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Catches of Perch, Roach and Viviparous Blenny

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

Abstract

The second annual report on monitoring of coastal fish is presented. Six control areas, lacking local environmental impacts, are covered by the monitoring; Råneå in the Bothnian Bay, Holmöarna in the Northern Quark, Finbo at Åland, Brunskär in the Archipelago Sea, Kvädöfjärden at the Swedish coast of the Baltic Proper and Hiiumaa in the Estonian Sea of Straits.

Data are summarized on the development of the catches of perch and roach, year-class strength of perch, trends from the Secchi depths measurements and the monitoring of abundance and reproduction of the viviparous blenny. Significant trends in perch catches were documented in two areas. The previously noted decrease of the perch catches in Hiiumaa reference area continued also in 1997, indicating overexploitation of the stock. An increase of perch catches was evident in the Kvädöfjärden area. The catches of roach increased at Brunskär and Holmöarna, but decreased at Kvädöfjärden. The year-class strength of perch followed a similar pattern in all areas with very strong year-classes in 1988, strong in 1987 and 1990 and weak in 1989 and 1991. Results from Råneå were lacking. The Secchi depth increased at Kvädöfjärden, Brunskär, Holmöarna and Råneå.

The viviparous blenny has been monitored at Kvädöfjärden, Brunskär, Finbo and Holmöarna. The abundance is too low for monitoring purposes at Hiiumaa and probably also at Råneå (investigations have not been performed yet) to allow meaningful monitoring. Catch-per-unit-effort in the other areas varied between 0.3 and 4.1. The share of retarded and dead fry in late development stages were low in all areas. The monitoring is still under development and programs will be established during the following 1-2 years.

Key words

Coastal monitoring, eutrophication, perch, roach, viviparous blenny

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Contents

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 standardized methods. 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 (1996a, b).

The monitoring in reference areas is coordinated by COBRA (The Coordination Organ for Baltic Reference Areas), with a secretariate 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, summarizing stock development of the dominant species perch and roach and the year-class strengths of perch, is annually produced. Selected themes are also included in the report.

2. The development of reference area monitoring

The aim of the reference area monitoring is to monitor typhical coastal communities, e.g. litoral plants, fish and sea birds and mammals within the selected areas and continous efforts are made to include additional compartments into the programme. In 1996 COBRA presented a suggestion for a programme in the Finbo area (Fig. 1) including monitoring of marine vegetation, bottom fauna, birds and mammals. To the existing programme for coastal fish reproduction of viviparous blenny has been added. Discussions concerning monitoring of benthic vegetation are taking place. In 1997 suggestions for enhanced monitoring programmes in Kvädöfjärden, Holmöarna and Råneå reference areas and in 1998 for the Brunskär area were presented. The suggested programmes are now being evaluated by the local authorities but decisions have not yet been made.

A new coastal monitoring programme is developed by HELCOM. Sweden, represented by the Institute of Coastal Research, is "lead country" for fish. In May 1998, HELCOM's monitoring committe (EC MON) recommended HELCOM to adopt the guidelines for monitoring of coastal fish followed in the reference areas (Neuman et al. 1997). All countries were also recommended to start monitoring in at least one reference area and to send data to COBRA. Hopefully, this will lead to an expansion of the reference area system to the south of the Baltic Sea and to the Gulf of Finland. Furthermore, Finland (Finnish Environment Institute) is working as lead country for introducing monitoring of benthic vegetation.

3. 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 southwestern Finland, to Finbo in northwestern Åland, to Holmöarna in the Northern Quark and to the bay of Råneå in the northernmost Bothnian Bay (Fig. 1, Appendix 1). The basic physical and biological characters of the reference areas are decribed in Ådjers et al. (1996) and the sampling sites in Ådjers et al (1997). Maps of the areas are found in appendix 1.

