

Life-history and population dynamics of a short-lived Norwegian capelin stock

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Supplementary Material

Table S1 Overview of temperatures in Balsfjord in deep water that is relevant as ambient temperature for capelin caught in 1981 (Nyholmen and Hopkins 1988), and 2019 and 2022 in this study. Temperatures are digitized from Oug (2000) (depth 175 m) and Bjørndalen (2023) (depth 140 m). Temperatures are for time periods spanning from quarter 2 in first year in “Time-period” to quarter 1 in last year

Time period	Matching year class	Age (years)	Spawning year at age 2	Source	
				Oug (2000) (°C)	Bjørndalen (2023) (°C)
1979-80	1979	0-1	1981	1.5	
1980-81	1979	1-2		2.4	2.5
2017-18	2017	0-1	2019		4.7
2018-19	2017	1-2			3.1
2020-21	2020	0-1	2022		3.2
2021-22	2010	1-2			3.7

Table S2 Overview of data for the period 1981-2006 used to calculate baseline mortality rates for Barents Sea capelin. SSB is the spawning stock biomass. Z is the total mortality rate (year⁻¹) in the age interval calculated as $Z = (\ln(N_1) - \ln(N_2)) / (\text{age } 2 - \text{age } 1)$ where N_1 is abundance at age 1 and N_2 is abundance at age 2. Data are from table 9.4 and table 9.5 in ICES (2016). Empty cells with no value for Z for age 1 to 2 are for years where numbers at age 2 are larger than numbers at age 1

Year	SSB (tons*10 ³)	Egg abundance (No. ind.) ¹	Larval abundance (No ind.)	Numbers at age 1 ² (10 ⁹ ind.)	Numbers at age 2 ³ (10 ⁹ ind.)	Z (Egg to larvae)	Z (Larvae to age 1)	Z (age 1 to age 2)
1981	316	9.23E+13	9.7E+12	528.3	200.2	2.25	2.91	0.97
1982	106	3.10E+13	9.9E+12	514.8	186.5	1.14	2.96	1.02
1983	100	2.92E+13	9.9E+12	154.8	48.3	1.08	4.16	1.16
1984	109	3.18E+13	8.2E+12	38.7	4.7	1.36	5.36	2.11
1985	*	*	8.6E+12	6	1.7		7.27	1.26
1986	*	*	0.0	37.6	28.7			0.27
1987	34	9.93E+12	3E+11	21	17.7	3.50	2.66	0.17
1988	*	*	3E+11	189.2	177.6		0.46	0.06
1989	84	2.45E+13	7.3E+12	700.4	580.2	1.21	2.34	0.19
1990	92	2.69E+13	1.3E+13	402.1	196.3	0.73	3.48	0.72
1991	643	1.88E+14	3E+12	351.3	53.4	4.14	2.14	1.88
1992	302	8.82E+13	7.3E+12	2.2	3.4	2.49	8.11	
1993	293	8.56E+13	3.3E+12	19.8	8.1	3.26	5.12	0.89
1994	139	4.06E+13	1E+11	7.1	11.5	6.01	2.65	
1995	60	1.75E+13	0.0	81.9	39.1			0.74
1996	60	1.75E+13	2.4E+12	98.9	72.6	1.99	3.19	0.31
1997	85	2.48E+13	6.9E+12	179	101.5	1.28	3.65	0.57
1998	94	2.74E+13	1.41E+13	156	110.6	0.67	4.50	0.34
1999	382	1.12E+14	3.65E+13	449.2	218.7	1.12	4.40	0.72
2000	599	1.75E+14	1.91E+13	113.6	90.8	2.21	5.12	0.22
2001	626	1.83E+14	1.07E+13	59.7	9.6	2.84	5.19	1.83
2002	496	1.45E+14	2.24E+13	82.4	24.8	1.87	5.61	1.20
2003	427	1.25E+14	1.19E+13	51.2	13	2.35	5.45	1.37
2004	94	2.74E+13	2.5E+12	26.9	21.7	2.40	4.53	0.21
2005	122	3.56E+13	8.8E+12	60.1	54.7	1.40	4.99	0.09
2006	72	2.10E+13	1.71E+13	221.7	231.4	0.21	4.35	

*) Indicates a very small spawning stock or very low egg abundance

1) Calculated from spawning stock biomass (SSB), average fecundity of 584 eggs per g female weight (Tereschenko 2002), assuming that females make up half the spawning stock biomass

2) This is the number of individuals at age 1 produced from the spawning stock in the given year

3) This is the number of individuals at age 2 produced from the spawning stock in the given year

Table S3 Overview of stage durations and average mortality rates (Z , year^{-1}) in various age intervals calculated from data from the Barents Sea capelin stock for 1981-2006 in table S2

