

1989/1990 STOCK STATUS AND TAC ASSESSMENT FOR *PATAGONOTOthen BREVICAUDA GUNTHERI* IN SOUTH GEORGIA SUBAREA (48.3)

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Abstract

The 1989/90 stock status and TAC assessments for *Patagonotothen breviceuda guntheri* from the South Georgia subarea (48.3) have been made using biostatistical material for 1978/79 through 1988/89 collected by Soviet scientists. VPA tuning has been accomplished using the regression equation between fishing mortality and standardized fishing effort for each age-class. Stock has been assessed at 123.1 thousand tonnes with a TAC of 28.3 thousand tonnes for the initial period of 1989/90 fishing season.

Résumé

Le statut du stock et les évaluations du TAC de *Patagonotothen breviceuda guntheri* provenant de la sous-zone de la Géorgie du Sud (48.3), pour l'année 1989/90, ont été réalisés à partir de matériaux biostatistiques rassemblés par les scientifiques soviétiques de 1978/79 à 1988/89. L'ajustement de la VPA a été effectué en utilisant l'équation de régression entre le taux de mortalité par pêche et l'effort de pêche standardisé pour chaque classe d'âge. Le stock a été évalué à 123 100 tonnes avec un TAC de 28 300 tonnes pour la première période de la saison de pêche de 1989/90.

Резюме

На основе биостатистического материала за 1978/79-1988/89 гг. была проведена оценка ТАС и состояния запаса *Patagonotothen breviceuda guntheri* в Подрайоне Южной Георгии (48.3) на 1989/90 г. Была проведена настройка VPA при использовании уравнения регрессии коэффициента промысловой смертности и стандартизованного промыслового усилия для каждого годового класса. Размер запаса на исходный период сезона 1989/90 г. был оценен в 123,1 тысячи тонн с ТАС в 28,3 тысячи тонн.

Resumen

La evaluación de la condición de las poblaciones en 1989/90 y de la capturas totales permisibles (TAC) de *Patagonotothen breviceuda guntheri* de la subárea de Georgia del Sur (48.3) se ha hecho utilizando material bioestadístico recopilado por los científicos soviéticos desde 1978/79 hasta 1988/89. El ajuste de VPA se ha realizado usando la ecuación de regresión entre la mortalidad pesquera y el esfuerzo de pesca estandarizado para cada clase de edad. Reservas han sido evaluadas en 123.1 mil toneladas, con un TAC de 28.3 mil toneladas para el período inicial de la temporada de pesca de 1989/90.

1. BACKGROUND DATA

1.1 The Fishery

Over a period of eleven years the largest catches of Patagonian rockcod (*Patagonotothen breviceuda guntheri*) occurred during the 1980/81 and 1981/82 seasons (SC-CAMLR-VII, Annex 5). In the following years catches varied from 5 to 16 thousand tonnes but on the whole remained steady within a range of 10.5 to 13.4 thousand tonnes. In 1988/89, since the introduction of catch limits, Soviet vessels landed 13 016 tonnes of *P.b. guntheri*.

1.2 Age Composition of Catches

Data for the 1978/79 to 1987/88 seasons are taken from the document WG-FSA-89/5 from the Working Group on Fish Stock Assessment. Age composition of the 1988/89 catch is calculated using an age/length key for the last quarter of 1988 and comprehensive measurements taken in December 1988 and January 1989. Data on age composition of catches are given in Table 1.

1.3 Catch-Per-Unit Fishing Effort and Fishing Effort

The largest catch-per-unit-effort occurred in 1978/79, the first fishing season (Table 2), followed by a marginal decline in catches to a level which remained steady until 1984/85. The next three years witnessed a decline in catch-per-unit, although in 1988/89 this indicator rose to the average level of previous years.

Soviet BRMT (large refrigerator trawler) was used in assessments as a standard type of fishing vessel. Catch-per-unit-effort data for the seasons 1978/79 to 1988/89 were used. Values for standardized fishing effort are derived from the division of total catch-per-season by the value of catch-per-unit-effort of a standard vessel. These values are presented in Table 2.

1.4 Mean Fish Mass by Age-Group

There are no data on fish mass for the 1979/80 season. Weight values from Bertalanffy's weight-growth equation were used in the calculations for this period. Due to an absence of data for 1984/85, mean mass by age-groups has been taken from the previous season's data. A substantial increase in the fish mass of older age-groups was noted in subsequent years. Weight of fish of age-group one for 1988/89 was corrected to the mean value of previous years (5.3 grams).

The values of mean mass by age and fishing season are given in Table 3.

2. PARAMETERS

2.1 Natural Mortality Rate

Calculations of natural mortality rates by various methods produced the following results (Shlibanov, in press):

- Baranov method 0.83
- Beverton/Holt method 0.94
- Beverton/Holt integral method 0.84
- Chapman/Robson method 1.06
- Rikhter/Efanov method 0.63
- Alverson/Carney method 0.73

The majority of these methods, with the exception of Rikhter/Efanov, are based on length-age composition data on the population of *P.b. guntheri* fished for the first time (i.e. based on identical factual material). Thus M varies from 0.73 to 1.06. For this calculation the value M = 0.9 is assumed.