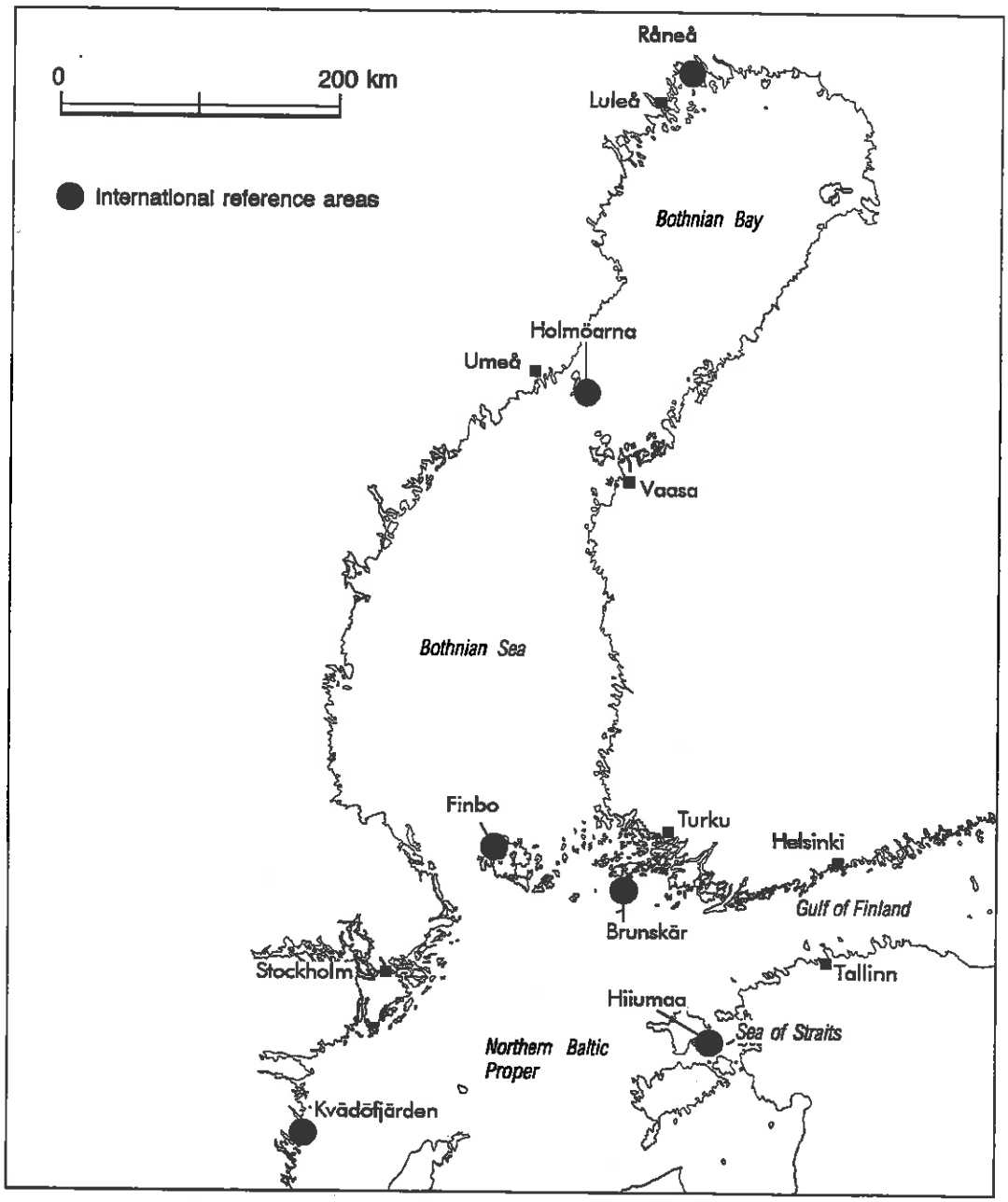

Figure 1. International reference areas (●) in the Baltic Sea.

4. Perch and roach - catches and composition

4.1. Background

The system of fish monitoring is optimised to produce accurate abundance data for mainly demersal coastal warm water species. Perch and roach are the most common species in this fish community. Hence they are selected subjects in the annual evaluation of the results from the monitoring of coastal fish.

4.2. Material and methods

Monitoring stations are placed in narrow strata, defined according to depth. In the depth stratum, groups of neighbouring stations with similar environmental conditions form sections. The sections represent different habitats regarding e.g. exposure and bottom type. When the monitoring is introduced for the first time in an area, a large number of stations are studied by test fishing for 2 - 3 years. Among these stations five - ten with similar species composition, catch levels and inter-year variations are selected (Ådjers et al. 1995). This design is developed for trend monitoring and is not optimal for inventory purposes e.g. to study biodiversity within the total fish community. The report includes results only from the finally selected stations. The stations are regarded as statistically independent of each other.

