IMR/PINRO
2
2023
Joint Report Series

JOINT

REPORT

# Advice on fishing opportunities for Barents Sea shrimp in 2023

Institute of Marine Research – IMR

Polar branch of the FSBSI “VINRO” (“PINRO”)

**Title (English and Norwegian):**

Advice on fishing opportunities for Barents Sea shrimp in 2023

Advice on fishing opportunities for Barents Sea shrimp in 2023


| Report series: | Year - No.: | Date: |
|---|---|---|
| IMR-PINRO | 2023-2 | 08.03.2023 |



**Author(s):**

Carsten Hvingel and Fabian Zimmermann (IMR)

Reasearch group leader(s): Carsten Hvingel (Bentiske ressurser og prosesser)
Approved by: Research Director(s): Geir Huse Program leader(s): Maria Fossheim



**Distribution:**

Open

**Research group(s):**

Bentiske ressurser og prosesser

**Number of pages:**

18

Content


| | | |
|---|---|---|
| 1 | **Advice on fishing opportunities** | 4 |
| 2 | **Stock development over time** | 5 |
| 3 | **Catch scenarios** | 6 |
| 4 | **Basis of the advice** | 7 |
| 5 | **Quality of assessment** | 8 |
| 6 | **Issues relevant for the advice** | 9 |
| 7 | **Reference points** | 10 |
| 8 | **Basis of the assessment** | 11 |
| 9 | **History of the advice, catch, and management** | 12 |
| 10 | **History of the catch and landings** | 13 |
| 11 | **Summary of the assessment** | 15 |
| 12 | **Sources and references** | 17 |

# 1 - Advice on fishing opportunities

Based on the MSY approach and an updated assessment methodology endorsed by an international panel of experts in 2022 ( ICES 2022 ), the catches in 2023 should not exceed 153 000 tonnes.

# 2 - Stock development over time

Fishing pressure on the stock is below $F_{MSY}$ and $F_{lim}$ and stock biomass is above MSY $_{Btrigger}$ and $B_{lim}$.

