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Composition of fish communities in Baltic Coastal reference areas (204 033)

Abstract

The third annual report on monitoring of coastal fish presents catches of perch, roach, viviparous blenny and results of Secchi depth in six international reference areas; Kvädöfjärden at the Swedish coast of the Baltic Proper, Hiiumaa in the Estonian Sea of Straits, Brunskär in the Archipelago Sea, Finbo at Åland, Holmöarna in the northern Quark and Råneå in the Bothnian Bay. Year class strength and growth of perch is also discussed.

Significant increasing trends of perch and roach catches together with a significant decreasing trend of Secchi depth in Brunskär indicated further eutrophication of the Archipelago Sea. After a continuos decrease of the perch catches since 1994, the catches increased in Hiiumaa in 1998, but the catches were still small. The declining perch population in the Sea of Straits suffers from overexploitation. Year-class strength showed that the year-class of 1992 was relatively good, except in Hiiumaa. The year-class strength has decreased since 1987 in Hiiumaa, which may be a result from the overexploitation of the population.
The results of the reproduction indexes of viviparous blenny indicated similar inter-year variations in all investigated areas.

Key words

Coastal monitoring, eutrophication, perch, roach, viviparous blenny

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Coastal Fish Monitoring in Baltic Reference Areas 1998

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1. Introduction

Monitoring of coastal fish is carried out in six Baltic reference areas within an internationally established system covering Sweden, Finland, Åland and Estonia (Fig. 1). It involves annual monitoring of biological key variables at fixed stations using standardised methods. The methods are recommended by HELCOM to be used in the whole Baltic Sea. The system of international reference areas is supplemented by monitoring in regional reference areas and "hot spots", also including Latvia and Lithuania. The objectives of an integrated monitoring programme design for coastal fish have been presented by Neuman and Sandström (1996 a, b).

The monitoring in reference areas is co-ordinated by COBRA (The Coordination Organ for Baltic Reference Areas), with a secretariat at the Provincial Government of Åland. Members of COBRA are appointed by the participating institutes, The Estonian Marine Institute, the Fisheries Division at the Provincial Government of Åland, the Finnish Game and Fisheries Research Institute and the Swedish National Board of Fisheries, Institute of Coastal Research.

A report, summarising stock development of the dominant species perch and roach, year-class strengths of perch and reproduction success of viviparous blenny, is annually produced (Ådjers et al. 1997, 1998). Growth of female perch is presented for the first time in this report.

2. Study areas

The reference areas are located to Kvädöfjärden in the Archipelago of Gryt at the Swedish east coast of the Baltic Proper, to Hiiumaa in the Sea of Straits in western Estonia, to Brunskär in the southern Archipelago Sea in south-western Finland, to Finbo in north-western Åland, to Holmöarna in the Northern Quark and to the bay of Råneå in the northernmost Bothnian Bay (Fig. 1). Detailed maps of the reference areas are presented in the earlier annual reports (Ådjers et al. 1997; Ådjers et al. 1998). General geographic and biotic characteristics of the areas have been described in Ådjers et. al (1996).

Secchi depth is determined during the test fishing in August (six measurements) and is used as a general indicator of eutrophication in the area. The Secchi depths showed significantly decreasing trends in Råneå and Brunskär reference areas (Fig. 1). No trends appeared in the other areas.

