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Advice on fishing opportunities
for Barents Sea shrimp in 2023



Institute of Marine Research – IMR



Polar branch of the FSBSI "VINRO" ("PINRO")

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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 F_{MSY} , 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 | | | |
|--|-------------------|----------------|----------------|-------|-------|-------|
| | | | 100 | 125 | 150 | 175 |
| 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 year’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.

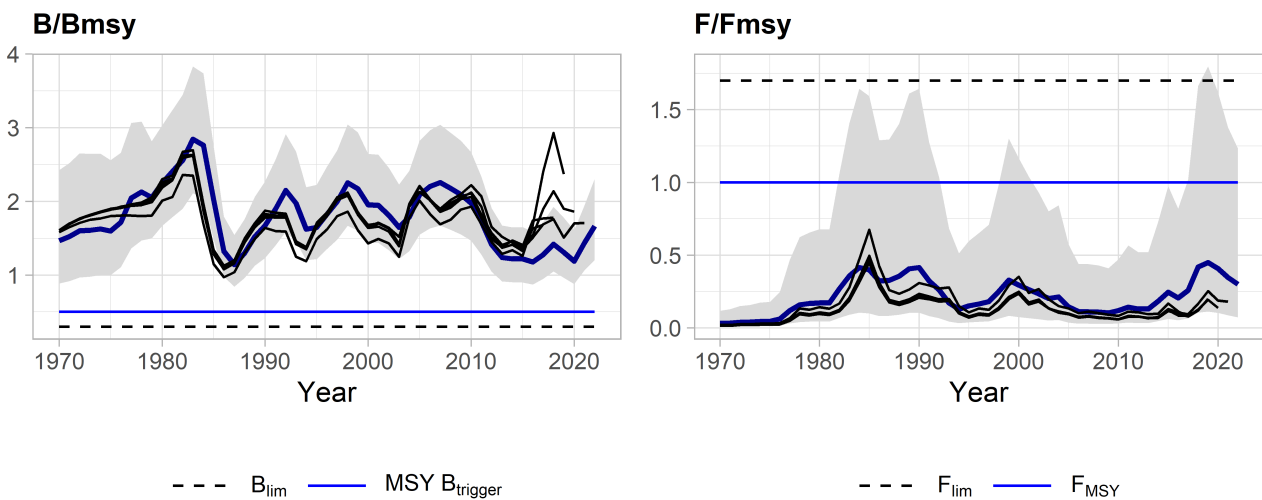


Figure 2 : Northern shrimp in ICES subareas 1 and 2. Current (bold dark-blue line) and historical assessment results (previous four years) .

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 point | 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 B _{lim}).* | 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 the assessment provides direct estimates 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 F_{lim} in the long term | 50000 | - | 29 931 |
| 2008 | Catch that will prevent exceeding F_{lim} in the long term | 50000 | - | 28 188 |
| 2009 | Catch that will prevent exceeding F_{lim} in the long term | 50000 | - | 27 272 |
| 2010 | Catch that will prevent exceeding F_{lim} 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 |

| Year | Norway | Russia | Others | Total |
|-------|--------|--------|--------|-------|
| 2003 | 34172 | 2776 | 2277 | 39225 |
| 2004 | 35918 | 2410 | 4406 | 42734 |
| 2005 | 37253 | 435 | 4930 | 42618 |
| 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 | Low | 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 |

| Year | B/B | | | Catch (t) | F /F | | |
|------|------|------|------|-----------|------|------|------|
| | Mean | Low | High | | Mean | Low | High |
| 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 |
| 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

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