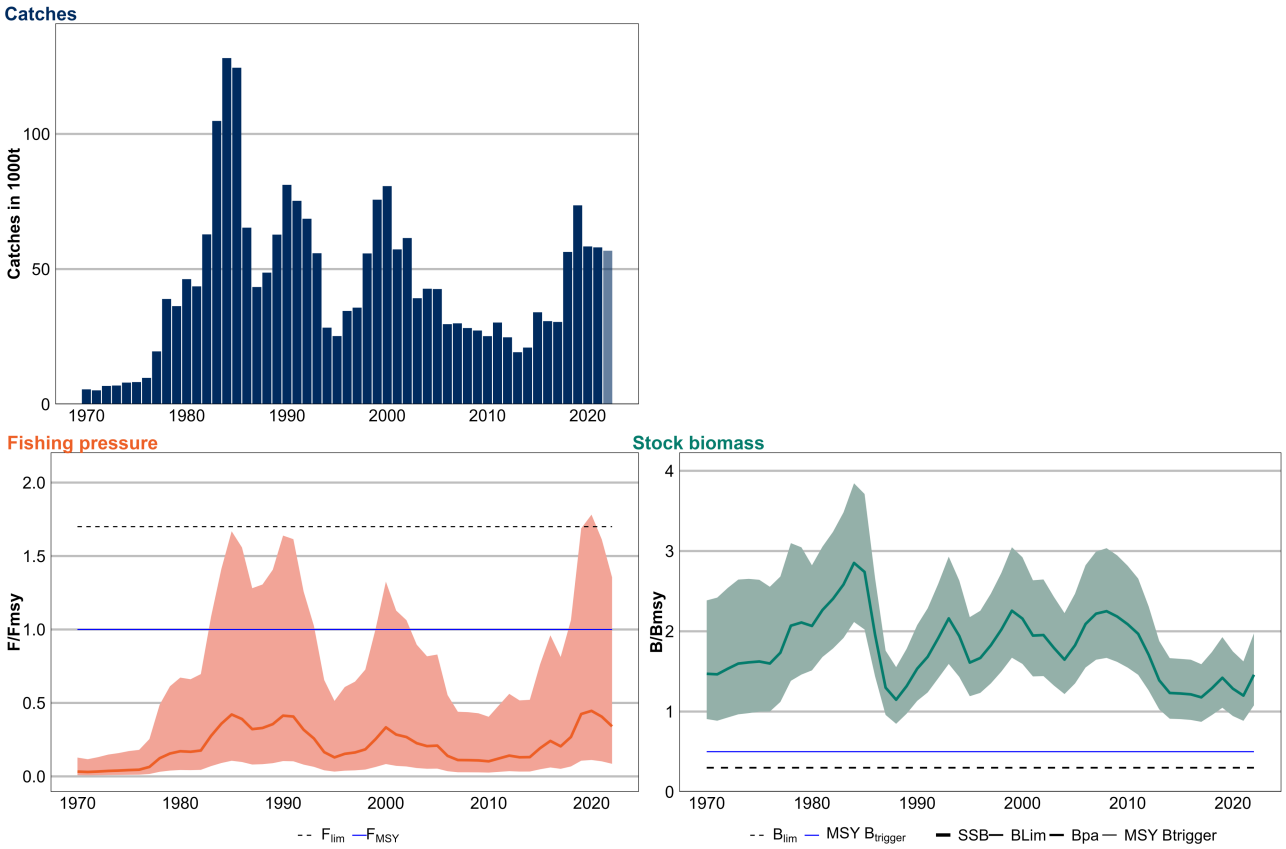


*Figure 1 : Northern shrimp in ICES subareas 1 and 2. Summary of the stock assessment. Top: total catches (the paler bar is preliminary estimation for 2022). Bottom: biomass and fishing mortality relative to B MSY and FMSY, respectively, with 95% confidence intervals.*

# 3 - Catch scenarios

*Table 1 : Northern shrimp in ICES subareas 1 and 2. The basis for the catch scenarios.*

| Variable | Value | Notes |
|---|---|---|
| Mean $F_{2022}/F_{MSY}$ | 0.30 | Corresponds to the estimated catch in 2022. |
| Mean $B_{2022}/B_{MSY}$ | 1.67 | $B_{2022}$ is the biomass at the end of 2022, considering the estimated catch in 2022. |
| Catch 2022 (t) | 56 792 | Preliminary data All catches are assumed to be landed;in tonnes. |

*Table 2 : Northern shrimp in ICES subareas 1 and 2. Annual catch scenarios for 2023.*

| Basis | Fish at $F_{MSY}$ | $F_{MSY}$ mode | Constant catch | | | |
|---|---|---|---|---|---|---|
| Catches (kt) | 188 | 153 | 100 | 125 | 150 | 175 |
| Stock size ($B/B_{MSY}$) | 1.54 | 1.58 | 1.63 | 1.61 | 1.58 | 1.55 |
| Fishing mortality ($F/F_{MSY}$) | 1.00 | 0.80 | 0.52 | 0.65 | 0.79 | 0.93 |
| Probability of falling below $B_{lim}$ | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Probability of falling below $B_{trigger}$ | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Probability of exceeding $F_{msy}$ | 50.0% | 39.1% | 20.0% | 29.2% | 38.1% | 46.2% |
| Probability of exceeding $F_{lim}$ | 24.8% | 16.9% | 6.4% | 11.0% | 16.3% | 21.9% |

# 4 - Basis of the advice

*Table 3 : Northern shrimp in ICES subareas 1 and 2. The basis of the advice.*

| | |
|---|---|
| Advice basis | MSY approach using $F_{MSY}$. |
| Management plan | No agreed precautionary management plan for northern shrimp in this area. |

# 5 - Quality of assessment

This stock was benchmarked in 2022 (ICES, 2022). Revised methods for estimation of CPUE and survey index, updated stock priors and a change of the modeling framework ( SpiCT ) were accepted. Combined, this did not alter the overall trends over time or the state of the stock in respect to reference points. Compared to the pre-benchmark assessment in 2021, this yearâ€™s assessment has resulted in a downward revision of stock biomass and an upward revision of F.