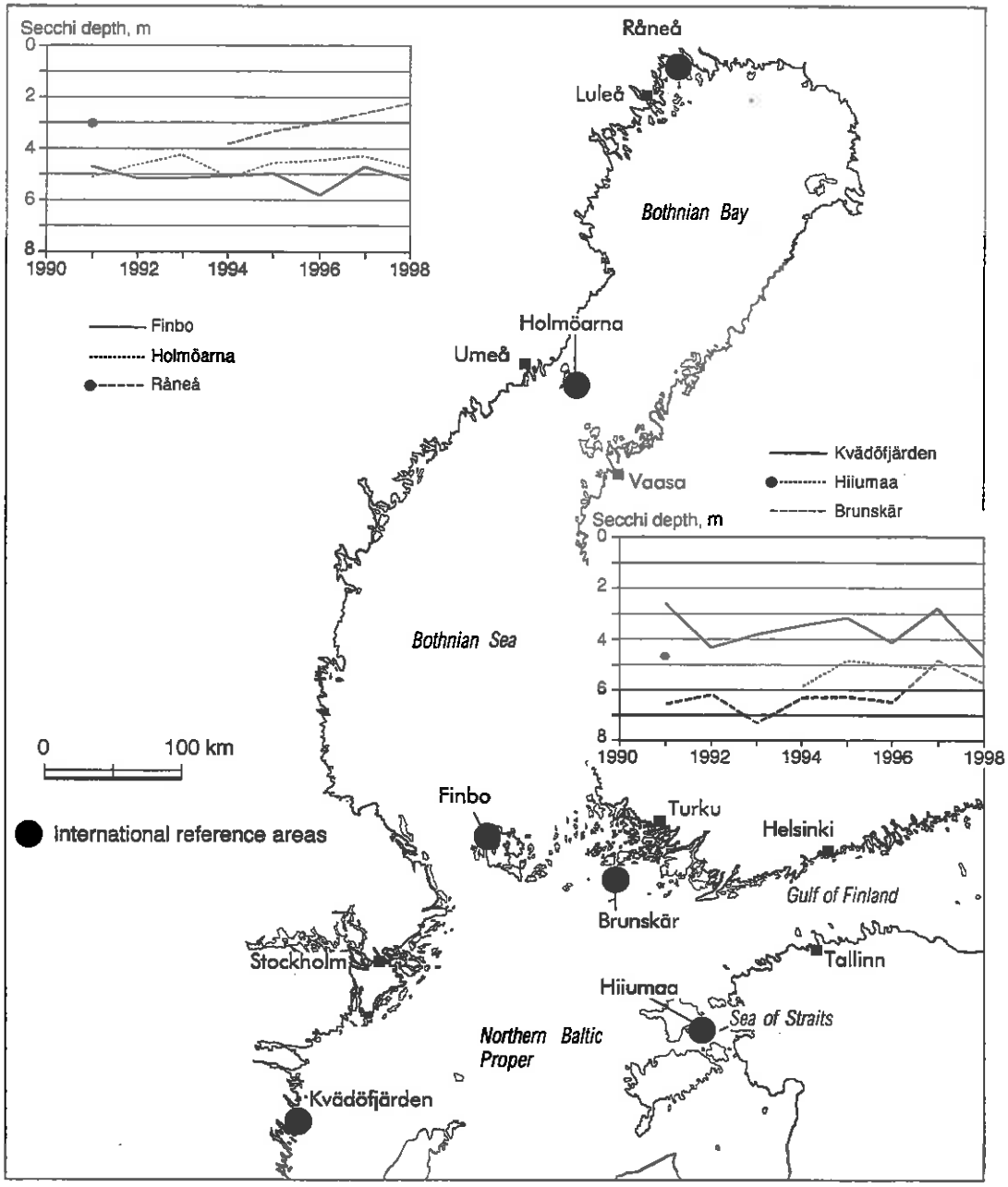

Figure 1. International reference areas (•) in the Baltic Sea with Secchi depths.

3. Material and methods

The test fishing methods, which are soon available as HELCOM guidelines for monitoring of coastal fish in the whole Baltic Sea, are described in Neuman et al. (1997). More detailed descriptions of the test fishing methods and the monitoring of viviparous blenny appeared in Ådjers et al. (1997, 1998).

Monitoring of coastal fish is annually carried out between 25 July and 15 August. Coastal survey nets or net links are used in the test fishing. Fishing is performed six nights on fixed stations. The results are expressed as catch-per-unit-effort (CPUE; catch in numbers per net and fishing night distributed into 2.5 cm length groups). Net sets were used in Kvädöfjärden and Hiiumaa and coastal survey nets in the other areas. The size of a survey net is almost twice the size of a net in the net sets and to gain comparable values in the analysis of year-class strength the results of catch-per-unit-effort from Kvädöfjärden and Hiiumaa were doubled. Bottom temperature is recorded during the test fishing at each station and day.

