

Reproduction areas of sea-spawning coregonids reflect the environment in shallow coastal waters

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Supplement. Sampling data, reference data and developmental stages of larvae

Table S1. Number of sampling sites, average CPUE, catch frequency per site by year, sampling period and gear and sub-area

BEACH SEINE

AREA/ YEAR	Number of sites			Whitefish CPUE			Whitefish catch frequency site ⁻¹			Vendace CPUE			Vendace catch frequency site ⁻¹			CPUE whitefish	CPUE vendace	Range whitefish	Range vendace
	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011	PERIOD 2009–2011			
1	13	--	--	4.1	--	--	38.5	--	--	0.0	--	--	0.0	--	--	4.1	0.3	0–42	0–0
2	--	14	--	--	3.9	--	--	57.1	--	--	0.0	--	--	7.1	--	3.9	0.4	0–31	0–1
3	10	7	--	3.4	1.2	--	80.0	57.1	--	0.1	0.0	--	10.0	0.0	--	2.5	0.5	0–31	0–1
4	--	4	--	--	4.0	--	--	75.0	--	--	0.0	--	--	0.0	--	4.0	0.5	0–21	0–0
5	20	--	--	22.4	--	--	75.0	--	--	0.2	--	--	5.0	--	--	22.4	0.6	0–294	0–4
6	--	21	--	--	3.7	--	--	71.4	--	--	0.0	--	--	0.0	--	3.7	0.5	0–66	0–0
7	--	4	--	--	329.3	--	--	100.0	--	--	1.0	--	--	50.0	--	329.3	1.0	1–947	0–3
8	18	--	--	70.0	--	--	83.3	--	--	0.4	--	--	5.6	--	--	70.0	0.7	0–472	0–9
9	--	--	8	--	--	387.2	--	--	87.5	--	--	33.2	--	--	75.0	387.2	0.6	0–4212	0–350
10	25	24	14	54.2	52.4	395.7	84.0	75.0	100.0	490.5	151.5	94.6	68.0	75.0	78.6	116.7	0.7	0–4717	0–10 834
11	--	22	10	--	106.4	16.7	--	72.7	90.0	--	687.6	8.8	--	95.5	80.0	78.8	0.6	0–843	0–9461
12	21	4	--	58.1	177.0	--	85.7	100.0	--	314.2	18.0	--	90.5	100.0	--	75.1	0.8	0–730	0–2489
13	1	--	4	135.0	--	28.6	100.0	--	75.0	65.0	--	18.0	100.0	--	75.0	46.3	0.7	0–135	0–88
14	8	--	--	176.3	--	--	75.0	--	--	47.0	--	--	75.0	--	--	176.3	0.7	0–845	0–294
15	6	--	2	292.7	--	118.5	100.0	--	100.0	49.5	--	4.0	100.0	--	50.0	249.1	1.0	2–415	0–104
16	--	5	2	--	1321.0	7.0	--	100.0	100.0	--	1.0	3.0	--	100.0	50.0	945.6	1.0	1–2956	0–6
17	18	--	--	18.2	--	--	83.3	--	--	1.5	--	--	33.3	--	--	18.2	0.7	0–195	0–10
18	--	19	--	--	48.1	--	--	89.5	--	--	9.8	--	--	42.1	--	48.1	0.8	0–377	0–108

19	27	27	--	46.9	48.0	--	81.5	92.6	--	0.1	0.9	--	11.1	25.9	--	47.5	0.8	0-412	0-15
20	--	27	--	--	5.0	--	--	66.7	--	--	0.0	--	--	0.0	--	5.0	0.5	0-60	0-0
21	8	10	14	0.2	0.7	2.6	37.5	30.0	71.4	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.3	0-20	0-0
22	13	--	--	0.0	--	--	0.0	--	--	0.0	--	--	0.0	--	--	0.0	0.0	0-0	0-0
23	--	9	--	--	0.6	--	--	22.2	--	--	0.0	--	--	0.0	--	0.6	0.1	0-9	0-0
24	20	21	--	4.1	0.5	--	30.0	33.3	--	0.0	0.1	--	0.0	4.8	--	1.9	0.2	0-65	0-4
25	13	16	--	0.0	0.7	--	7.7	18.8	--	0.0	0.0	--	0.0	0.0	--	0.4	0.1	0-11	0-0

TOW NET

AREA/ YEAR	Number of sites			Whitefish CPUE			Whitefish catch frequency site ⁻¹			Vendace CPUE			Vendace catch frequency site ⁻¹			CPUE whitefish	CPUE vendace	Range whitefish	Range vendace
	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011	PERIOD 2009-2011			
9	--	--	3	--	--	0.0	--	--	0.0	--	--	0.0	--	--	0.0	0.0	0.0	0-0	0-0
10	23	--	5	1.4	--	0.0	13.0	--	0.0	0.0	--	0.0	0.0	--	0.0	1.1	0.1	0-22	0-0
11	--	--	4	--	--	0.0	--	--	0.0	--	--	9.5	--	--	75.0	0.0	0.0	0-0	0-20
12	7	--	--	0.3	--	--	14.3	--	--	0.0	--	--	0.0	--	--	0.3	0.1	0-2	0-0
25	--	2	--	--	0.0	--	--	0.0	--	--	0.0	--	--	0.0	--	0.0	0.0	0-0	0-0