The 2022 survey data from the Russian EEZ (approximately 50% of the entire survey area) was not available in time for the stock assessment. The incomplete survey data set for 2022 adds uncertainty to the assessment.

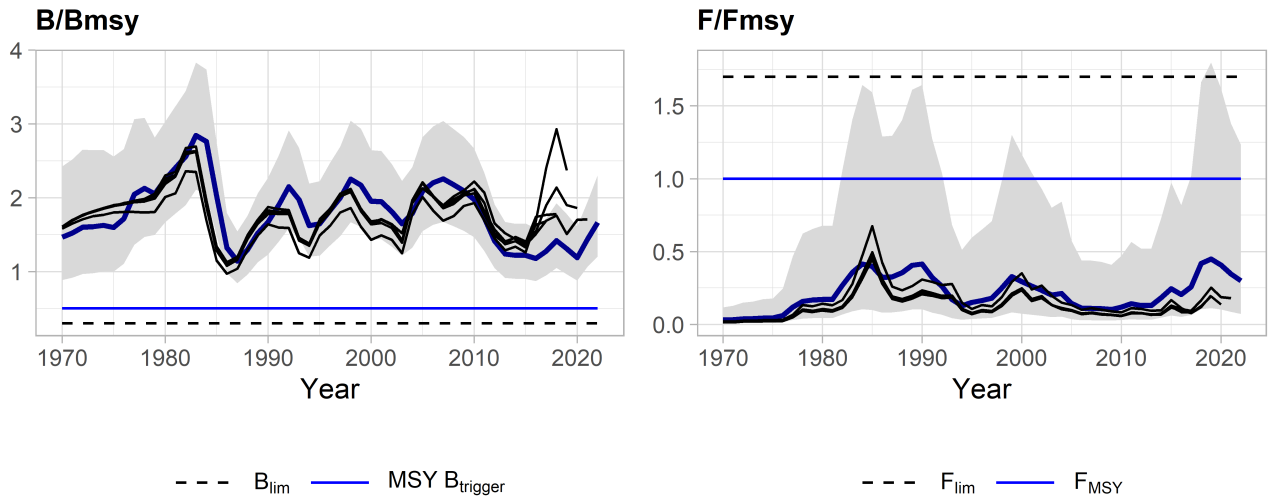


*Figure 2 : Northern shrimp in ICES subareas 1 and 2. Current (bold dark-blue line) and historical assessment results (previous four years) .*

# 6 - Issues relevant for the advice

The advice was derived by IMR (Institute of Marine Research) based on the assessment framework endorsed in 2022 by the benchmark workshop on Pandalus stocks (WKPRAWN) (ICES 2022). The mode of the probability distribution of $F_{MSY}$ is used as the basis for the advice, given the higher uncertainty on the right-hand side of its probability distribution. Catches corresponding to the fishing mortality at median $F_{MSY}$ would imply catches of 188 000 tonnes in 2023.

# 7 - Reference points

*Table 4 : Northern shrimp in ICES subareas 1 and 2. Reference points, values, and their technical basis.*

| Framework | Reference p oint | Value | Technical basis | Source |
|---|---|---|---|---|
| MSY approach | MSY $B_{trigger}$ | 0.5 × $B_{MSY}$ * | Relative value. $B_{MSY}$ is estimated directly from the assessment model and changes when the assessment is updated. | ICES (2013) |
| MSY approach | $F_{MSY}$ | r/2 * | Relative value. $F_{MSY}$ is estimated directly from the assessment model and changes when the assessment is updated. | ICES (2013) |
| Precautionary approach | $B_{lim}$ | 0.3 × $B_{MSY}$ | Relative value (equilibrium yield at this biomass is 50% of MSY). | ICES (2013) |
| Precautionary approach | $B_{pa}$ | Not defined | ** | |
| Precautionary approach | $F_{lim}$ | 1.7 × $F_{MSY}$ | Relative value (the F that drives the stock to Blim).* | ICES (2013) |
| Precautionary approach | $F_{pa}$ | Not defined | ** | |

