NOT TO BE CITED WITHOUT PRIOR
REFERENCE TO THE AUTHOR(S)

Northwest Atlantic Fisheries Organization

Serial No. N7255 **NAFO SCR Doc. 21/052**

NAFO/ICES *PANDALUS* ASSESSMENT GROUP – NOVEMBER 2021

Russian fishery for the northern shrimp (*Pandalus borealis*) in the Barents Sea in 2000-2021

Sergey Bakanev

Polar branch of the FSBSI "VNIRO" ("PINRO" named after N.M. Knipovich)
6 Akademika Knipovicha St., Murmansk, Russia, 183038

Abstract

In 2018-2020, a recovery in large-scale Russian northern shrimp fishery was observed in the Barents Sea. The average annual catch was about 20 thousand tons. In 2015-2019, fishing efficiency increased due to the use of foreign-made highly efficient fishing gear and due to the positive dynamics of the commercial stock. In 2020-2021, there is a decrease in the fishing efficiency to the average long-term level. In 2021, the catch is expected to be about 13 thousand tons, which is 40% 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 fishery database contained data collected in the result of 69,325 fishery operations, of which Russian operations amounted to 65,847; Norwegian operations – 1,471; Faroe Islands – 1,796 (Table 1). The information was analyzed from 2000 to September 18, 2021 for each fishing operation of the Russian fleet, 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.

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 from March to September, however, some vessels go fishing all year round (Table 2).

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 Russian catch decreased to 21 thousand tons. In 2021, the Russian catches go on declining and the expected catch will not exceed 13.5 thousand tons. A decrease in catch, in comparison with 2020, occurred against the background of a significant decrease (by 50%) in the fishing efforts.

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 3). 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 efficiency during this period, which is probably related to trends in stock dynamics. The maximum efficiency was recorded in 2019. In 2020, this indicator significantly decreased and was slightly below the level of 2017 (Table 2). In 2021, standardized CPUE increased by 9% compared to the previous year (non-standardized by 17%).

A lower interannual variability is shown by the CPUE time series of the international catch of northern shrimp in the areas of the Russian EEZ (Fig. 4). The maximum efficiency was recorded in 2017-2019. In 2020-2021, the CPUE corresponded to the long term mean.

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. Northern shrimp catches by Russian and international fleets, as well as non-standardized Russian and international CPUE (kg / trawling) in the Barents Sea in 2000-2021.

Year/ Area	Russian catch (tons)					International catch in REZ (tons)					
	REZ	Svalbard	NEZ	Total	Russian raw CPUE	Norway	Greenland	Iceland	Faroe Is.	Total	International raw CPUE
2000	7449	11028	465	18943	187						
2001	257	4682	326	5265	182						
2002	23	2581	224	2827	181						
2003	181	710	276	1167	146						
2004	34	1365	629	2028	207						
2005	1	431	0	432	491						
2007		122	25	147	197						
2008	7	8	11	26	290						
2011									83	83	516
2012						1817			897	2714	609
2013	859	195		1054	312	2318			2407	4725	541
2014	602	21		623	289	1384	18	346	1284	3032	359
2015	1062	38		1100	261	1714	68		1554	3336	505
2016	2489			2489	374	714			1802	2516	506
2017	3735	111		3846	397	2138			3082	5220	816
2018	11735	428		12163	454	3804	498		4436	8737	719
2019	27892			27892	558	6014	462		3478	9953	758
2020	21264			21264	443	1014			1967	2981	457
2021*	12214			12214	534	364			1798	2162	610

* – data up to September inclusive

Table 2. The main indicators of the Russian northern shrimp fishery in the Barents Sea in 2000-2021.

