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Russian fishery for the northern shrimp (*Pandalus borealis*) in the Barents Sea in 2000-2020

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Abstract

Over the past three years, a recovery in large-scale Russian northern shrimp fishery has been observed in the Barents Sea. The average annual catch was about 20 thousand tons. In 2015-2019, fishing productivity increased due to the use of foreign-made highly efficient fishing gear and due to the positive dynamics of the commercial stock. In 2020, there is a decrease in the fishing productivity to the average long-term level and the catch is expected to be about 21-22 thousand tons, which is 25% less than in the previous year.

Introduction

The Soviet fishery for the northern shrimp in the Barents Sea was started in 1978. The maximum annual catch (29-43 thousand tons) was achieved in 1983-1985 and it was very variable in subsequent years. In 2009-2012, the Russian fishery was completely stopped. In recent years, there has been an increased interest of Russian fishermen in the northern shrimp stock. The reasons for the increase in the annual catch aren't only due to the favorable state of the stock, but also to the increase in fishing productivity because of the use of foreign-made trawls (Hafioslo 2300, MoreNot 2400, Cosmos 2005, Vonin Kodiak 2630, Egersund 3000).

Materials and methods

To form time series of fishery data, PINRO database "Fishery" was used, which was formed on the basis of daily vessel activity reports (FSBI "Centre of Fishery Monitoring and Communications"). The information was analyzed for each fishing operation, including the following characteristics: side number of the vessel; date of operation; type of trawl; trawling duration; tonnage of the vessel; coordinates; depth; catch of shrimp.

The fishery database contained data collected in the result of 54680 fishery operations. A generalized linear model (GLM) was used to standardize catch per effort, with the following categories (factors) assigned to each operation: year (YEAR), month (MONTH), trawl type (TrawlType), fishing area (LOCAL), depth (DEPTHRANGE).

The standardization procedure was implemented in the influ package. The package for the R statistical language which can generate step plots, influence plots, CDI plots, and influence metrics is available at http://projects.trophia.com/influ (Bentley et al., 2011).

Results

Spatial distribution

In the early 2000s, the main areas of Russian fishery were the open part of the Barents Sea and the Svalbard area (Fig. 1). With the resumption of fishery in 2013, the main fishing grounds were shifted eastward. Currently, fishery is carried out in the EEZ of the Russian Federation in the areas of the Novaya Zemlya Bank, the Perseus Upland, Cape Zhelaniya and Cape Sukhoi Nos. The prevailing depths of trawling are 230-270 m. The main fishing period is March-September, however, some vessels go fishing all year round (Table 1).

Landings

In 2000-2008, the annual catch was decreasing from 20 thousand tons to the complete cessation of fishing in 2009-2012. In 2013-2015, the fishery was resumed, but the annual catch was insignificant (about 1,000 tons). Since 2016, there has been an increase in the annual catch, which, in 2019, reached its maximum value over the last 20 years – 28 thousand tons. In 2020, the catch is expected to be at the level of 21-22 thousand tons. A decrease in catch, in comparison with 2019, occurred against the background of a significant decrease (by 25-50%) in the fishing productivity of the majority of vessels, some of which ended the fishing season ahead of schedule.

Standardized CPUE

A comparative analysis of two series of CPUE showed that the high growth of non-standardized CPUE in 2015-2019 occurred due to the use of foreign-made highly efficient fishing gear (Fig. 1). The TrawlType variable has the greatest influence among the predictors (Table 2). The inclusion of this variable in the GLM model significantly changes the time trend of CPUE (Fig. 3). The standardized series also shows an increase in productivity during this period, which is probably related to trends in stock dynamics. The maximum productivity was recorded in 2019. In 2020, this indicator significantly decreased and was slightly below the level of 2017 (Table 1). It should be noted that the failure in 2015 and a big mistake in 2005 in the standardized performance are related to the lack of data and the peculiarities of fleet performance in these years.

References

Bentley, N., Kendrick, T. H., Starr, P. J., & Breen, P. A. (2011). Influence plots and metrics: tools for better understanding fisheries catch per unit effort standardisations. ICES Journal of Marine Science, 69: 84-88.