* Fishing mortality is presented in relation to $F_{MSY}$ , and total stock biomass is presented in relation to $B_{MSY}$ . r is the intrinsic biomass growth rate. These values are directly estimated from the stock assessment and change when the assessment is updated. ** $B_{pa}$ and $F_{pa}$ are not defined as t he assessment provides direct estimate s of the probabilities of $B < B_{lim}$ and of $F > F_{lim}$.

# 8 - Basis of the assessment

*Table 5 : Northern shrimp in ICES subareas 1 and 2. Basis of the assessment and advice.*

| **Assessment type** | **Surplus production in continuous time (SPiCT)** |
|---|---|
| Input data | Fishery catches 1970–2022. Three survey indices: the Norwegian shrimp survey 1982–2004 [G3653], the Russian shrimp survey 1984–2005 [G4941], and the Norwegian–Russian ecosystem survey (Eco-Norw-Q3 [A5216]) since 2004; one fishery-based index (standardized CPUE from Norwegian logbooks) since 1980. |
| Discards and bycatch | Discarding is considered to be negligible. |
| Other information | None |

# 9 - History of the advice, catch, and management

*Table 6 : Northern shrimp in ICES subareas 1 and 2. ICES advice and official landings. Weights are in tonnes.*

| Year | Advice | Catches corresponding to advice | Agreed TAC | ICES catches |
|---|---|---|---|---|
| 2005 | No increase compared to 2004 | 43600 | - | 42 618 |
| 2006 | No increase in catch above recent level | 40000 | - | 29 627 |
| 2007 | Catch that will prevent exceeding Flim in the long term | 50000 | - | 29 931 |
| 2008 | Catch that will prevent exceeding Flim in the long term | 50000 | - | 28 188 |
| 2009 | Catch that will prevent exceeding Flim in the long term | 50000 | - | 27 272 |
| 2010 | Catch that will prevent exceeding Flim in the long term | 50000 | - | 25 198 |
| 2011 | Catch that will prevent exceeding $F_{MSY}$ in the long term | 60000 | - | 30 226 |
| 2012 | Catch that will prevent exceeding $F_{MSY}$ in the long term | 60000 | - | 24 756 |
| 2013 | Catch that will maintain stock at current high biomass | 60000 | - | 19 249 |
| 2014 | No new advice, same as for 2013 | 60000 | - | 20 964 |
| 2015 | Move exploitation towards $F_{MSY}$ | < 70000 | - | 34 022 |
| 2016 | Move exploitation towards $F_{MSY}$ | < 70000 | - | 30 749 |
| 2017 | Move exploitation towards $F_{MSY}$ | ≤ 70000 | - | 30 442 |
| 2018 | MSY approach: move exploitation towards $F_{MSY}$ | ≤ 70000 | - | 56 341 |
| 2019 | MSY approach: move exploitation towards $F_{MSY}$ | ≤ 70000 | - | 76 086 |
| 2020 | MSY approach: mode of the $F_{MSY}$ distribution as basis | ≤ 150000 | - | 61 877 |
| 2021 | MSY approach: mode of the $F_{MSY}$ distribution as basis | ≤ 140000 | - | 58 030 |
| 2022 | MSY approach: mode of the $F_{MSY}$ distribution as basis | ≤ 140000 | - | 56 791 |
| 2023 | MSY approach: mode of the $F_{MSY}$ distribution as basis | ≤ 1 53 000 | | |