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	II-XII	23	10076	556	390	28.081
2020	II-XII	19	8733	443	301	21.264
2021	II-IX	12	4198	534	329	12.214

* – data up to September inclusive

Table 3. 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	15	121888	32	-
MONTH	11	118541	35	7.8
TrawlType	30	111479	43	17.5
LOCAL	31	109552	45	14.6
DEPTHRANGE	63	109207	45	1.5

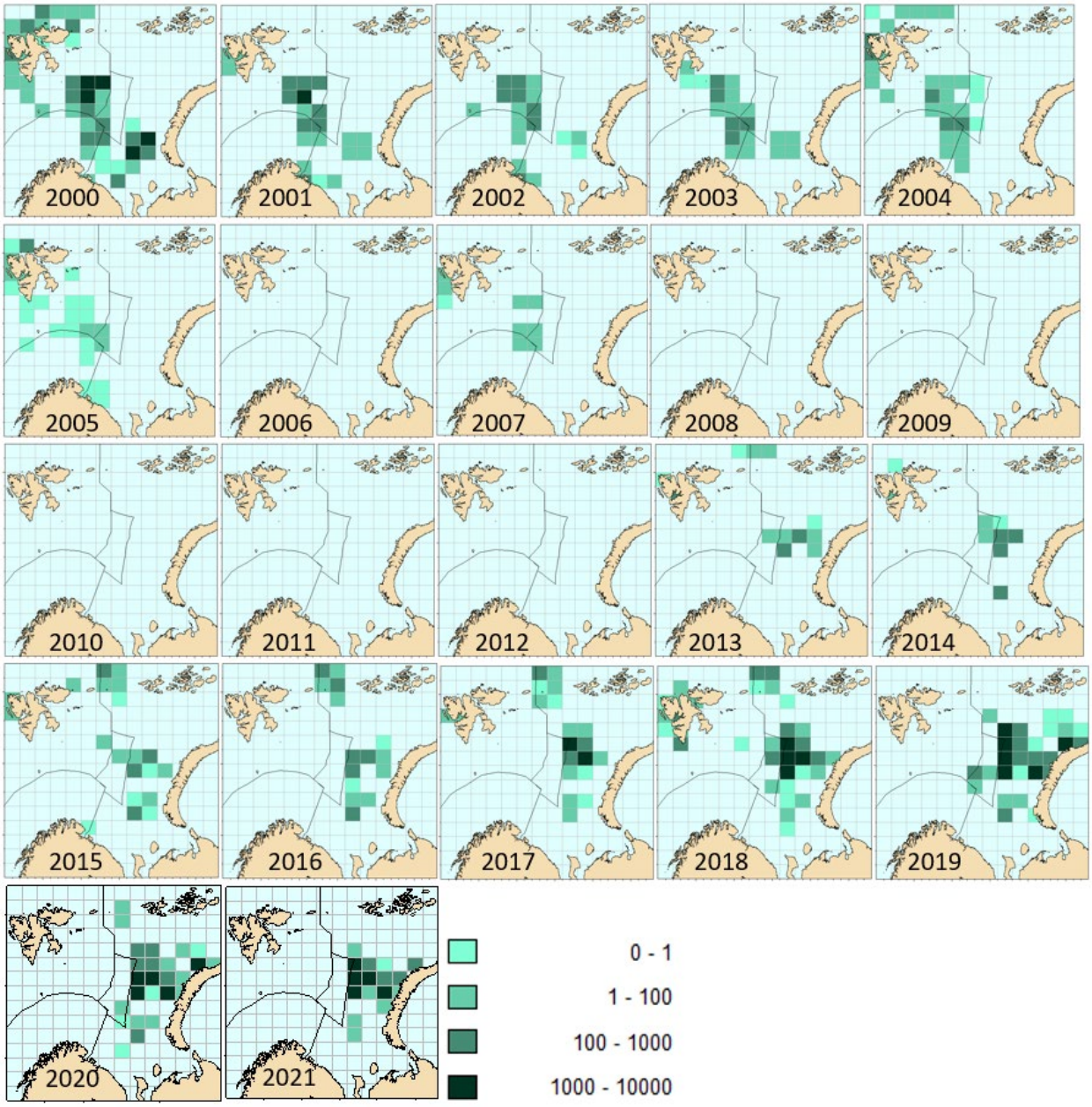

Figure 1. Distribution of catches by Russian vessels since 2000 based on logbook information. (2021 only data until September)