Table 1. The main indicators of the Russian fishery for the northern shrimp in the Barents Sea in 2000-2019

Fishery period		Number of		CPUE, kg/hr		Catch, ktons
Year	Month	vessels	hauls	Absolute	Standartised	
2000	I-XII	91	21599	190	243	19.596
2001	I-XII	49	5839	175	228	5.846
2002	II-X	20	4319	172	241	3.790
2003	III-XII	19	3486	151	218	2.776
2004	II-XII	13	2268	213	299	2.410
2005	I,II,IV,V,VIII,IX,XII	5	211	208	240	0.435
2006	I	1	4	NA	NA	0.004
2007	IV,V	2	194	192	237	0.192
2008	V-IX	1	378	NA	NA	0.417
2013	III-VII,IX-XI	2	685	292	249	1.067
2014	III-IX	1	415	300	246	0.741
2015	I-XII	2	754	263	236	1.151
2016	II-XI	7	1426	383	351	2.490
2017	III-XII	8	1957	399	313	3.849
2018	I-XII	15	5391	453	335	12.561
2019	I-XII	23	10076	556	390	28.081
2020*	I-XII	19	6335	475	301	20.203

* – data including September

Table 2. Summary of the explanatory power and influence in the standardization model, with explanatory variables listed in order of their acceptance into the model.

Term	Degrees of freedom	AIC	Explained dispersion (%)	Overall influence (%)
YEAR	14	109315	31	-
MONTH	11	106929	34	6.4
TrawlType	30	100174	42	17.3
LOCAL	32	98251	44	14.0
DEPTHRANGE	61	97904	45	0.9