Gill covers of female perch were sampled for age and growth analyses. Sampling was carried out by taking 50 samples from each 2.5 cm length group starting from fish with a length of 12.6 cm and 25 samples or all fish caught from length groups >27.5 cm. After age determination length at age data were combined with the test fishing results to produce an age distribution for the total catch. Year class strength was calculated by summarising the catch-per-unit-effort of the individual cohorts during ages 4 – 6 over the whole sampling period. The last year class included in this analysis thus is 1992.

Monitoring of viviparous blenny is performed in October-November, when the females carry the fry in the ovarian cavity. Collections are made with small eel fyke nets on fixed stations. The results are expressed as catch-per-unit-effort (CPUE; catch in numbers per fyke net and fishing night). Pregnant females are dissected and the fry length is determined and they are separated in living, dead and malformed individuals. Different reproduction indexes are calculated and presented. Detailed methodological descriptions was presented in Ådjers et al. (1998).

Trends in the development of the Secchi depth and species abundance were analysed with Mann-Kendall nonparametric trend analysis with 95 % confidence level.

4. Results

4.1. Catches of perch and roach

The catches of both perch and roach were relatively low at Kvädöfjärden (Fig. 2). The catches of roach decreased significantly during the period 1989 - 1998. The mean bottom temperature were the lowest recorded since 1989.

The catches of perch had increased compared to 1997 at Hiiumaa, although the catches were still very low (Fig. 2). The negative trend since monitoring started in 1992 was significant. Overexploitation caused this drastic decrease of the population (Kangur, 1996). The roach catches increased significantly compared to the catches during the period 1994 – 1997. The mean bottom temperature was the lowest recorded since 1992.

The catches of both perch and roach have increased since 1992 at Brunskär (Fig. 2). The increase was significant for perch but not for roach. It is notable that the Secchi depth showed a significant decreasing trend during the same period (Fig. 1). All these parameters indicate progressing eutrophication in the area. The mean bottom temperature in 1998 was also in this area the lowest recorded during the test fishing period.

Perch and roach were caught in moderate numbers at Finbo and Holmöarna (Fig. 2). No trends appeared. The catches of perch were low and the catches of roach were at a moderate level at Råneå (Fig. 2). No trends were noted. The mean bottom temperatures were at moderate levels in these three areas.