# 10 - History of the catch and landings

*Table 7 : Northern shrimp in ICES subareas 1 and 2. ICES catches (tonnes). "Others" are EU, Iceland, Faroes, Greenland, and UK.*

| Year | Norway | Russia | Others | Total |
|---|---|---|---|---|
| 1970 | 5508 | 0 | 0 | 5508 |
| 1971 | 5116 | 0 | 26 | 5142 |
| 1972 | 6772 | 0 | 0 | 6772 |
| 1973 | 6921 | 0 | 0 | 6921 |
| 1974 | 8008 | 0 | 0 | 8008 |
| 1975 | 8197 | 0 | 2 | 8199 |
| 1976 | 9752 | 0 | 0 | 9752 |
| 1977 | 14700 | 0 | 4854 | 19554 |
| 1978 | 20484 | 18270 | 189 | 38943 |
| 1979 | 25435 | 10474 | 390 | 36299 |
| 1980 | 35061 | 11219 | 0 | 46280 |
| 1981 | 32713 | 9886 | 1011 | 43610 |
| 1982 | 43451 | 15552 | 3835 | 62838 |
| 1983 | 70798 | 29105 | 4903 | 104806 |
| 1984 | 76636 | 43180 | 8246 | 128062 |
| 1985 | 82123 | 32104 | 10262 | 124489 |
| 1986 | 48569 | 10216 | 6538 | 65323 |
| 1987 | 31353 | 6690 | 5324 | 43367 |
| 1988 | 32021 | 12320 | 4348 | 48689 |
| 1989 | 47064 | 12252 | 3432 | 62748 |
| 1990 | 54182 | 20295 | 6687 | 81164 |
| 1991 | 39663 | 29434 | 6156 | 75253 |
| 1992 | 39657 | 20944 | 8021 | 68622 |
| 1993 | 32663 | 22397 | 806 | 55866 |
| 1994 | 20162 | 7108 | 1063 | 28333 |
| 1995 | 19337 | 3564 | 2319 | 25220 |
| 1996 | 25445 | 5747 | 3320 | 34512 |
| 1997 | 29079 | 1493 | 5163 | 35735 |
| 1998 | 44792 | 4895 | 6103 | 55790 |
| 1999 | 52612 | 10765 | 12293 | 75670 |
| 2000 | 55333 | 19596 | 5768 | 80697 |
| 2001 | 43031 | 5846 | 8408 | 57285 |
| 2002 | 48799 | 3790 | 8899 | 61488 |
| 2003 | 34172 | 2776 | 2277 | 39225 |
| 2004 | 35918 | 2410 | 4406 | 42734 |
| 2005 | 37253 | 435 | 4930 | 42618 |

| Year | Norway | Russia | Others | Total |
|---|---|---|---|---|
| 2006 | 27352 | 4 | 2271 | 29627 |
| 2007 | 25558 | 192 | 4180 | 29930 |
| 2008 | 20662 | 417 | 7109 | 28188 |
| 2009 | 19784 | 0 | 7489 | 27273 |
| 2010 | 16776 | 0 | 8419 | 25195 |
| 2011 | 19928 | 0 | 10298 | 30226 |
| 2012 | 14159 | 5 | 10600 | 24763 |
| 2013 | 8846 | 1067 | 9335 | 19248 |
| 2014 | 10234 | 741 | 9989 | 20964 |
| 2015 | 16618 | 1151 | 16253 | 34022 |
| 2016 | 10898 | 2491 | 17359 | 30749 |
| 2017 | 7010 | 3849 | 19582 | 30442 |
| 2018 | 23126 | 12561 | 20654 | 56341 |
| 2019 | 23925 | 28081 | 21576 | 73582 |
| 2020 | 19116 | 21265 | 18000 | 58380 |
| 2021* | 30281 | 12378 | 15370 | 58030 |
| 2022* | 368 62 | 3790 | 1613 8 | 56791 |