Age interval	Egg -> larvae	Larvae -> 0-group -> age 1	Age 1->Age 2
Duration age interval (days)	76	472	365
Duration in years	0.208	1.293	0.499
End of age interval (years)	0.208	1.501	2.000
Av Z (year^{-1})	9.93	3.24	0.80^1
SD (year^{-1})	6.34	1.30	0.61^1
Z (day^{-1})	0.027	0.009	0.002

1) Calculated for a time-period of 1.0 year between surveys in October

Table S4 Overview of input values and parameters for data from 2019 used in the Balsfjord capelin offspring model to calculate P/B through Monte Carlo simulation and filtering. The age (in years) at start of the age interval is given in brackets in the first column. Baseline values and half_intervals (baseline – half_interval, baseline + half_interval) were used to define the uniform distributions for generating random input values for the Monte Carlo simulations. Z represent the mortality rate (year⁻¹). Spawning biomass refers to the calculated life-time spawning biomass of one single female. The standard deviation (SD) or 95% confidence intervals (CI) for baseline values is given in parentheses. Ranges for acceptable spawning biomass and observed proportions of age classes in the spawning stock are shown in square brackets

Stage/age interval (age)	Variable	Unit	Baseline value	half_interval
Mature fish	Fecundity	No female ⁻¹	8910 ¹	1848
Egg (0.0)	W	(g)	0.00034 ²	0.00006
Larvae (0.208)	W	(g)	0.0033 ³	0.002
0-group 1 Sep. (0.333)	W	(g)	0.074 ⁴	0.007
Age 1 (1.0)	W	(g)	0.66 (CI 0.10) ⁵	0.10
Age 2 (2.00)	W	(g)	9.05 (CI 0.5) ⁵	2
Age 3 (3.00)	W	(g)	10.4 (CI 1.3) ⁵	2
Age 4 (4.00)	W	(g)	10.4 ⁶	2.32
Eggs to larvae	Non-spawn. Z1	(year ⁻¹)	9.9 (SD 6.3) ⁷	8
Larvae to 0-gr	Non-spawn. Z2	(year ⁻¹)	3.3 (SD 1.3) ⁷	2.0
0-gr to age 1	Non-spawn. Z3	(year ⁻¹)	3.3 (SD 1.3) ⁷	2.0
Age 1 to 5	Non-spawn. Z4-Z9	(year ⁻¹)	1.9 (CI 0.5) ⁸	1.0
Age 2	Pmat ₂	Prop.	0.70 ⁹	0.30
Age 3	Pmat ₃	Prop.	1.0 ⁹	0.0
Age 4-5	Pmat ₄₋₅	Prop.	1.0 ⁹	0.0
Age 2-4	Pmort ₂₋₄	Prop.	0.25 ⁹	0.25
Female spawning biomass	SB	(g)	8.2 [4.1, 12.3] ¹⁰	
Age 2-4	Age. comp.	Prop.	[0.92, 0.008, 0.00] ¹¹	

- 1) Data from this study, calculated from relative fecundity and half_interval assuming same SD/mean as in Table 2 with pooled 2019 and 2002 data
- 2) From Christiansen et al. (2008)
- 3) Based on Moksness (1982) and Jakobsen et al. (2004), assumed length of 20 mm at 45 days post hatching
- 4) Assumed length of 3.5 cm on 1th September, based on growth rate from Jakobsen et al. (2004)
- 5) This study, based on back-calculated lengths converted to body weights
- 6) Assumed to be equal to three-year-old fish
- 7) Based on mortality rates from the Barents Sea half intervals increased to account for increased uncertainty due to “borrowing” of value
- 8) This study, from Chapman -Robson catch curve method. A common baseline value was input for age intervals from 1 to 5, but separate z-values were drawn for each age interval
- 9) Proportion maturity at age (Pmat) and proportion spawning mortality (Pmort) from inspection of spawning stock age composition
- 10) This study, test criterion equal to average weight of females in the spawning stock and range corresponding to a 50% increase or decrease produced female spawning biomass
- 11) This study, test criterion. Observed age-composition (proportions) in the spawning stock for pooled data from 2019

Table S5 Overview of input values and parameters for data from 2022 used in the Balsfjord capelin offspring model to calculate P/B through Monte Carlo simulation and filtering. The age (in years) at start of the age interval is given in brackets in the first column. Baseline values and half_intervals (baseline – half_interval, baseline + half_interval) were used to define the uniform distributions for generating random input values for the Monte Carlo simulations. Z represent the mortality rate (year⁻¹). Spawning biomass refers to the calculated life-time spawning biomass of one single female. The standard deviation (SD) or 95% confidence intervals (CI) for baseline values is given in parentheses. Ranges for acceptable spawning biomass and observed proportions of age classes in the spawning stock are shown in square brackets