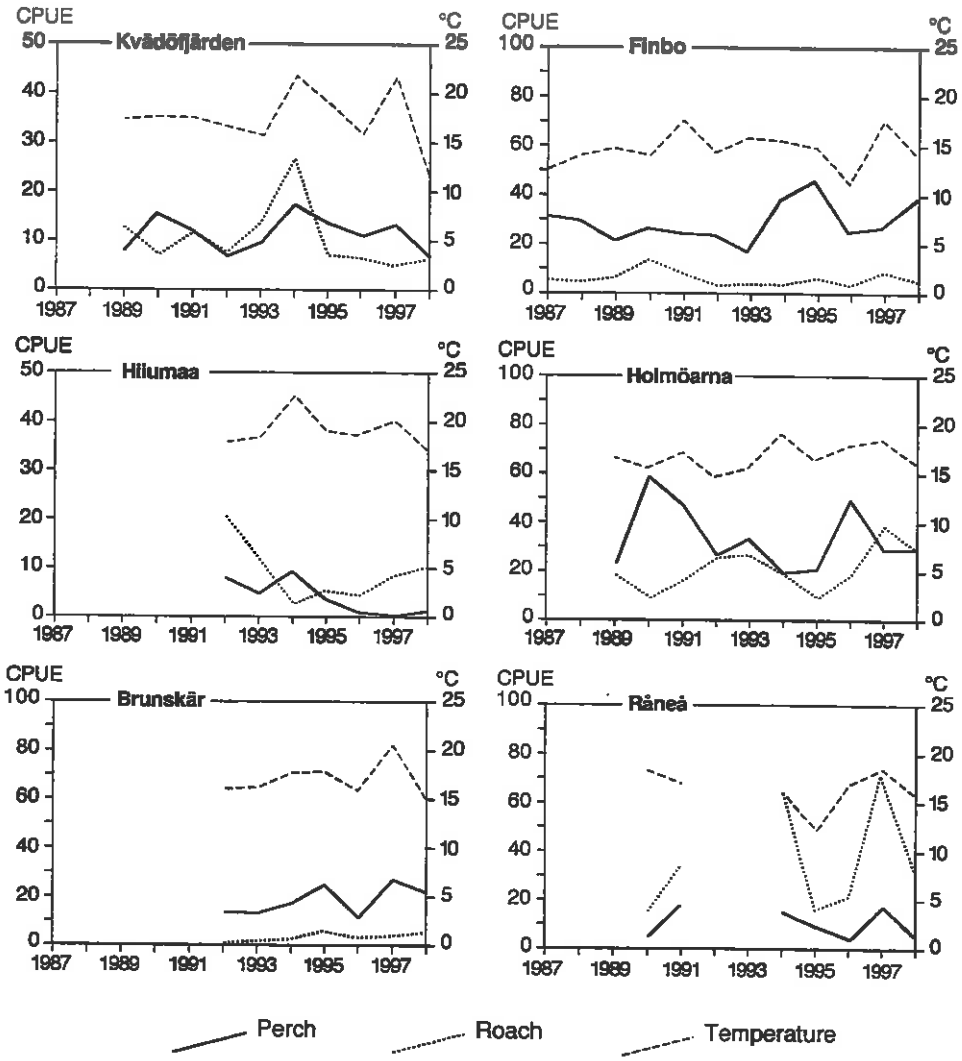

Figure 2. Catches of perch and roach expressed as catch-per-unit-effort with mean bottom temperature in the Baltic reference areas.

4.2. Year-class strength of female perch

Year-class strength of perch has been shown to vary according to a common pattern in areas with low anthropogenic influence in the whole Baltic sea (Böhling et. al. 1991). The reference areas Kvädöfjärden, Brunskär and Holmöarna showed a peak in 1988 and relatively high values in 1992 (Fig. 3). Finbo and Hiiumaa deviated from this pattern with decreasing trends. The high values of the year-class strengths in 1989 and 1990 at Finbo is a result of large catches of these year-classes in 1994 and 1995. The large catches were explained by higher temperatures during the test fishing these years (Ådjers et al. 1998). The weak year-class strengths at Hiiumaa may be a result of the declining perch population in the area. The analysis is based on catch-per-unit-effort data, which indicated that the year-class strength is still strong in 1992, despite of the decrease, at Finbo. On the same basis it can be concluded that the year-class strengths were very weak at Hiiumaa in 1991 and 1992.

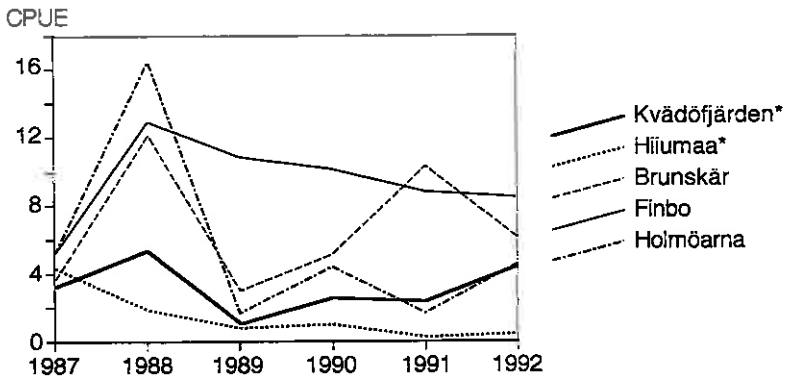

Figure 3. Year-class strength of female perch (*CPUE x 2).

4.3. Growth of female perch

Growth rate was similar at Kvädöfjärden, Hiiumaa, Brunskär and Holmöarna (Fig. 4). Slower, relatively similar growth rates were found in Finbo and Råneå. The longest fish as seven years old were found at Holmöarna (276 mm) and shortest at Råneå (228 mm). It is probable that latitude did not influence the growth rate in any larger degree. Local low temperatures, noted at Finbo and Råneå, probably determined the slow growth rates. Also the local feeding conditions may affect the growth rate. The occurrence of small fish is considered good at Holmöarna, which may be an explanation to the fast growth rate. The occurrence of food competitors such as ruffe (*Gymnocephalus cernuus*) affects the access of food and hence the growth rate. Furthermore perch is dependent on light for feeding and the northern populations can compensate the short growth season by feeding both days and nights during the light summer period.