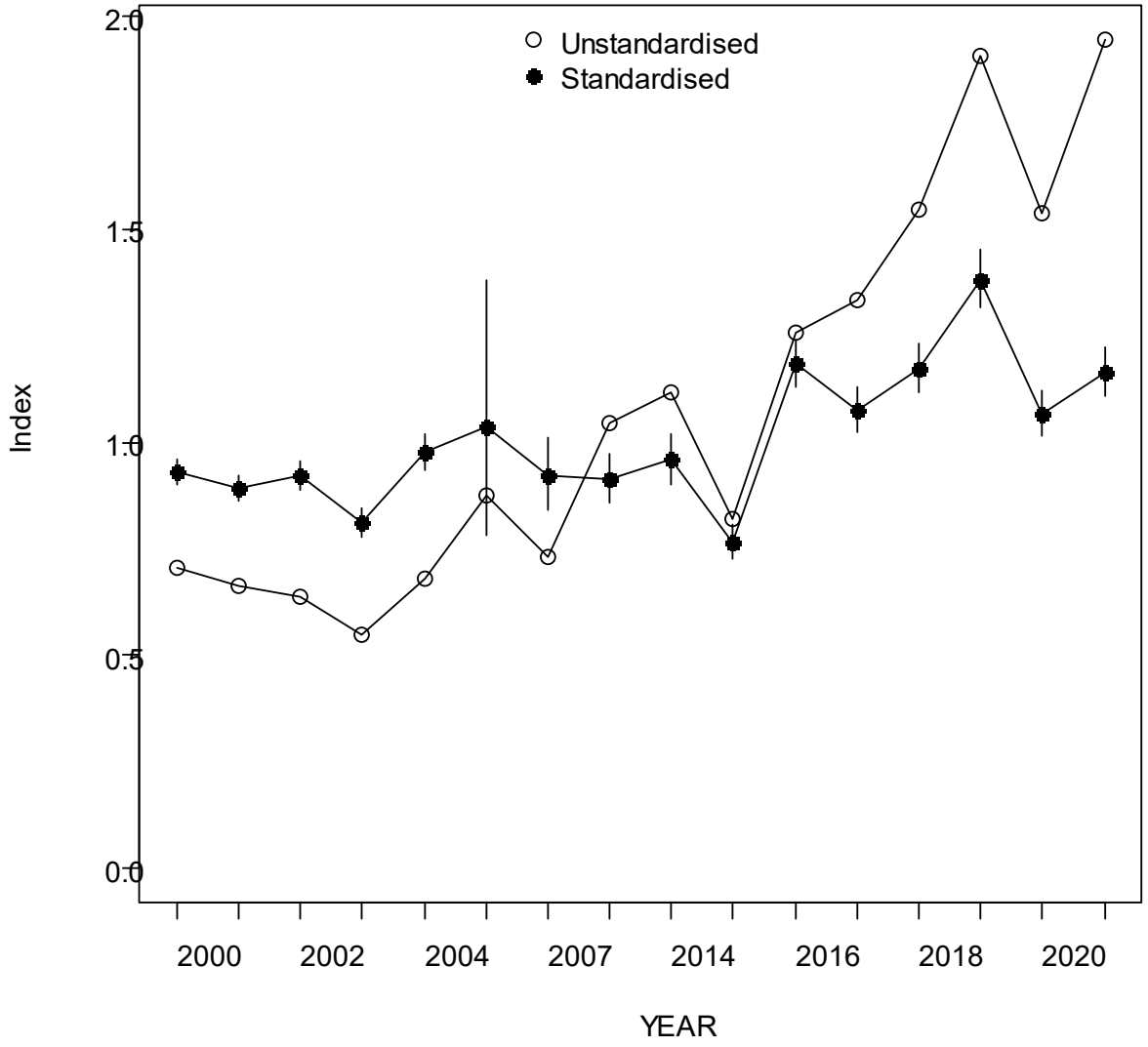

Figure 2. Unstandardized (geometric mean of annual observations) and standardized (year coefficients from GLM) CPUE indices for Russian shrimp fishery. Error bars indicate +2 s.e. Each series has been normalized to a geometric mean of 1.