2.2 Age at Sexual Maturity

According to Lisovenko and Pinskaya's data (1987), 50% of fish reach sexual maturity at a length of 15.6 to 16.5 cm, while semi-mature specimens are first noticed at a length of 11 to 13 cm at an age of two years. Our studies indicate that mass maturation of *P.b. guntheri* occurs in the summer-autumn period when a length of 12 to 14 cm, which corresponds to the age of 2.5 years, is reached.

3. STOCK ASSESSMENT USING VPA

The VPA calculations were tuned by applying the formula of regression between fishing mortality rates and standardized fishing effort. At the final stage of the integration process the coefficients of correlation between these values were:

Age-Group	1	2	3	4	5	6
Coefficient of Correlation	-0.13	0.44	0.71	0.82	0.76	0.81

Calculated fishing mortality rates, abundance and biomass coefficients are presented in Tables 4,5 and 6 respectively.

Abundance estimation of age-group one for the last fishing season has been corrected to the mean value over the previous years.

The stock size of *P.b. guntheri* for 1988/89 has been estimated at 117.5 thousand tonnes.

4. YIELD-PER-RECRUIT

The calculation of yield-per-recruit using Thompson and Bell's method is given in Table 7. The following values were used in calculations:

$$F_{MSY} = 1.90; F_{0.1} = 1.12$$

5. TAC ASSESSMENT FOR 1989/90

Calculation of TAC was done with the following assumptions:

- mean fish mass is maintained at the 1989/90 level;
- rate of partial recruitment for 1978/79 to 1988/89 was calculated using fishing mortality rates;
- abundance of age-group one is assumed to be at a level of the mean value over previous years; and
- total fishing mortality rate for 1989/90 will be at a level of $F_{0.1}$.

Results of the TAC assessment are detailed in Table 8.

Within these parameters the stock size of *P.b. guntheri* at the beginning of the 1989/90 season is estimated at 123.1 thousand tonnes. TAC in 1989/90 is 28.3 thousand tonnes.

REFERENCES

- CCAMLR. 1989. Analyses carried out during the 1988 Meeting of the Working Group on Fish Stock Assessment. WG-FSA-88/5.
- LISOVENKO, L.A. and I.A. PINSKAYA. 1987. On the Breeding of *Patagonotothen breviceuda guntheri* in the Shag Rocks Area of the Scotia Sea. Theses of Reports of the Second All-Union Meeting "Natural Resources of the Southern Ocean and Problems of their Rational Exploitation". Kerch. pp. 138-129.
- SHLIBANOV, V.I. (In print). Growth and Natural Mortality of *Patagonotothen breviceuda guntheri* of the shelf of Shag Rocks.

Table 1: Age composition of catches of *P.b. guntheri* in Subarea 48.3.

Age-Group	Fishing Seasons										
	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
1	33.00	11.80	80.90	34.50	19.10	55.10	84.60	20.80	2.68	4.00	0.71
2	274.90	21.30	467.50	320.30	46.20	36.20	173.70	454.80	57.88	79.90	109.76
3	160.50	91.70	306.70	382.00	43.00	58.90	102.60	77.40	177.31	238.80	102.15
4	97.90	84.70	336.10	232.10	47.30	125.00	83.20	70.10	70.59	95.00	147.55
5	9.90	8.20	60.00	59.70	10.40	36.00	18.90	29.40	15.72	21.10	3.62
6	6.30	0.90	6.10	4.70	1.30	3.20	2.50	5.60	10.37	13.90	0.28

Table 2: Total catch, catch-per-unit fishing effort of a BRMT type vessel and standardized fishing effort by fishing seasons.

Fishing Season	Total Catch (thousand tonnes)	Yield-Per-Recruit	Fishing Effort
1978/79	16.2	50.2	322.8
1979/80	8.6	46.1	186.4
1980/81	40.8	44.7	912.1
1981/82	35.3	43.4	814.3
1982/83	5.7	39.7	143.5
1983/84	12.8	44.9	285.3
1984/85	12.6	42.4	297.3
1985/86	16.2	26.2	617.8
1986/87	13.0	23.4	556.7
1987/88	17.5	19.4	902.9
1988/89	13.0	37.4	348.0

Table 3: Fish mass (g) of *P.b. guntheri* by age-groups for 1978 to 1989.

Age-Group	Fishing Seasons										
	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
1	5.30	5.30	5.30	5.50	6.00	5.70	5.70	4.50	5.30	5.30	10.00*
2	13.50	13.50	14.00	11.50	14.50	13.30	13.30	14.50	20.70	23.30	14.70
3	25.20	25.20	27.30	21.60	28.50	25.80	25.80	22.50	31.60	37.90	32.80
4	39.00	39.00	37.00	42.50	39.00	39.60	39.60	36.30	60.30	59.50	52.00
5	51.70	51.70	46.30	58.50	51.50	52.10	52.10	49.50	95.10	90.00	87.30
6	72.70	72.70	66.30	90.00	69.50	77.30	77.30	57.00	137.20	130.00	120.00

* Determined from one specimen.