The test fishing methods are standardized according to Thoresson (1996). Test fishings are carried out annually between 25 July and 15 August in shallow waters between 2 and 5 m. Fishing is repeated six times at every station. The nets are set between 2 and 4 pm and lifted the next day between 7 and 10 am. In the Gulf of Bothnia and Archipelago Sea (Brunskär, Finbo, Holmöarna, Råneå) coastal survey nets are used, which are 35 m long, 3 m deep (2.5 m in water) and composed of five 7 m long parts with mesh sizes 17, 21, 25, 33 and 50 mm from knot to knot. Two linked nets are set at each station. In the southern areas (Kvädöfjärden, Hiiumaa) net links are used, which consist of four 30 m long, 1.8 m deep (1.5 m in water) nets. Each net is made up of a single mesh size (17, 21, 25 and 30 mm). One link is set in each station. The size of a survey net is almost twice the size of a net in the net links. The size of the catches, expressed as catch per unit effort (CPUE; catch in numbers per net and fishing night), can be roughly compared by doubling the figures from Kvädöfjärden and Hiiumaa. Trends in the abundance of selected species and trends in the development of the Secchi depth were analysed with Mann-Kendall nonparametric trend analysis. A 95 % confidence level is used in all cases.

The relative year-class strength of perch of the year-classes 1987 - 1991 was calculated by summarizing the catch-per-unit-effort of 4 - 6 years old fish. Age samples were not available from the Råneå area.

The Secchi depth can be used as a simple indicator of eutrophication of a water body. It is measured with a white plastic disc with a diameter of 25 cm. The disc is lowered into the water and the Secchi depth is noted when it is no longer visible. It is determined during the August test fishing when the nets are lifted.

4.3. Results and discussion

The catches of perch were at a moderate level at Kvädöfjärden (Fig. 2). High water temperatures were registered in both sections, close to 22°C. The catches in section 5 have increased significantly since 1987. The roach catches were low in both sections and the catches in section 5 have decreased significantly since 1987.

The drastic decrease of the perch catches at Hiiumaa, which started in 1995, continued and the very small catches in 1997 support the opinion that the population is overexploited (Fig. 3). The decreasing trend was significant in both sections. The overexploitation concerns the whole Sea of Straits (Kangur, 1996). The roach catches were similar as before in section 1 and higher compared to the three previous years in section 2. The water temperatures were about 20°C, which was only slightly higher than temperatures in earlier years.

The catches of perch at Brunskär were the highest recorded, while the catches of roach were similar to the three previous years (Fig. 4). No trend was found for the perch catches. The increasing trend for roach was significant for the years 1992 -1996 (Ådjers et al., 1997). When the results of 1997 were included to the analysis the significant increase could not be confirmed since the catch development at the different stations was not homogenous. The water temperatures were the highest recorded during the study period, over 20°C.

Both perch and roach were caught in moderate numbers at Finbo compared to earlier years (Fig. 5). The water temperatures were high, but this did not seem to affect the catches in any noticable degree. No trends were found.

The catches of perch in section 1 were relatively low at Holmöarna, while the catches of roach were high compared to earlier years (Fig. 6). The catches of roach in section 1 have increased significantly since 1989. The perch catches in section 2 were similar compared to the five previous years and the roach catches in this exposed area have always been low and 1997 was no exception. No trend was found. The water temperatures were high in section 1 but normal in section 2, probably due to exchange with the open sea.

The catches of both perch and roach as well as the water temperatures were high in Råneå (Fig. 7). No trends were found.

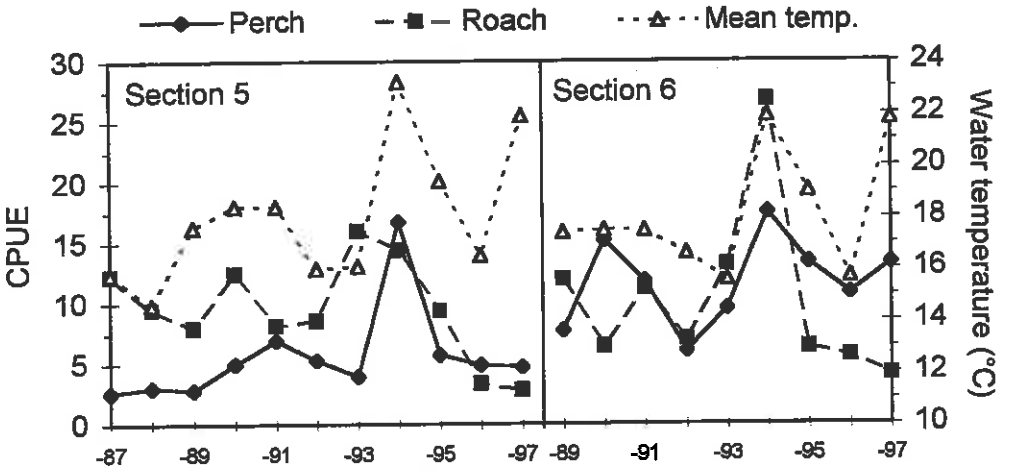

Figure 2. Annual variations of perch and roach catches and water temperatures in the Kvädöfjärden area.

