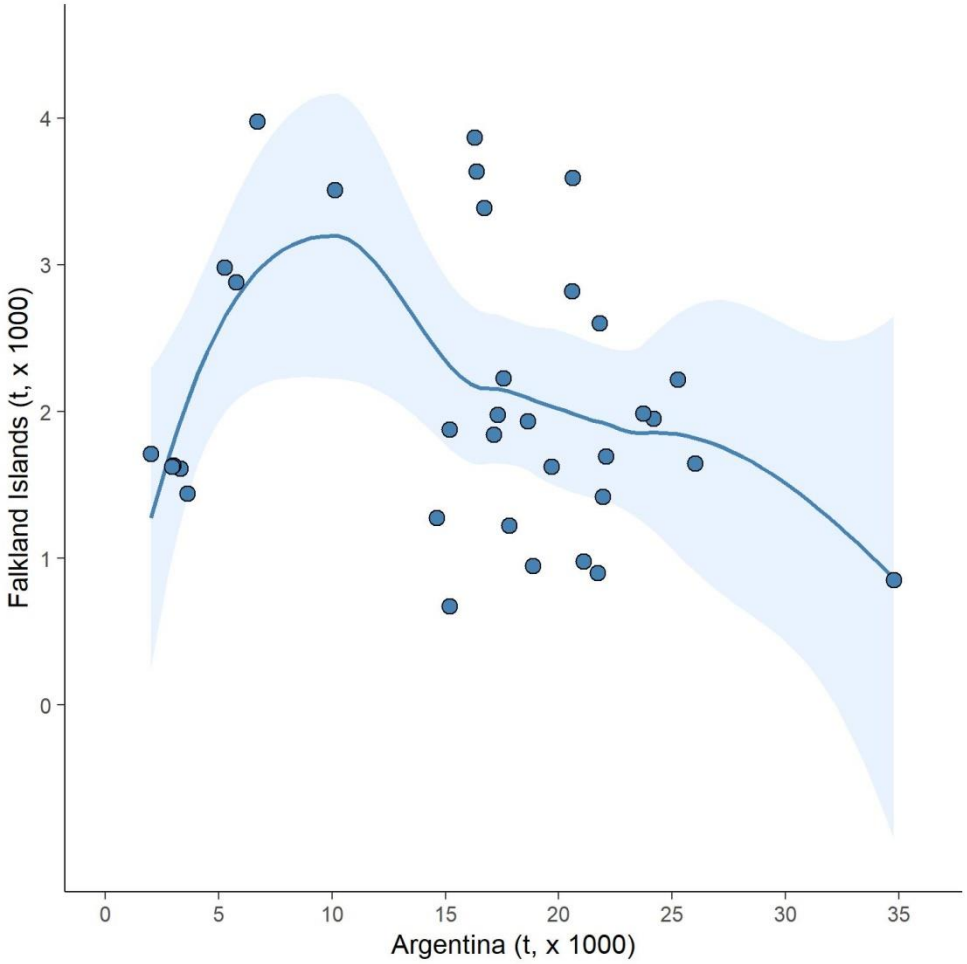

Figure 2. Annual commercial catches of kingclip *Genypterus blacodes* in Argentina vs. the Falkland Islands from 1987 to 2020. Blue line is LOESS smooth ± 95% confidence intervals.

Total Allowable Catch

Total Allowable Catch (TAC) for the year 2022 under the ICES category 5 assessment framework was estimated at 1,587 t.

$$TAC_{2022} = \frac{Catch_{2018} + Catch_{2019} + Catch_{2020}}{n_{years\ (2018-2020)}}$$

$$TAC_{2022} = \frac{1439 + 1702 + 1620}{3} = 1587\ t$$

TAC_{2022} is a less than 20% reduction from the total kingclip in-zone catch in 2020 (which was still allocated by Total Allowable Effort), and therefore should represent the effective TAC without need of an uncertainty cap.