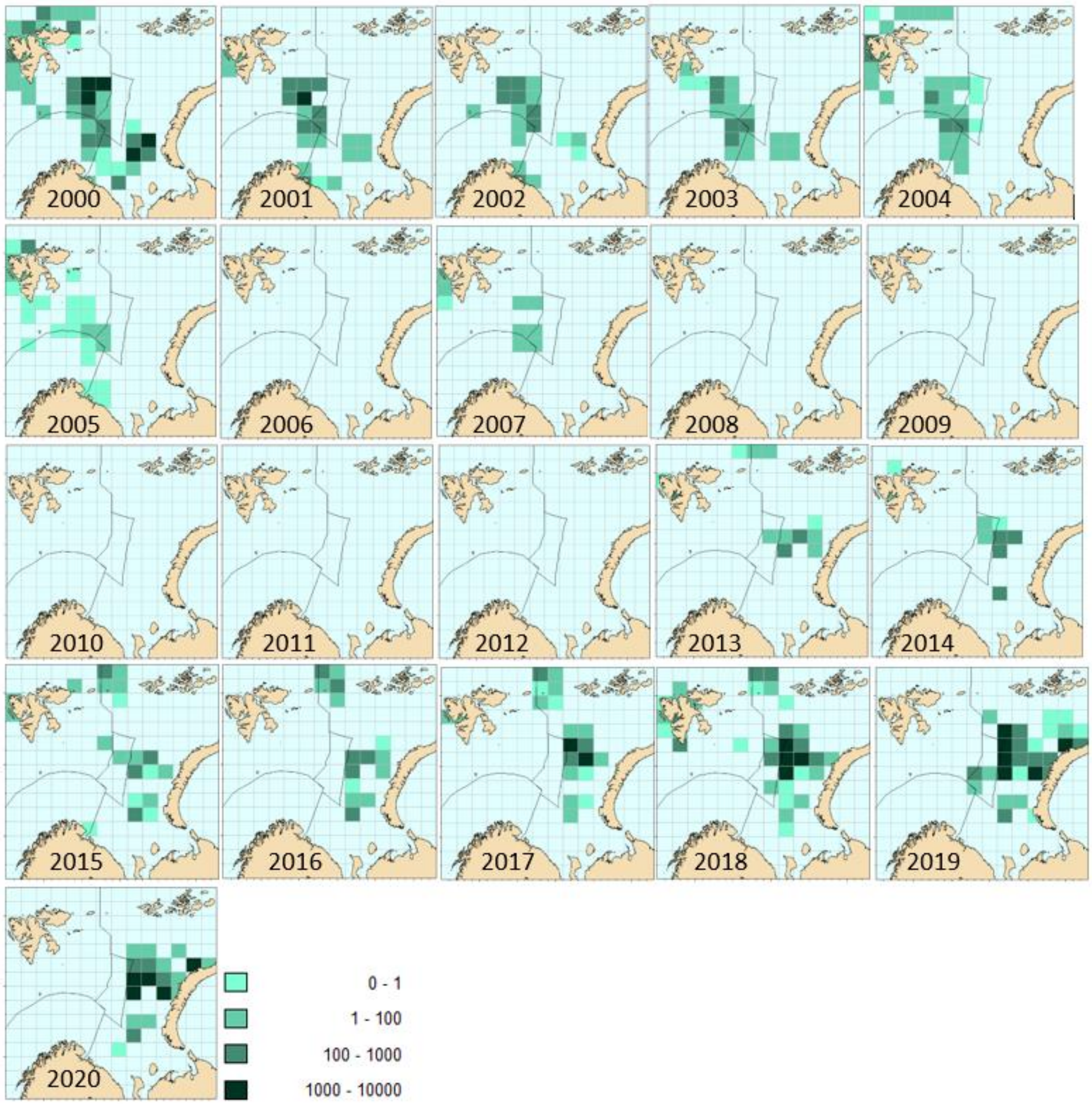

Figure 1. Distribution of catches by Russian vessels since 2000 based on logbook information. (2020 only data until September)

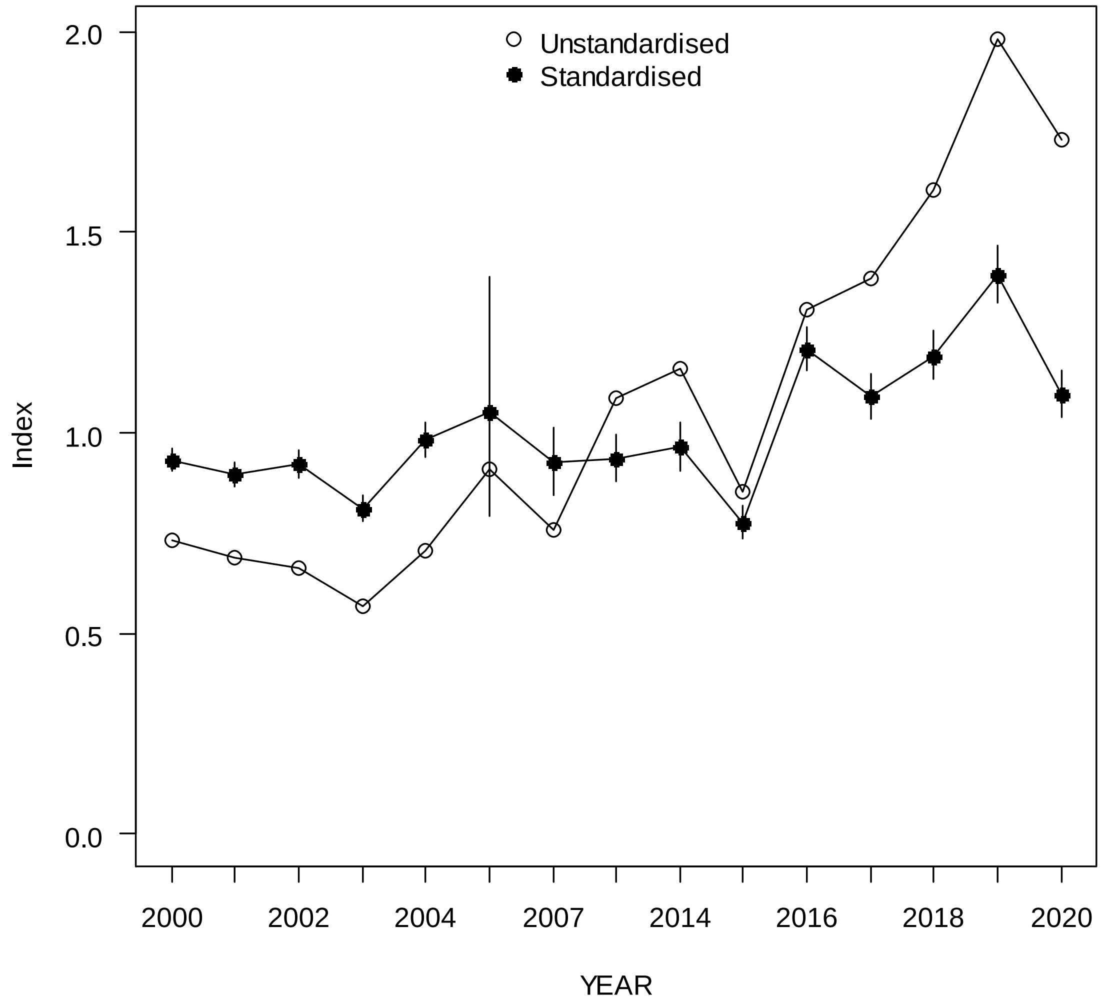

Figure 2. Unstandardized (geometric mean of annual observations) and standardized (year coefficients from GLM) CPUE indices for Russian shrimp fishery. Error bars indicate +2 s.e. Each series has been normalized to a geometric mean of 1.