Stage/age interval (age)	Variable	Unit	Baseline value	half_interval
Mature fish	Fecundity	No female ⁻¹	8490 (CI 1761) ¹	1761
Egg (0.0)	W	(g)	0.00034 ²	0.00006
Larvae (0.208)	W	(g)	0.0033 ³	0.002
0-group 1 Sep. (0.333)	W	(g)	0.074 ⁴	0.007
Age 1 (1.0)	W	(g)	0.66 (CI 0.10) ⁵	0.10
Age 2 (2.00)	W	(g)	8.7 (CI 0.5) ⁵	0.5
Age 3 (3.00)	W	(g)	9.9 (CI 1.3) ⁵	1.3
Age 4 (4.00)	W	(g)	9.9 ⁶	1.3
Eggs to larvae	Non-spawn. Z1	(year ⁻¹)	9.9 (SD 6.3) ⁷	8
Larvae to 0-gr	Non-spawn. Z2	(year ⁻¹)	3.3 (SD 1.3) ⁷	2.0
0-gr to age 1	Non-spawn. Z3	(year ⁻¹)	3.3 (SD 1.3) ⁷	2.0
Age 1 to 5	Non-spawn. Z4-Z9	(year ⁻¹)	1.9 (CI 0.5) ⁸	1.0
Age 2	Pmat ₂	Prop.	0.70 ⁹	0.30
Age 3	Pmat ₃	Prop.	1.0 ⁹	0.0
Age 4-5	Pmat ₄	Prop.	1.0 ⁹	0.0
Age 2-4	Pmort ₂₋₄	Prop.	0.25 ⁹	0.25
Female spawning biomass	SB	(g)	8.9 [4.5, 13.4] ¹⁰	
Age 2-4	Age. comp.	Prop.	[0.74, 0.26, 0.00] ¹¹	

4) Data from this study, based on 18 fish

- 5) From Christiansen et al. (2008)
- 6) Based on Moksness (1982) and Jakobsen et al. (2004), assumed length of 20 mm at 45 days post hatching
- 4) Assumed length of 3.5 cm on 1th September, based on growth rate from Jakobsen et al. (2004)
- 5) This study, based on back-calculated lengths converted to body weights
- 6) Assumed to be equal to three-year-old fish
- 7) Based on mortality rates from the Barents Sea half intervals increased to account for increased uncertainty due to borrowing of value
- 8) This study, from Chapman -Robson catch curve method. A common baseline value was input for age intervals from 1 to 5, but separate z-values were drawn for each age interval
- 9) Proportion maturity at age (Pmat) and proportion spawning mortality (Pmort) from inspection of spawning stock age composition
- 10) This study, test criterion equal to average weight of females in the spawning stock and range corresponding to a 50% increase or decrease produced female spawning biomass
- 11) This study, test criterion. Observed age-composition (proportions) in the spawning stock for pooled data from 2022

Table S6 Overview of input values and parameters for data from 1981 used in the Balsfjord capelin offspring model to calculate P/B through Monte Carlo simulation and filtering. The age (in years) at start of the age interval is given in brackets in the first column. Baseline values and half_intervals (baseline – half_interval, baseline + half_interval) were used to define the uniform distributions for generating random input values for the Monte Carlo simulations. Z represent the mortality rate (year⁻¹). Spawning biomass refers to the calculated life-time spawning biomass of one single female. The standard deviation (SD) or 95% confidence intervals (CI) for baseline values is given in parentheses. Ranges for acceptable spawning biomass and observed proportions of age classes in the spawning stock are shown in square brackets

Stage/age interval (age)	Variable	Unit	Baseline value	half_interval
Mature fish	Fecundity	No female ⁻¹	7114 ¹⁾	1761
Egg (0.0)	W	(g)	0.00034 ²⁾	0.00006
Larvae (0.208)	W	(g)	0.0033 ³⁾	0.002
0-group 1 Sep. (0.333)	W	(g)	0.074 ⁴⁾	0.007
Age 1 (1.0)	W	(g)	0.66 (CI 0.10) ⁵⁾	0.10
Age 2 (2.00)	W	(g)	5.6 ⁵⁾	2
Age 3 (3.00)	W	(g)	8.7 ⁵⁾	2
Age 4 (4.00)	W	(g)	8.7 ⁶⁾	2
Eggs to larvae	Z1	(year ⁻¹)	9.9 (SD 6.3) ⁷⁾	8
Larvae to 0-gr	Z2	(year ⁻¹)	3.3 (SD 1.3) ⁷⁾	2.0
0-gr to age 1	Z3	(year ⁻¹)	3.3 (SD 1.3) ⁷⁾	2.0
Age 1 to 5	Non-spawn. Z4-8	(year ⁻¹)	1.9 (CI 0.5) ⁸⁾	1.0
Age 2	Pmat ₂	Prop.	0.70 ⁹⁾	0.30
Age 3	Pmat ₃	Prop.	1.0 ⁹⁾	0.0
Age 4-5	Pmat ₄₋₅	Prop.	1.0 ⁹⁾	0.0
Age 2-4	Pmort ₂₋₄	Prop.	0.25 ⁹⁾	0.25
Female spawning biomass	SB	(g)	6.7 [3.3, 9.8] ¹⁰⁾	
Age 2-4	Age. comp.	Prop.	[0.69, 0.28, 0.02] ¹¹⁾	