Surveys

In both July 2017 and July 2020, kingclip was mainly distributed to the north-west and west of West Falkland Island (Figure A1). The estimated biomass of kingclip in the July 2020 survey (35,243.69 t) was 73% greater than in the July 2017 survey (20,419.63 t) (Table II). 95% confidence intervals were computed from the randomized re-samples of the inverse-distance weighting algorithm, which also provided an estimate of significance of the difference between July 2017 and July 2020. A total of 27,005 out of 30,000 paired re-samples had higher biomass estimate values in July 2020 than in 2017, thus marginal at $p < 0.10$ but not significant at $p < 0.05$. CPUE estimates suggest greater concentration of kingclip in the '*Loligo box*' (where the *D. gahi* pre-season survey takes place) during July 2020 than in July 2017. The difference in commercial annual catches between 2020 (1,620 t) and 2017 (1,624 t) was only 0.24%, but the commercial outcome is qualified by kingclip not being a primary target in any year. For comparison, the February survey biomass estimate in 2020 (14,886.91 t) was 21.8% less than the February survey biomass estimate in 2017 (19,034.72 t; Table III in Ramos & Winter 2020) but this difference was not significant ($p > 0.10$). Differences in biomass estimates between February and July surveys are likely due to the migratory pattern of kingclip.

Table II. July surveys trawl effort, and catch, CPUE and biomass estimates (mean ± 95% confidence intervals) of kingclip *Genypterus blacodes* in Falkland Islands waters.

Year	Survey	Trawls (n)	Swept area (km^2)	Effort (h)	Catch (kg)	CPUE (kg/h)	Biomass (t)
2017	Groundfish	74	15.40	74	4087.50	55.23	20419.63 (5269.48 – 36691.49)
	D. gahi	[a]59	54.70	114	70.15	0.61	
	Total	133	70.10	188	4157.65	22.11	
2020	Groundfish	[b]33	7.14	33	1836.44	55.64	35243.69 (20200.95 – 50152.81)
	D. gahi	55	98.57	101	709.09	7.02	
	Total	88	105.71	134	2545.53	18.99	

[a]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 kingclip.

[b]Twelve additional trawls were conducted in high seas during the July 2020 survey; these trawls were not included in the analyses.

Conclusions

Nearly 94.5% of the kingclip catch in 2020 was taken between the three finfish licences (A–, G– and W–licences), with most of the kingclip catch taken under A–licence (40%).

Kingclip catches in Falkland Islands waters represent on average 16% of the Falkland Islands and Argentine combined annual catch, although this proportion has increased to an average of 36% since 2016 with the decline of Argentine catches.

A Total Allowable Catch of 1,587 t of kingclip *Genypterus blacodes* is recommended for 2022. TAC_{2022} = 1,587 t represents a decrease of 2.04% from the total commercial catch in 2020 (1,620 t), corresponding to a conservative catch limit.

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Appendix

Table AI. Annual commercial catches (t) of kingclip *Genypterus blacodes* reported in Falkland Islands (excluding E–licence), Argentina and Chile. Kingclip catch data from Chile were not available for 2020 at the time of producing this report.

Year	Catch (t)		
	Falkland Islands	Argentina	Chile
1987	674	15,175	11,711
1988	1,977	17,307	15,246
1989	979	21,092	14,683
1990	850	34,775	13,203
1991	949	18,850	9,577
1992	1,953	24,174	6,483
1993	1,647	26,010	4,643
1994	898	21,725	4,626
1995	1,986	23,711	5,438
1996	1,686	22,095	5,780
1997	1,421	21,939	6,410
1998	2,215	25,245	6,836
1999	2,602	21,793	5,721
2000	1,875	15,183	6,269
2001	1,626	19,667	7,522
2002	1,224	17,817	4,518
2003	1,276	14,605	4,767
2004	1,839	17,125	5,801
2005	1,937	18,628	3,870
2006	2,752	20,588	5,225
2007	3,592	20,609	4,585
2008	2,226	17,559	3,346
2009	3,388	16,694	3,690
2010	3,635	16,357	3,253
2011	3,855	16,276	2,863
2012	3,475	10,112	2,381
2013	3,944	6,694	1,905
2014	2,875	5,750	855
2015	2,968	5,238	1,366
2016	1,607	3,298	1,250
2017	1,624	3,000	1,228
2018	1,439	3,608	1,176
2019	1,702	2,002	1,206
2020	1,620	2,921	NA