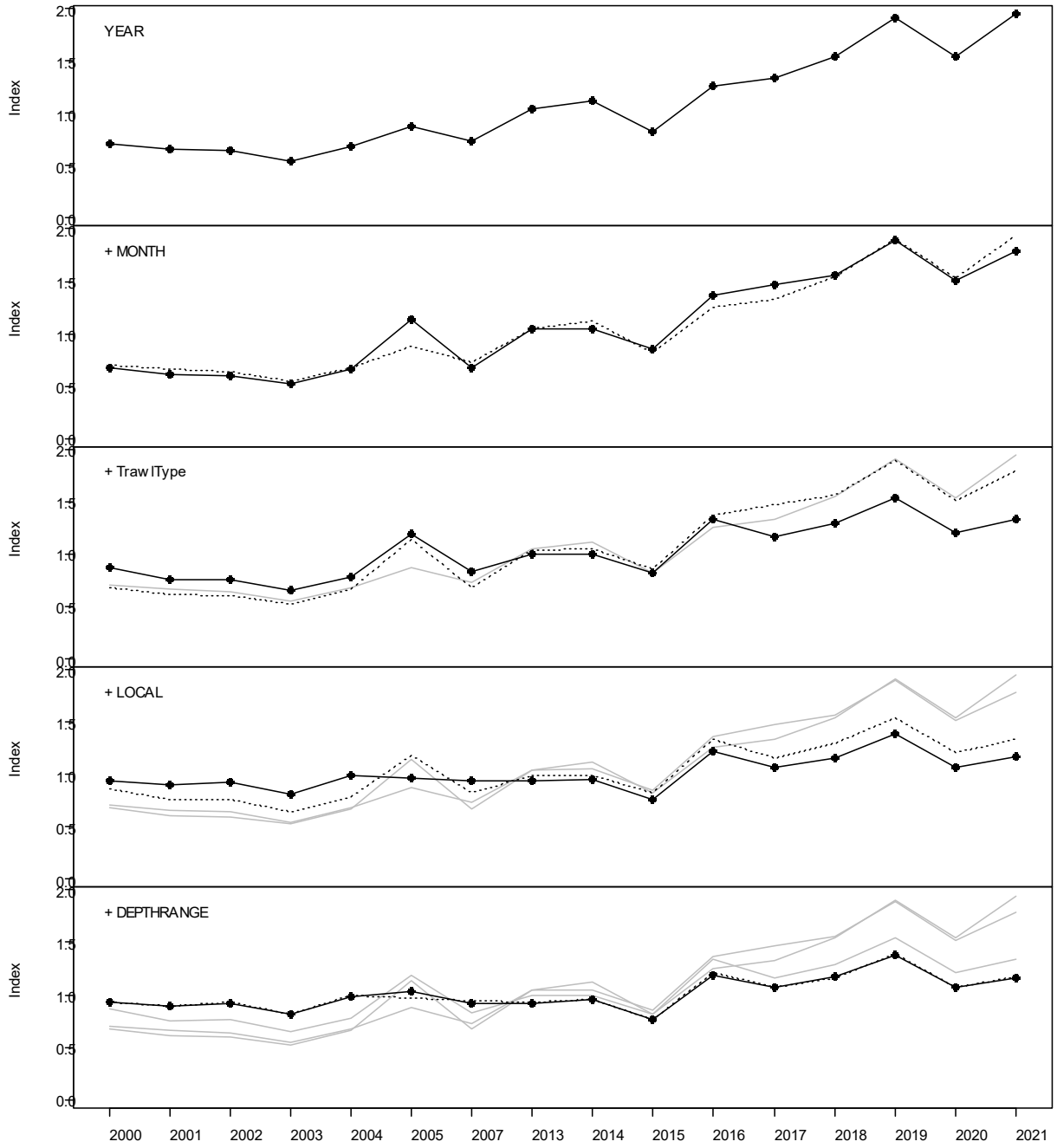

Figure 3. Step plot and annual influence plot for Russian shrimp fishery. CPUE index at each step in the stepwise selection of variables. Each panel shows the standardized CPUE index as each explanatory variable is added to the model. The index obtained in the previous step (if any) is shown by a dotted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