7) Data from this study, based on 18 fish from 2019 and 2022. Fecundity is adjusted to individual weights for 1981. Half_interval is the same as for pooled 2019 and 2022 data

8) From Christiansen et al. (2008)

- 9) Based on Moksness (1982) and Jakobsen et al. (2004), assumed length of 20 mm at 45 days post hatching
- 4) Assumed length of 3.5 cm on 1st September, based on growth rate from Jakobsen et al. (2004)
- 5) This study, based on back-calculated lengths converted to body weights
- 6) Assumed to be equal to three-year-old fish
- 7) Based on mortality rates from the Barents Sea half intervals increased to account for increased uncertainty due to borrowing of value
- 8) This study, from Chapman -Robson catch curve method
- 9) Proportion maturity at age (P_{mat}) and proportion spawning mortality (P_{mort}) from inspection of spawning stock age composition
- 10) This study, test criterion equal to average weight of females in the spawning stock and range corresponding to a 50% increase or decrease produced female spawning biomass
- 11) This study, test criterion. Observed age-composition in the spawning stock for pooled data from 1981

Table S7 Overview of average total lengths for capelin of age 2 and 3 sampled in 2019 and 2022 in Balsfjord. n is the number of fish SD is the standard deviation. t is the t-value for test for equal average values between groups). p-value is the significance probability. F = females, M = males. The Shapiro-Wilks test is used to test for deviation from normality

Comparison	Year	Sex	Age (years)	n	Av. Length (cm) (SD)	Shapiro-Wilks test	t p-value
Between years within sex and age class	2019	F	2	12	12.6 (0.7)	p = 1.0	t = 4.2
	2022			12	11.6 (0.4)	p = 0.29	p = 0.0006
	2019	M	2	31	13.2 (0.8)	p = 0.49	t = 2.1
	2022			31	12.8 (0.6)	p = 0.61	p = 0.04
	2019	F	3	3	13.1 (0.1)	p = 1.0	t = -0.28
	2022			6	13.2 (0.7)	p = 0.20	p = 0.8
	2019	M	3	1	13.3		
	2022			8	13.4 (1.2)	p = 0.30	
Between sex within year and age class	2019	F	2	12	12.6 (0.7)	p = 1.0	t = -2.3
		M		31	13.2 (0.8)	p = 0.49	p = 0.03
	2022	F	2	12	11.6 (0.4)	p = 0.29	t = -7.1
		M		31	12.8 (0.6)	p = 0.61	p < 0.001
	2022	F	3	6	13.2 (0.7)	p = 1.0	t = 1.32
		M		8	13.4 (1.2)	p = 0.30	p = 0.7
Between sex for pooled years and age classes,	2019 & 2022	F	2 & 3	34	12.4 (0.9)	p = 0.42	t = -3.6 p < 0.001
	2019 & 2022	M	2 & 3	72	13.1 (0.8)	p = 0.29	

Table S8 Overview of average wet weights for capelin of age 2 and 3 sampled in 2019 and 2022 in Balsfjord. n is the number of fish. SD is the standard deviation. t is the t-value for test of equal average values between groups. p is the significance probability. F = females, M = males. The Shapiro-Wilks test is used to test for deviation from normality. For tests where at least one group deviate from normality the Wilcoxon two test sample is applied with W as the test statistic

Comparison	Year	Sex	Age (years)	n	Av. weight (g) (SD)	Shapiro-Wilks test	Two-group test p-value
Between years within sex and age class	2019	F	2	12	8.1 (2.1)	p = 0.01	W = 125
	2022			12	6.0 (1.1)	p = 0.50	p = 0.002
	2019	M	2	31	10.0 (2.4)	p = 0.10	t = 2.0
	2022			31	8.9 (1.7)	p = 0.93	p = 0.05
	2019	F	3	3	9.4 (1.1)	p = 0.09	t = 0.25
	2022			6	9.2 (1.3)	p = 0.37	p = 0.8
	2019	M	3	1	11.4		
	2022			8	10.7 (3.8)	p = 0.32	
Between sex within year and age class	2019	F	2	12	8.1 (2.1)	p = 0.01	W = 97.5
		M		31	10.0 (2.4)	p = 0.10	p = 0.02
	2022	F	2	12	6.0 (1.1)	p = 0.50	t = -6.8
		M		31	8.9 (1.7)	p = 0.93	p < 0.001
	2022	F	3	6	9.2 (1.3)	p = 0.37	t = -1.0
		M		8	10.7 (3.8)	p = 0.32	p = 0.3
Between sex for pooled years and age classes,	2019 & 2022	F	2 & 3	34	7.7 (2.0)	p = 0.20	W = 635
	2019 & 2022	M	2 & 3	72	9.6 (2.4)	p = 0.02	p < 0.001
Between ages for pooled years and sex	2019 & 2022	F & M	2	94	8.7 (2.2)	p = 0.007	W = 631
			3	19	9.9 (2.6)	p = 0.03	p = 0.05