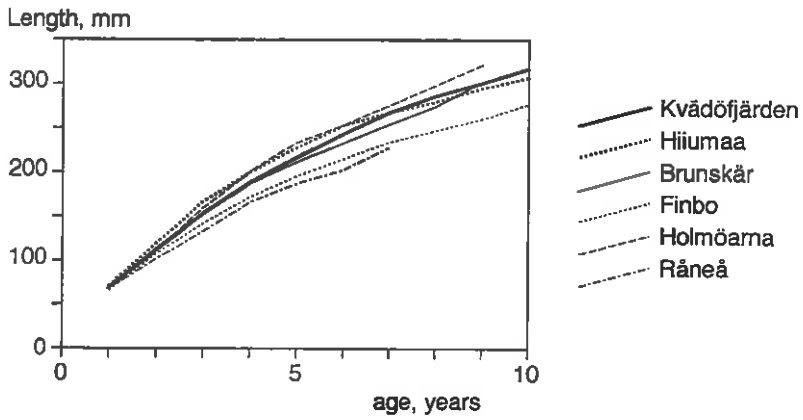

Figure 4. Length increment of female perch.

The growth rate for 2 years old fish has increased since 1985, while no trends were obvious for 4 and 6 years old fish (Fig. 5). The variations of growth between years correlated relatively good ($r^2 \geq 0.60$) between all areas for 2 years old fish, except for Hiiumaa. Hiiumaa did not correlate in any case to another area. Despite of the deviating growth rates between Finbo and Holmöarna, the variations between years correlated well ($r^2 \geq 0.84$) for the analysed ages. Relatively high correlation coefficients ($r^2 \geq 0.57$) appeared between Brunskär/Finbo and Brunskär/Holmöarna for the analysed ages. Results from Råneå were not included into the analysis due to few replicates.

The variations of annual growth was similar between years for young fish. Similar annual variations appeared to some extent between Brunskär, Finbo and Holmöarna. Hiiumaa deviated in all cases probably due to the fact that the water depth in the area is very shallow, which allows high water temperature every year. The growth variations is hence in a higher degree determined by other growth determining parameters.

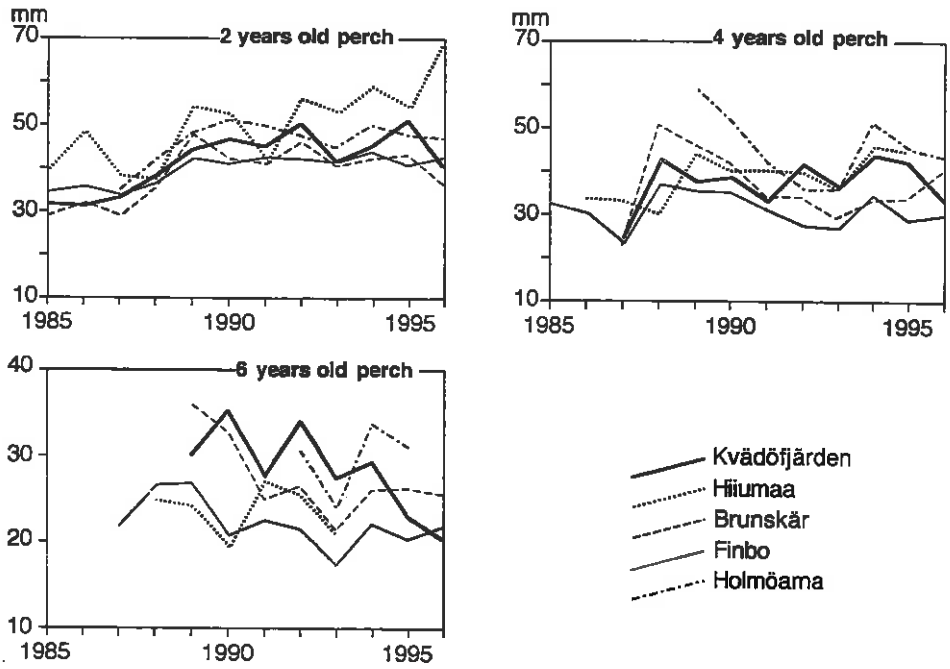

Figure 5. Annual growth of 2, 4 and 6 years old female perch.