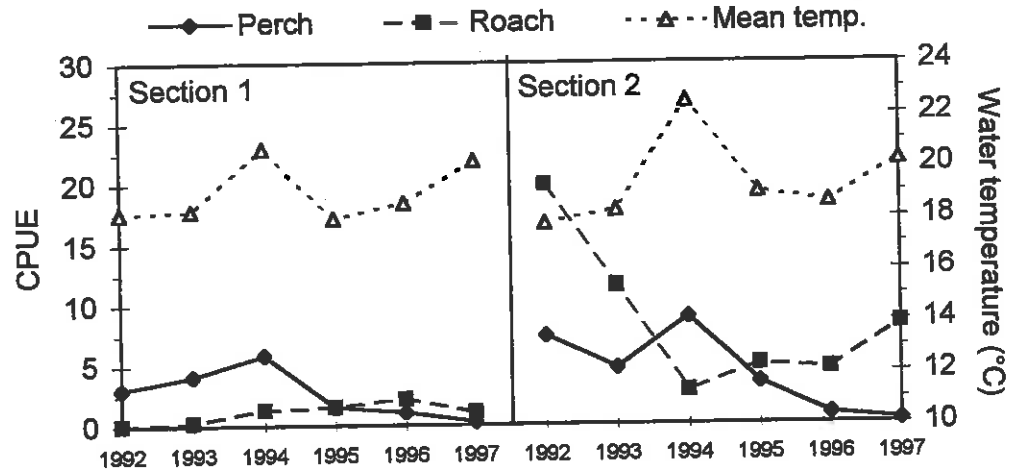

Figure 3. Annual variations of perch and roach catches and water temperatures in the Hiiumaa area.

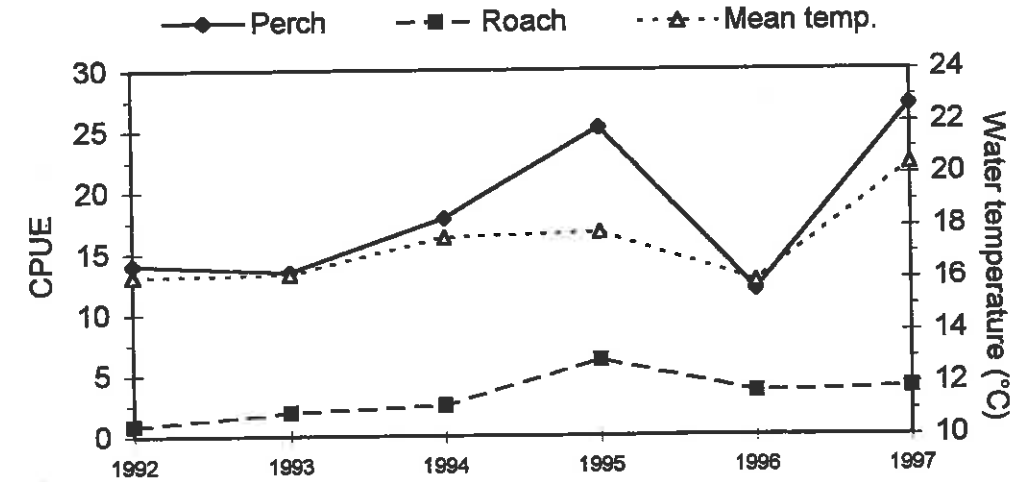

Figure 4. Annual variations of perch and roach catches and water temperatures in the Brunskär area.