Table S9 Comparison of total lengths of capelin sampled in Balsfjord in 2019 and 2022 versus 1981. Fork lengths (FL) from 1981 from Nyholmen and Hopkins (1988) were converted to total lengths (TL): $(TL = FL * 1.08)$. Average lengths from 2019 or 2022 were tested versus a point value (average) from 1981 using a t-test if groups did not deviate from normality. The Shapiro-Wilks test is used to test for deviation from normality. For groups that deviate from normality, a Wilcoxon signed rank test is used with V as a test-statistic. F = females, M = males.

Sampling years	Average total length for 2019 (cm)	Average total length for 2022 (cm)	Average total length for 1981 (cm)	Age classes (years)	Sex	Test statistics
2019 & 1981	12.6 ¹		10.8	2	F	V = 78, p = 0.002
2019 & 1981	13.2		11.9	2	M	t = 8.5, df=30, p < 0.001
2022 & 1981		11.6	10.8	2	F	t = 6.9, df=11, p < 0.001
2022 & 1981		12.8	11.9	2	M	t = 7.4, df=30, p < 0.001
2019 & 1981	13.1		12.3	3	F	t = 14.3, df=2, p = 0.004
2019 & 1981	13.3 ²		13.3	3	M	
2022 & 1981		13.2	12.3	3	F	t = 3.1, df = 5, p = 0.03
2022 & 1981		13.4	13.3	3	M	t = 0.18, df = 7, p = 0.9

¹ Significant deviation from normality

² Only one individual, could not perform test

Table S10 Overview of the results of an Analysis of Variance (ANOVA) of effects of input parameters on the variation in output P/B-values from the various Monte Carlos filtering simulations (n = 1000 for each filtering run). ANOVA model is: P/B = intercept + Fec + Z1 + Z2 + Z3 + Z4 + Z5 + Z6 + Z7 + Z8 + W1 + W2 + W3 + W4 + W5 + W6 + W7 + W8 + matu_2 + matu_3 + matu_4 + matu_5. See table S4, S5 and S6 for explanation of variable names. The six input parameters (variables in the ANOVA model) that explain most of the variation in P/B are listed with % of variation in output P/B listed for each input parameter. Input parameters and their baseline values are listed in table 2, 3, Supplementary table S4, S5 and S6.

Rank of input variable	Monte Carlo filtering runs				
	Balsfjord 2019 and 2022 (%)	Barents Sea 1980-1982 (%)	Balsfjord 2019 (%)	Balsfjord 2022 (%)	Balsfjord 1981 (%)
1	Z3 50.2	Z1 48.7	Z3 60.4	Z3 37.1	Z3 37.8
2	Z1 22.7	Z3 35.1	Z1 27.9	Z4 27.5	Z1 20.2
3	Z4 15.7	Z5 5.7	Z4 8.3	Z1 18.2	Z4 17.4
4	W2 3.4	Z4 3.3	W2 3.2	W2 6.0	W2 6.0
5	Z2 0.4	W3 0.7	W5 1.9	Fec 1.8	W5 5.5
6	W5 0.3	W5 0.7	Fec 0.9	W5 0.24	Fec 4.0
Sum of variation for six input p. (%)	92.7	94.2	92.6	90.8	90.9
Residuals (%)	7.3	4.4	6.6	8.3	8.0

Table S11 Comparison of relative fecundity of capelin from Balsfjord capelin and other areas. SD is standard deviation. 95% confidence interval of the mean value is given in brackets

Relative fecundity (eggs/g fish weight)	SD (no eggs/ g fish weight)	Location	Source
1086 [903, 1269]	368	Balsfjord	This study
760	145	Balsfjord	Christiansen et al. (2008)
610	65	Barents Sea	Christiansen et al. (2008)
820		Barents Sea (1996)	Huse and Gjøsæter (1997)
594	49	Barents Sea 1980-2000	Tereshchenko (2002)
730		Iceland	Johannsdottir & Vilhjalmsón (1999)
1286-1576		Newfoundland	Penton and Davoren (2013)
590	236	Norton Sound, Alaska	Ressel et al. (2020)