*Preliminary

# 11 - Summary of the assessment

*Table 8 : Northern shrimp in ICES subareas 1 and 2. Assessment summary. Biomass is relative to BMSY at the end of the year and fishing mortality relative to FMSY. High and low values are the 95% confidence intervals. Catches are in tonnes. Catches for 2021 and 2022 are preliminary.*

| Year | $B/B_{MSY}$ | | | Catch (t) | $F/F_{MSY}$ | | |
|---|---|---|---|---|---|---|---|
| | Mean | L ow | High | | Mean | Low | High |
| 1970 | 1.47 | 0.89 | 2.43 | 5508 | 0.03 | 0.01 | 0.12 |
| 1971 | 1.52 | 0.92 | 2.52 | 5142 | 0.03 | 0.01 | 0.13 |
| 1972 | 1.60 | 0.97 | 2.65 | 6772 | 0.04 | 0.01 | 0.15 |
| 1973 | 1.61 | 0.98 | 2.65 | 6921 | 0.04 | 0.01 | 0.16 |
| 1974 | 1.63 | 1.00 | 2.65 | 8008 | 0.04 | 0.01 | 0.17 |
| 1975 | 1.60 | 1.00 | 2.56 | 8199 | 0.05 | 0.01 | 0.18 |
| 1976 | 1.72 | 1.11 | 2.66 | 9752 | 0.06 | 0.02 | 0.24 |
| 1977 | 2.05 | 1.36 | 3.06 | 19554 | 0.12 | 0.03 | 0.47 |
| 1978 | 2.13 | 1.47 | 3.08 | 38943 | 0.16 | 0.04 | 0.62 |
| 1979 | 2.05 | 1.50 | 2.82 | 36299 | 0.17 | 0.04 | 0.66 |
| 1980 | 2.25 | 1.67 | 3.03 | 46280 | 0.17 | 0.04 | 0.68 |
| 1981 | 2.41 | 1.79 | 3.24 | 43610 | 0.17 | 0.04 | 0.68 |
| 1982 | 2.56 | 1.90 | 3.45 | 62838 | 0.27 | 0.07 | 1.06 |
| 1983 | 2.84 | 2.11 | 3.83 | 104806 | 0.36 | 0.09 | 1.41 |
| 1984 | 2.76 | 2.04 | 3.74 | 128062 | 0.42 | 0.10 | 1.64 |
| 1985 | 2.02 | 1.49 | 2.75 | 124489 | 0.40 | 0.10 | 1.59 |
| 1986 | 1.32 | 0.98 | 1.79 | 65323 | 0.32 | 0.08 | 1.29 |
| 1987 | 1.14 | 0.84 | 1.55 | 43367 | 0.33 | 0.08 | 1.29 |
| 1988 | 1.30 | 0.96 | 1.76 | 48689 | 0.36 | 0.09 | 1.40 |
| 1989 | 1.52 | 1.13 | 2.06 | 62748 | 0.41 | 0.10 | 1.61 |
| 1990 | 1.67 | 1.23 | 2.27 | 81164 | 0.41 | 0.10 | 1.64 |
| 1991 | 1.90 | 1.40 | 2.57 | 75253 | 0.32 | 0.08 | 1.28 |
| 1992 | 2.15 | 1.59 | 2.91 | 68622 | 0.26 | 0.07 | 1.04 |
| 1993 | 1.98 | 1.46 | 2.68 | 55866 | 0.17 | 0.04 | 0.68 |
| 1994 | 1.62 | 1.20 | 2.19 | 28333 | 0.13 | 0.03 | 0.51 |
| 1995 | 1.65 | 1.22 | 2.23 | 25220 | 0.15 | 0.04 | 0.60 |
| 1996 | 1.83 | 1.35 | 2.47 | 34512 | 0.16 | 0.04 | 0.65 |
| 1997 | 2.00 | 1.48 | 2.69 | 35735 | 0.18 | 0.05 | 0.71 |
| 1998 | 2.25 | 1.67 | 3.04 | 55790 | 0.25 | 0.06 | 0.99 |
| 1999 | 2.17 | 1.61 | 2.94 | 75670 | 0.33 | 0.08 | 1.30 |
| 2000 | 1.96 | 1.44 | 2.65 | 80697 | 0.29 | 0.07 | 1.17 |
| 2001 | 1.95 | 1.44 | 2.64 | 57285 | 0.26 | 0.07 | 1.04 |
| 2002 | 1.81 | 1.34 | 2.46 | 61488 | 0.23 | 0.06 | 0.93 |
| 2003 | 1.65 | 1.22 | 2.23 | 39225 | 0.20 | 0.05 | 0.80 |