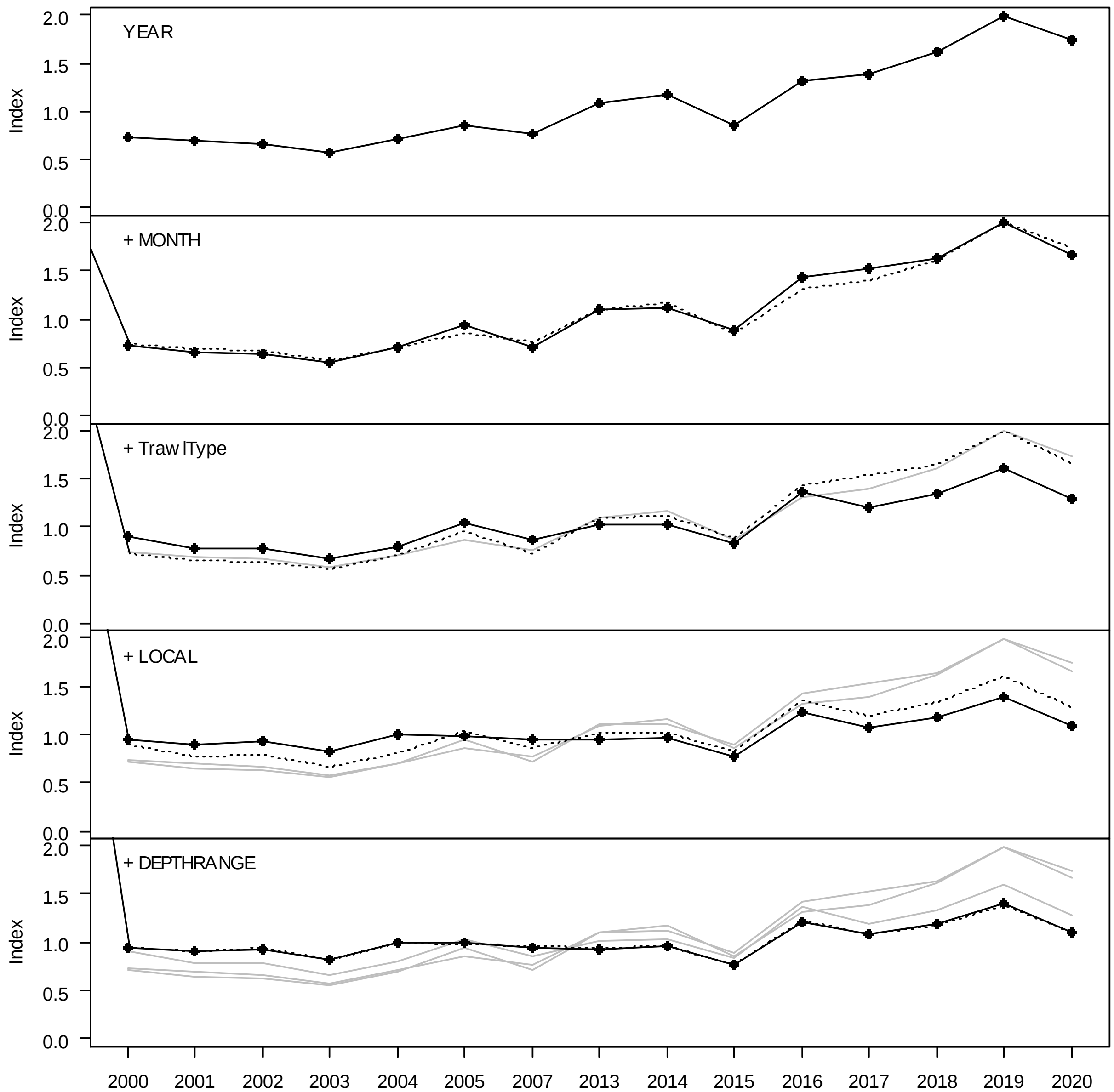

Figure 3. Step plot and annual influence plot for Russian shrimp fishery. CPUE index at each step in the stepwise selection of variables. Each panel shows the standardized CPUE index as each explanatory variable is added to the model. The index obtained in the previous step (if any) is shown by a dotted line and for steps before that by grey lines.