Table S12 Overview of published production per biomass (P/B, year⁻¹) values for capelin from Balsfjord and the Barents Sea. CV is the coefficient of variation

Area or stock	P/B (year ⁻¹)	Method/comment	Source
Balsfjord, pooled data 2019 & 2022	2.21 [1.84, 2.52]	Monte Carlo filtering, loss production method	This study
Barents Sea, 1980-1982	1.66 [1.38, 1.84]	Monte Carlo filtering, loss production method	This study
	0.5		Sakshaug (1997)
	0.47 (CV = 0.35)	From multispecies VPA and predation from cod	Bulgakova and Bobyrev (2020)
	1.0	Ecopath model	Berdnikov et al. (2019)
	1.0	Ecopath model	Dommasnes et al. (2002)
	2.0	Age 1, Ecopath model	Blanchard et al. (2002)
	1.0	Age 2+, Ecopath model	
	6	Age 0, Ecopath model	Skaret and Pitcher (2016)
	1.2	Age 1, Ecopath model	
	1.3	Age 2+, Ecopath model	
	1.5	Age 1, Ecopath model	Bentley et al. (2017)
	1.0	Age 2+, Ecopath model	
	1.07	Age 0-2, Ecopath model	Pedersen et al. (2021)
	1.60	Age 3+, Ecopath model	
	2.8	From catches, stock biomass and consumption estimates	Planque et al. (2024)



Figure S1 Male (upper) and female (lower) capelin from Balsfjord sampled on 18 February 2022 with gonads dissected out. Number scale show length in cm