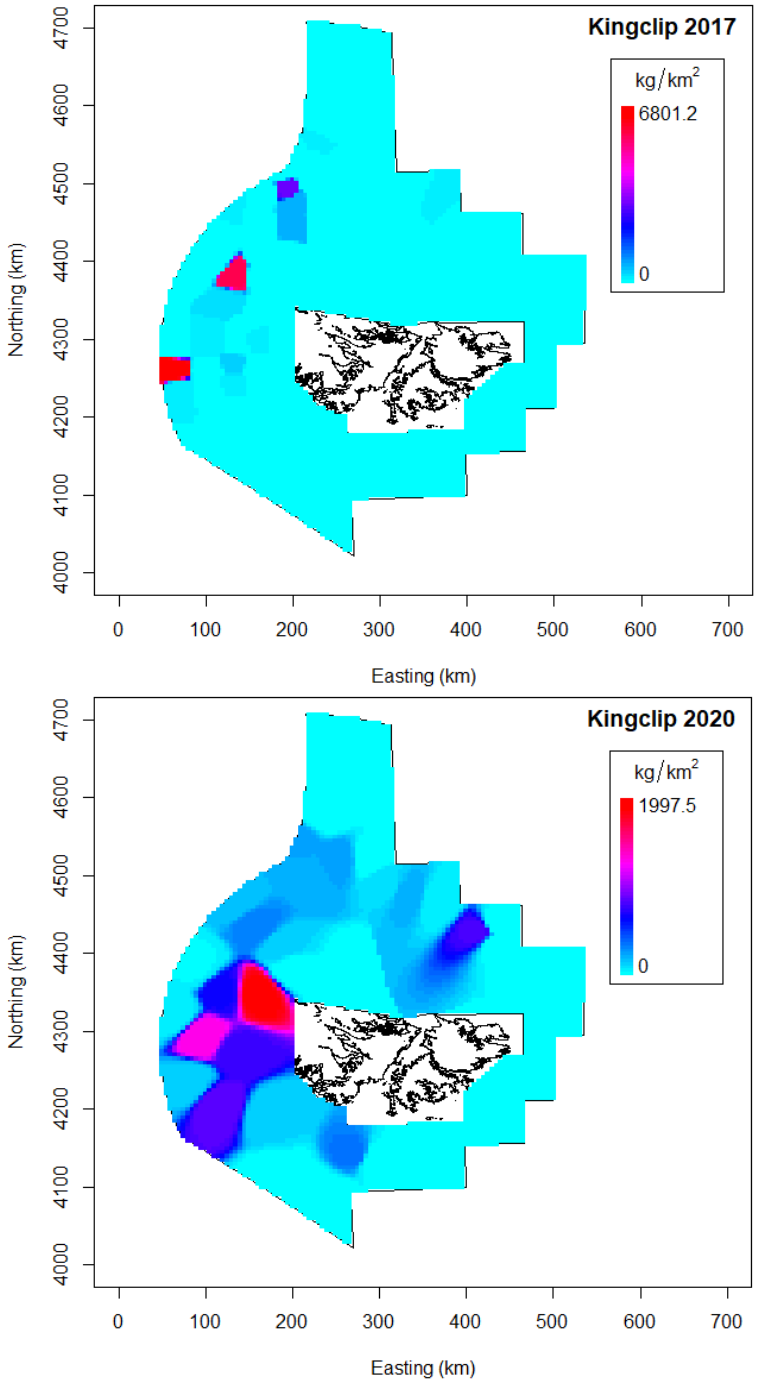

Figure A1. Densities of kingclip *Genypterus blacodes* modelled by inverse distance weighting throughout the Falkland Islands fishing zone, in July 2017 and July 2020.