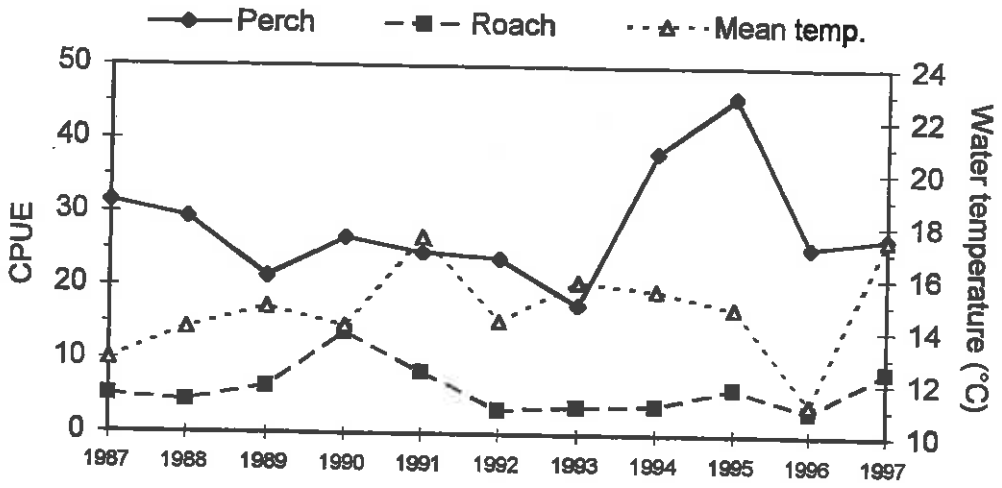

Figure 5. Annual variations of perch and roach catches and water temperatures in the Finbo area.

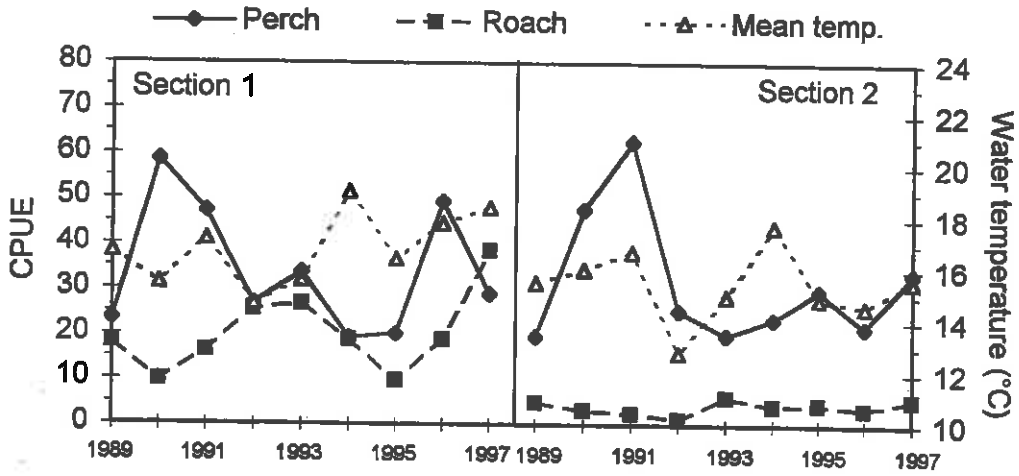

Figure 6. Annual variations of perch and roach catches and water temperatures in the Holmöarna area.

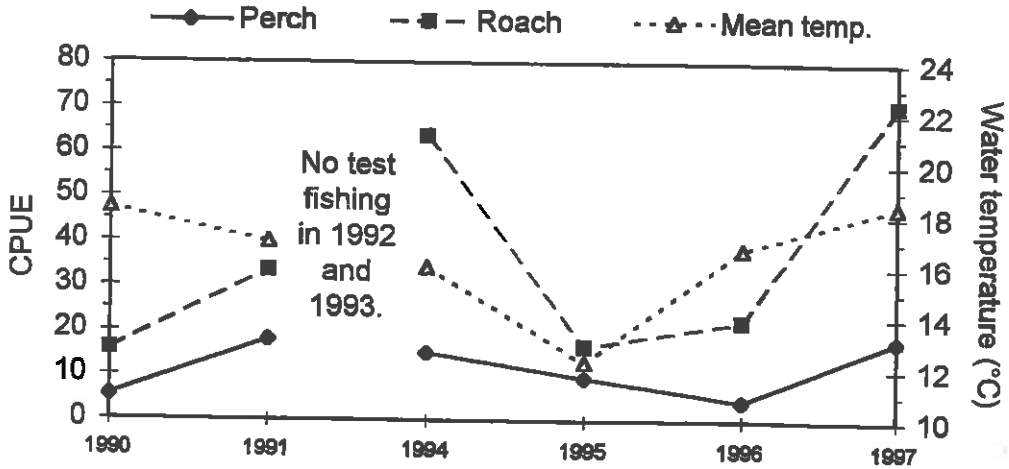

Figure 7. Annual variations of perch and roach catches and water temperatures in the Råneå area.