4.4. The viviparous blenny

Catch-per-unit-effort of viviparous blenny varied between 0.31 and 4.14. Both extreme values were obtained at Brunskär (Tab. 1). The female mean length varied between 191 and 236 mm. The smallest females appeared at Holmöarna, around 200 mm every year (Tab. 1). The shares of females in the catches were between 64 and 68 %, in most cases. Kvädöfjärden deviated with 45 % and Finbo with 78 % in 1998 (Tab. 1).

Tab. 1. Catch-per-unit-effort (CPUE), mean length of females and shares of females of viviparous blenny in reference areas.

	CPUE			Mean length of females			Shares of females		
	-96	-97	-98	-96	-97	-98	-96	-97	-98
Kvädöfjärden	1.84	0.83	1.04	236	229	219		66	45
Brunskär	4.14	0.31	0.38	218	224	200	68	65	68
Finbo	1.40	1.39	0.64	226	218	213	66	64	78
Holmöarna				202	191	208	66	65	68

The most frequent length group of normally developed fry showed that the juvenile growth was slower at Finbo compared to the other areas (Tab 2). From length group 44 it decreased to length group 36 during three years at Kvädöfjärden. The shares of retarded fry were in general below 5 % (Tab. 2). The highest index value, 6.5 %, was noted at Holmöarna. Notable is that the indexes covariated between the years. The 1998 indexes were lower compared to the earlier indexes in the same area. The shares of late dead fry were also generally very low (Tab. 2). These indexes were high in 1996 compared to later indexes in the same area. Consequently the shares of females carrying late dead fry were also high compared to later indexes in the same area, with the exception of Kvädöfjärden, where the lowest index was noted in 1996 (Tab. 2). However, the shares of females carrying late dead fry varies considerably both within area and between years.

The time series of monitoring viviparous blenny are still too short for performing trend analysis, analysis of station selection, catch levels etc. Similar variations of reproduction indexes between years over a larger geographical area was however indicated. The appearances of different failures of the reproduction were low and gave no reason for concern.

Tab. 2. Reproduction indexes of viviparous blenny sampled in reference areas.

	Reproduction index											
	1			2			3			4		
	-96	-97	-98	-96	-97	-98	-96	-97	-98	-96	-97	-98
Kvädöfjärden	44	41	36	3.9	2.7	0.4	2.0	1.6	0.5	8	20	12
Brunskär	41	41	46	1.3	4.7	1.7	2.2	0	0.5	29	0	11
Finbo	39	36	39	2.4	2.6	0.3	1.6	0.3	0.6	20	11	9
Holmöarna				4.4	6.5	3.3	3.4	0.1	0.2	22	7	4

Reproduction indexes; 1. The most frequent length group of developed fry. 2. The share (%) of retarded fry. 3. The share (%) of dead fry >15mm (late dead fry) of the annual number of fry per brood. 4. The share (%) of females carrying late dead fry of the total number of pregnant females.

5. Conclusions

The summer of 1998 was cold in large parts of the Baltic area and the lowest mean bottom temperatures since the beginning of the test fishings were recorded in the three southernmost areas. The temperatures in the three northern areas were close to average levels.

The trends of the increasing perch and roach population and the decreasing Secchi depth in Brunskär, discussed in the former report (Ådjers et al. 1997), are indications of increasing eutrophication in the area. The perch population at Hiiumaa is still small, despite of larger catches in 1998 than in 1997. This might, however, be an indication of a recovery of the population.

Growth of female perch showed to be determined more by local temperature and feeding conditions rather than by latitude. Indications of similar annual variations of growth were found for young perch between all areas, except Hiiumaa and for older fish between Brunskär, Finbo and Holmöarna.

Results from the monitoring of viviparous blenny gave indications of similar variations of reproduction indexes between years and areas.

6. Acknowledgements

The field work requires the efforts of many persons and co-operation partners. We thank the Finnish Forest and Park Service for co-operation and financial contribution to the test fishing in Brunskär reference area and the Hiiumaa Islets State Landscape Reserve for successful co-operation in Hiiumaa reference area. We are also grateful to all employees in the participating institutes who have contributed to the reference system and to the fishermen taking part in the field work.

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