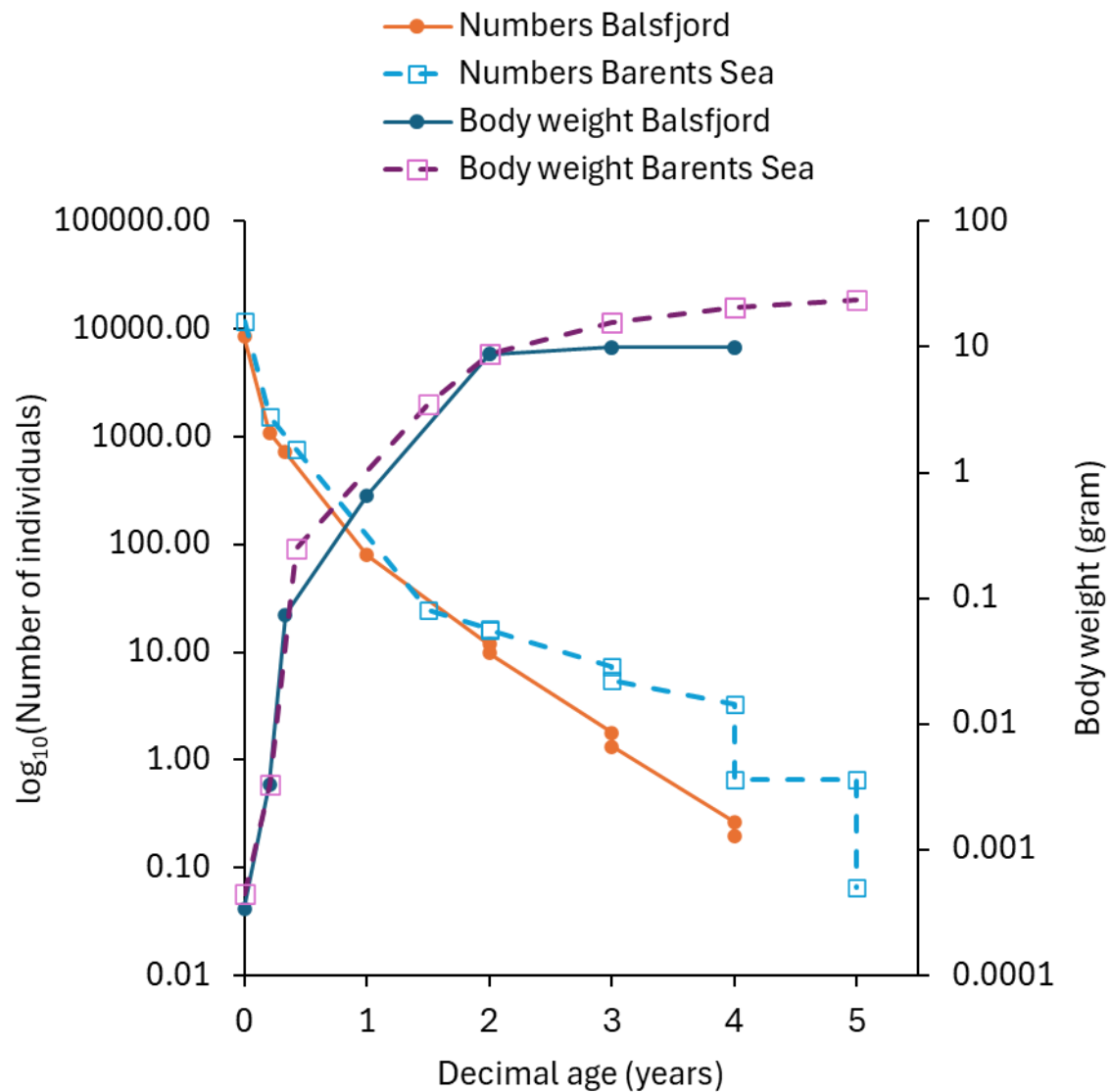


Figure S2 Overview of number of individuals and body weight at age calculated from the baseline values for the Monte Carlo simulations based on values for Balsfjord capelin (pooled data from 2019 and 2022, table 2) and Barents Sea (1980-82, table 3). Number of individuals at decimal age 0 is equal to fecundity of an average female capelin. Number of individuals less than 1.0 individuals is the average decimal number offspring left

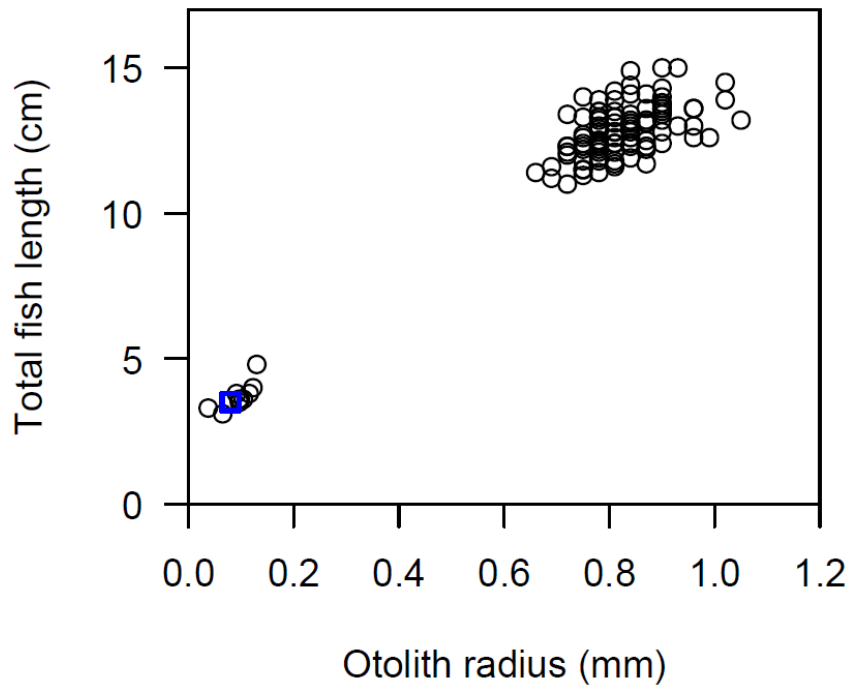


Figure S3 Relationship between otolith radius and total fish length for capelin from Balsfjord in 2019 and 2022 (length > 10 cm) and Porsangerfjord (capelin with lengths between 3 and 5 cm). The point of biological intercept, total length = 3.5 cm, otolith radius = 0.08 mm, from Gjøsæter (1999) is shown as a blue square