Table 4: Fishing mortality rates for *P.b. guntheri* in Subarea 48.3.

Age-Group	Fishing Seasons										
	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
1	0.0057	0.0020	0.0165	0.0074	0.0055	0.0212	0.0231	0.0034	0.0007	0.0013	0.0093
2	0.0867	0.0090	0.2107	0.1749	0.0248	0.0259	0.1792	0.3579	0.0234	0.0560	0.0886
3	0.2330	0.0773	0.3757	0.6122	0.0657	0.0817	0.1988	0.2409	0.5239	0.2689	0.1977
4	0.8894	0.4099	1.1184	1.5359	0.3050	0.6282	0.3428	0.4510	0.8771	1.7980	0.6113
5	0.8723	0.3660	1.6682	1.9344	0.5602	1.0091	0.4012	0.4354	0.3797	2.6476	0.7069
6	0.8820	0.3888	1.3999	1.7440	0.4306	0.8170	0.3730	0.4441	0.6290	2.2266	0.6597

Table 5: Abundance (millions of specimens) of *P.b. guntheri* in Subarea 48.3.

Age-Group	Fishing Seasons										
	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
1	8869.62	9057.55	7472.55	7070.36	5308.27	3981.80	5620.87	9359.16	5450.93	4814.57	116.68
2	4986.05	3585.78	3675.25	2988.29	2853.33	2146.41	1584.96	2233.20	3792.33	2214.53	1954.99
3	1151.11	1858.75	1444.74	1210.42	1019.93	1131.64	850.39	538.70	634.78	1506.22	851.30
4	236.47	370.72	699.49	403.41	266.81	388.31	423.99	283.40	172.13	152.84	468.02
5	24.23	39.50	100.04	92.94	35.31	79.96	84.23	122.35	73.40	29.11	10.29
6	15.30	4.12	11.14	7.67	5.46	8.20	11.85	22.93	32.18	20.41	0.84
Total	15282.80	14916.40	13403.20	11773.10	9489.20	7736.30	8576.30	12559.70	10155.70	8737.70	3402.10

Table 6: Biomass (thousands of tonnes) of *P.b. guntheri* in Subarea 48.3.

Age-Group	Fishing Seasons										
	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
1	47.0	48.0	39.6	38.9	31.8	22.7	32.0	42.1	28.9	25.5	35.5
2	67.3	48.4	51.4	34.4	41.4	28.5	21.1	32.4	77.2	51.6	28.7
3	29.0	46.8	39.4	26.1	29.1	29.2	21.9	12.1	20.0	57.1	27.9
4	9.2	14.4	25.9	17.1	10.4	15.4	16.8	10.3	10.4	9.1	24.3
5	1.2	2.0	4.6	5.4	1.8	4.2	4.4	6.1	7.0	2.6	0.9
6	1.1	0.3	0.7	0.7	0.4	0.6	0.9	1.3	4.4	2.6	0.1
Total	154.9	160.1	161.7	122.7	114.9	100.6	97.1	104.3	147.9	148.6	117.5

Table 7: Yield-per-recruit values (Thompson/Bell method).

F	Y/R	F	Y/R
0.20	0.0013	1.15	0.0035
0.40	0.0022	1.20	0.0035
0.50	0.0025	1.30	0.0036
0.60	0.0027	1.40	0.0037
0.70	0.0029	1.50	0.0037
0.80	0.0031	1.60	0.0038
1.00	0.0033	1.70	0.0038
1.05	0.0034	1.80	0.0039
1.10	0.0034	1.90	0.0039

Table 8: Forecast of stock status and TAC calculated using predetermined rates of fishing intensity for *P.b. guntheri* in Subarea 48.3. Fishing intensity in the forecast period is equal to the optimal intensity according to Gulland's method of $F_{0.1}$ calculation: $F_{OPT}=1.120$.

Age-Group	Natural Mortality Rate	Rate of Partial Recruitment	Average Fish Mass (kg)	1989				1990			
				F	C (millions)	N (millions)	B (thousands)	F	C (thousands)	N (millions)	B (thousands)
1	0.900	0.0132	0.005	0.0093	0.71	6700.42	35.51	0.0148	0.34	6700.42	35.51
2	0.900	0.1827	0.015	0.0884	109.76	1954.72	28.73	0.2046	4.91	2698.97	39.67
3	0.900	1.0000	0.033	0.1977	102.15	851.15	27.92	1.1200	11.48	727.49	23.86
4	0.900	1.0000	0.052	0.6113	147.55	468.05	24.34	1.1200	7.10	283.97	14.77
5	0.900	1.0000	0.087	0.7069	3.62	10.29	0.90	1.1200	4.34	103.26	9.01
6	0.900	1.0000	0.120	0.6597	0.28	0.84	0.10	1.1200	0.12	2.06	0.25
Total:					364.10	9985.40	117.50	Total:	28.30	10516.20	123.1

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