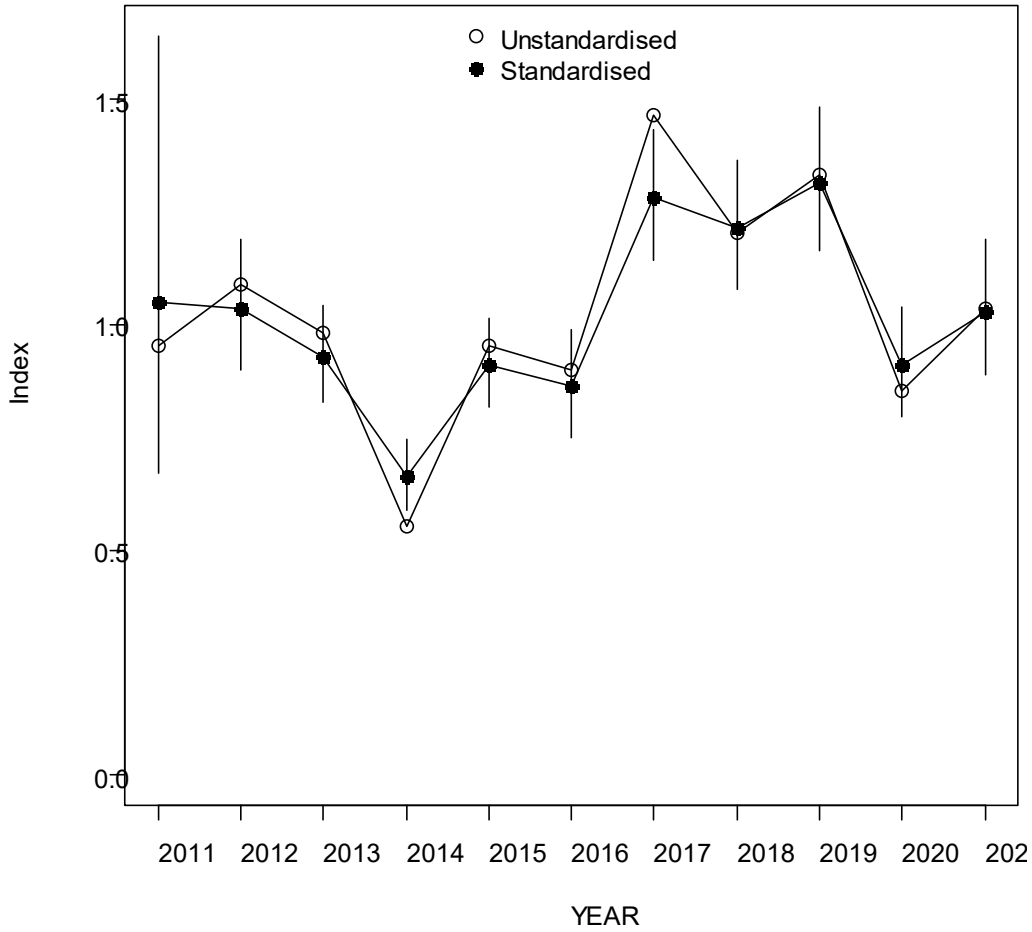

Figure 4. Unstandardized (geometric mean of annual observations) and standardized (year coefficients from GLM) CPUE indices for international shrimp fishery in Russian Economical Zone. Error bars indicate +2 s.e. Each series has been normalized to a geometric mean of 1.