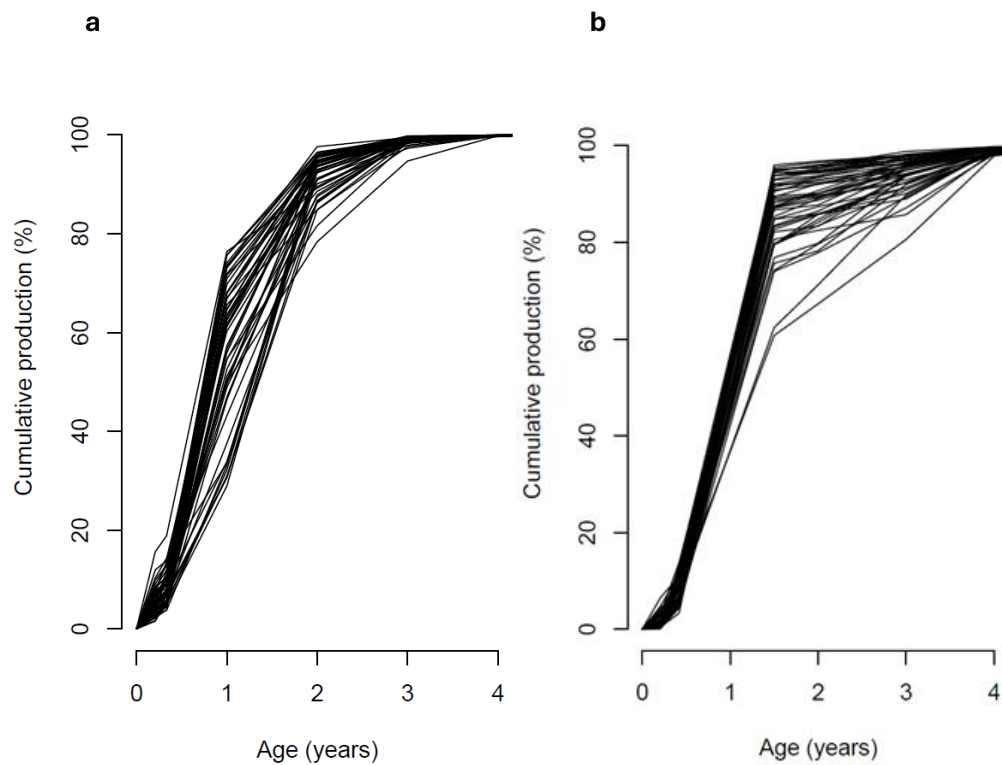


Figure S4 Cumulative production from acceptable Monte Carlo simulations plotted versus decimal age for (a) Balsfjord pooled 2019 and 2022 data, (b) Barents Sea data from 1980-82. Each line shows one accepted Monte Carlo simulation and a total of 50 simulations are shown in each figure. Note that decimal age of 1.50 for the Barents Sea capelin corresponds to time (October) for survey and data on abundance and body weight

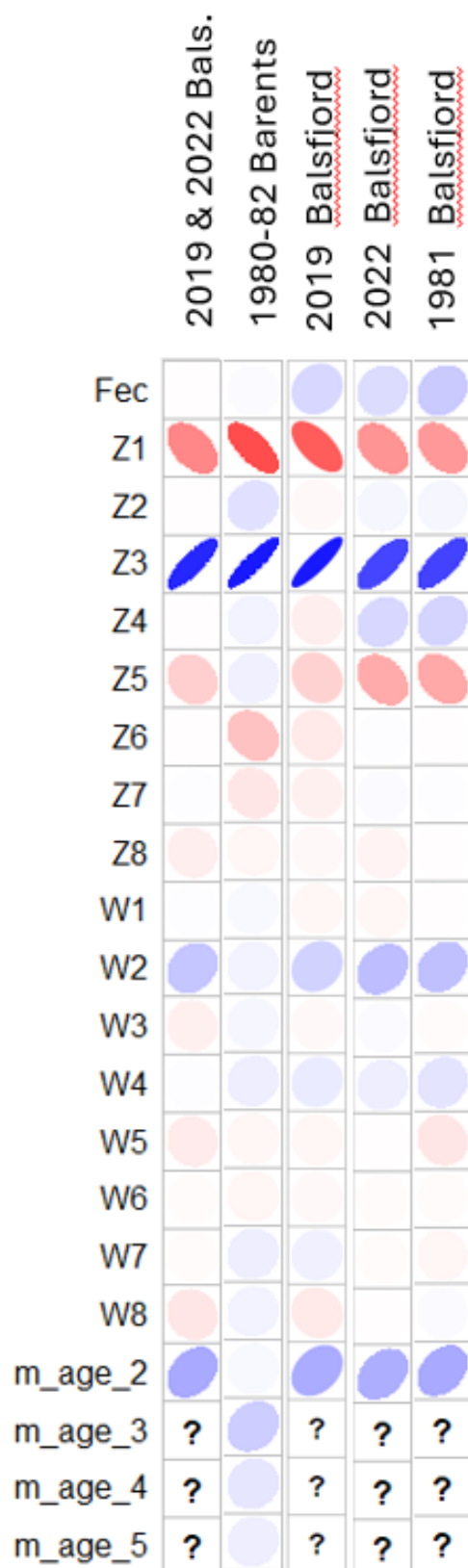


Figure S5 Overview of correlations (Pearson correlation coefficient) between input parameters (listed to the left of the correlation plots) and output P/B of the accepted simulations from the five offspring model Monte Carlo filtering runs. For each of the five sets of input and output (P/B-ratio), correlation coefficients are based 1000 acceptable simulations. The degree of ellipticity in the correlation ellipses indicates the strength of correlation. Negative correlations are shown in red, while positive correlations are shown in blue. Fec is fecundity; Z1 to Z8 are mortality rates (year⁻¹) for each age interval; W1 to W8 are the body wet weights for each age interval; m_age_2 to m_age_5 are the proportion mature (Pmat₂ to Pmat₅) of each spawning age class from age 2 to age 5. “?” means that there is no variation in input value (fixed value)

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