| Year | B/B | | | Catch (t) | F /F | | |
|---|---|---|---|---|---|---|---|
| | Mean | L ow | High | | Mean | Low | High |
| 2004 | 1.79 | 1.32 | 2.41 | 42734 | 0.21 | 0.05 | 0.84 |
| 2005 | 2.09 | 1.55 | 2.82 | 42618 | 0.14 | 0.04 | 0.57 |
| 2006 | 2.20 | 1.63 | 2.97 | 29627 | 0.11 | 0.03 | 0.44 |
| 2007 | 2.26 | 1.67 | 3.04 | 29930 | 0.11 | 0.03 | 0.44 |
| 2008 | 2.18 | 1.62 | 2.93 | 28188 | 0.11 | 0.03 | 0.43 |
| 2009 | 2.09 | 1.55 | 2.82 | 27273 | 0.10 | 0.03 | 0.41 |
| 2010 | 1.98 | 1.47 | 2.67 | 25195 | 0.12 | 0.03 | 0.47 |
| 2011 | 1.73 | 1.28 | 2.33 | 30226 | 0.14 | 0.04 | 0.57 |
| 2012 | 1.41 | 1.04 | 1.91 | 24763 | 0.13 | 0.03 | 0.52 |
| 2013 | 1.24 | 0.92 | 1.67 | 19248 | 0.13 | 0.03 | 0.52 |
| 2014 | 1.22 | 0.90 | 1.65 | 20964 | 0.18 | 0.05 | 0.73 |
| 2015 | 1.22 | 0.90 | 1.65 | 34022 | 0.24 | 0.06 | 0.97 |
| 2016 | 1.18 | 0.87 | 1.59 | 30749 | 0.21 | 0.05 | 0.82 |
| 2017 | 1.28 | 0.95 | 1.72 | 30442 | 0.26 | 0.07 | 1.02 |
| 2018 | 1.42 | 1.05 | 1.93 | 56341 | 0.42 | 0.11 | 1.66 |
| 2019 | 1.31 | 0.96 | 1.78 | 73582 | 0.45 | 0.11 | 1.80 |
| 2020 | 1.19 | 0.88 | 1.61 | 58380 | 0.41 | 0.10 | 1.62 |
| 2021 | 1.44 | 1.06 | 1.94 | 58030 | 0.35 | 0.09 | 1.38 |
| 2022 | 1.67 | 1.20 | 2.31 | 56792 | 0.30 | 0.07 | 1.23 |

# 12 - Sources and references

Hvingel, C. and Zimmerman, F. 2023. Stock assessment report for Northern shrimp (*Pandalus borealis*) in the Barents Sea (ICES Subareas 1 and 2). IMR-PINRO report series 2 -2023 .

ICES. 2013. Report of the Inter-Benchmark Protocol on Pandalus in Skagerrak and the Norwegian Deep (IBPPand), 12–19 September 2013, Dartmouth, NS, Canada. ICES CM 2013/ACOM:71. 10 pp. https://doi.org/10.17895/ices.pub.5688.

ICES. 2022. Benchmark workshop on Pandalus stocks ( WKPRAWN ). Edited by C. Lordan, and J. Lövgren. https://doi.org/10.17895/ices.pub.19714204.v1

Institute of Marine Research – IMR

Polar branch of the FSBSI “VINRO” (“PINRO”)