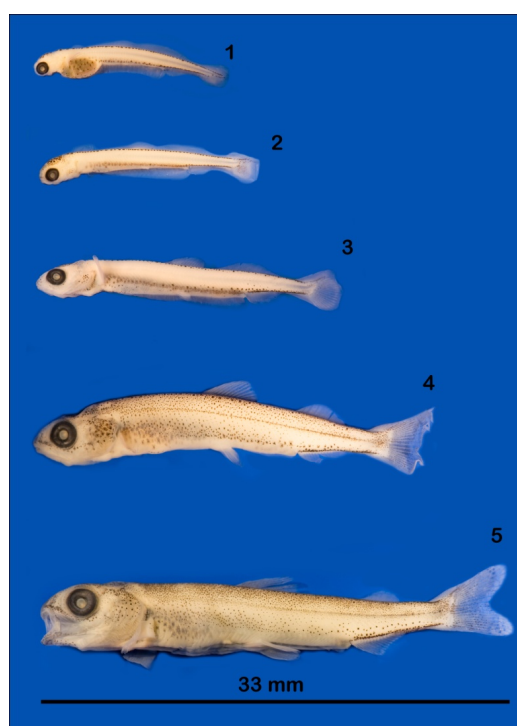
GULF-OLYMPIA

AREA/ YEAR	Number of sites			Whitefish CPUE		Whitefish catch frequency site ⁻¹		Vendace CPUE		Vendace catch frequency site ⁻¹		CPUE whitefish	CPUE vendace	Range whitefish	Range vendace
	2009	2010	2009	2010	2009	2010	2009	2010	2009	2010	PERIOD 2009-2011				
10	--	26	--	0.1	--	3.8	--	0.0	--	30.8	0.1	0.0	0-3	0-6	
19	20	26	0.1	0.5	5.0	30.8	0.6	0.0	0.0	23.1	0.3	0.2	0-2	0-4	
20	--	28	--	0.0	--	0.0	--	0.0	--	0.0	0.0	0.0	0-0	0-0	

Table S2. Whitefish larval data from Leskelä et al. (1991) used as comparison material

Region	Area number in Leskelä et al. (1991)	Name of area	N	E	Sampling period	Number of tows	Mean	Range	Total
I	8	Boviksbad	64.74°	21.21°	1990	4	6	2–10	24
I	9	Piteå	65.23°	21.57°	1990	5	8.6	4–22	43
II	10	Hailuoto	65.03°	24.73°	1979	9	62.2	0–514	560
II	11	Kalajoki	64.24°	23.81°	1979–1990	846	55.1	0–2000	46 599
II	12	Storsand	63.48°	22.29°	1980–1991	210	29.3	0–217	9309
III	7	Holmö	63.67°	20.87°	1990	15	0.4	0–5	6
III	13	Valsörarna	63.42°	21.09°	1990–1991	9	1.6	0–8	14
IV	2a	Forsmark	60.42°	18.17°	1990	11	11.7	0–109	129
IV	2b	Gräsö	60.42°	18.57°	1990	12	7.2	0–31	79
IV	3	Hornslandet	61.66°	17.46°	1990–1991	26	1.2	0–12	31
IV	4	Härnösand	62.59°	17.99°	1990	6	3	0–9	18
IV	5	Nordingrå	62.97°	18.49°	1990	6	6.5	0–16	39
IV	6a	Sörmjölefjärden	63.61°	19.94°	1990–1991	23	50	0–286	1150
IV	6b	Norrmjölefjärden	63.65°	20.15°	1990–1991	10	5.1	0–20	51
V	1	Åland	60.32°	20.12°	1991	9	1.7	0–7	16
V	14	Merikarvia	61.84°	21.41°	1990–1991	59	2.3	0–30	133

Fig. S1. The developmental stages of whitefish larvae according to Evropejtseva, (1949). Photo: Lari Veneranta



Developmental stage 1 – yolk sac

Age of coregonid larvae 6–11 d post hatching. The 1st developmental stage covers the period from hatching to atrophy of yolk sac.

Developmental stage 2 – formation of tail fin

The formation of the tail fin starts and the end of the notochord turns upwards. Pigmentation becomes stronger and the swim bladder develops. The duration of this stage is 4–7 d.

Developmental stage 3 – the formation of secondary symmetric tail fin

From the turning of the notochord to formation of fin bones. The tail fin stands out from the adipose fin. The bones for anal and pelvic fins form. The duration of this stage is 11–13 d.

Developmental stage 4 – definitive formation, prejuveniles

All fins have bones. Transparency disappears and larvae become silver in color.

Developmental stage 5 – juvenile fish

Scales have developed, the form of the fish resembles adult coregonid.

LITERATURE CITED

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