The perch year-class strengths followed a common pattern with strong year-classes 1987 and 1990, very strong in 1988 and weak in 1989 and 1991 (Fig. 8). The Finbo area, with small inter-year variations, except in 1987 when the year-class strength was weak, was deviating from the pattern. The year-class strength decreases with time in the Hiiumaa area, which may be caused by overexploitation. The year-class strength of 1991 in Brunskär deviates from the pattern by a high value.

The perch year-class strength deviated strongly at the Finbo area (Fig. 8). The peak in 1988, found in most of the other areas, was absent. By calculating the year-class strength according to a modified version of Svärdson (1961) and Neuman (1974) a peak, 30 - 40 % higher than the other years, was, however, evident. The catches per unit effort in the test-fishing in 1994 and 1995 were very large in the Finbo area (Fig. 5). Perch from the year-classes 1989 - 1991 were well represented in these catches and when summing the catches the peak from 1988 was masked (Fig. 8). The method of Svärdson uses shares of the catches eliminating the impact of between-years variations in catch levels. The large catches in 1994 and 1995 are perhaps explained by higher temperatures during the fishing period. This was not indicated by the bottom temperature measurements (Fig. 5), but the mean surface temperature, in most years about 15°C, was above 18°C during 1994 and 1995. Upwellings of cold water are very common in this area and it is probable that the upwellings during these years reached the layers, where the temperaure measurements are made (4 - 5m). Most of the nets were still placed in the warm water layer and the swimming activity of perch should have been increased by high temperatures, which probably explains the large catches.

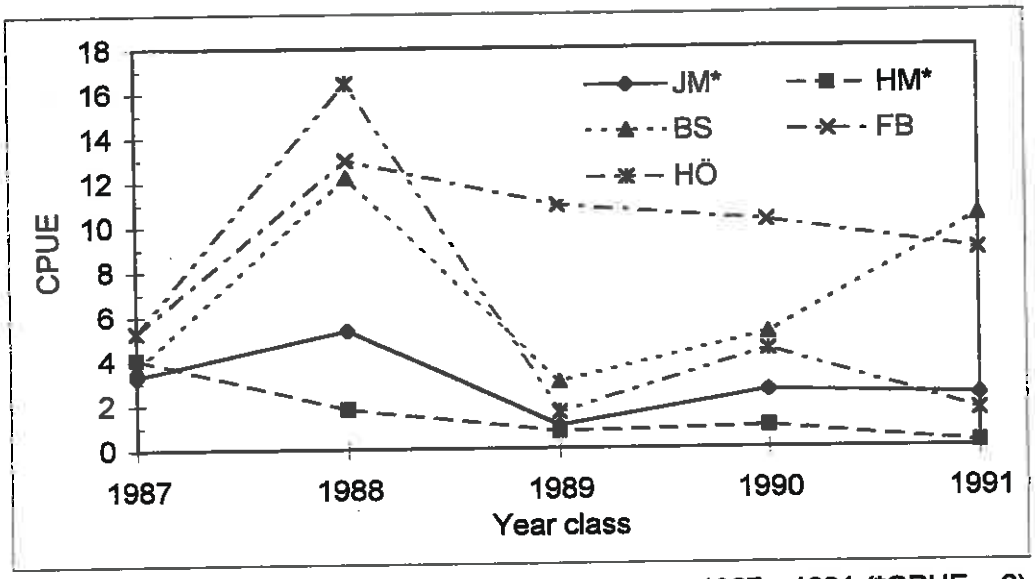

Fig. 8. Year-class strength of perch during the years 1987 - 1991 (*CPUE x 2).

Significant decreasing trends for the Secchi depths were found in four areas/sections (section 5 in Kvädöfjärden, section 1 in Holmöarna, Brunskär and Råneå) and there was no example of an increasing trend (Fig. 9). This indicates an increased large-scale eutrophication of the coastal waters, with an anticipated effect on the fish communities. Roach is a species known to be favoured by eutrophication. A negative correlation between the catches per unit effort of cyprinids and the Secchi depths has been shown for the reference areas (Ådjers et al. 1997). The decreasing Secchi depth trends were at Brunskär and Holmöarna (section 1) associated with significant increasing trends of the roach catches. At Kvädöfjärden (section 5), however, the trend was decreasing. Roach is a slow growing species and population increase, as a result of increased eutrophication, may perhaps need more than a few years investigations to be detected.

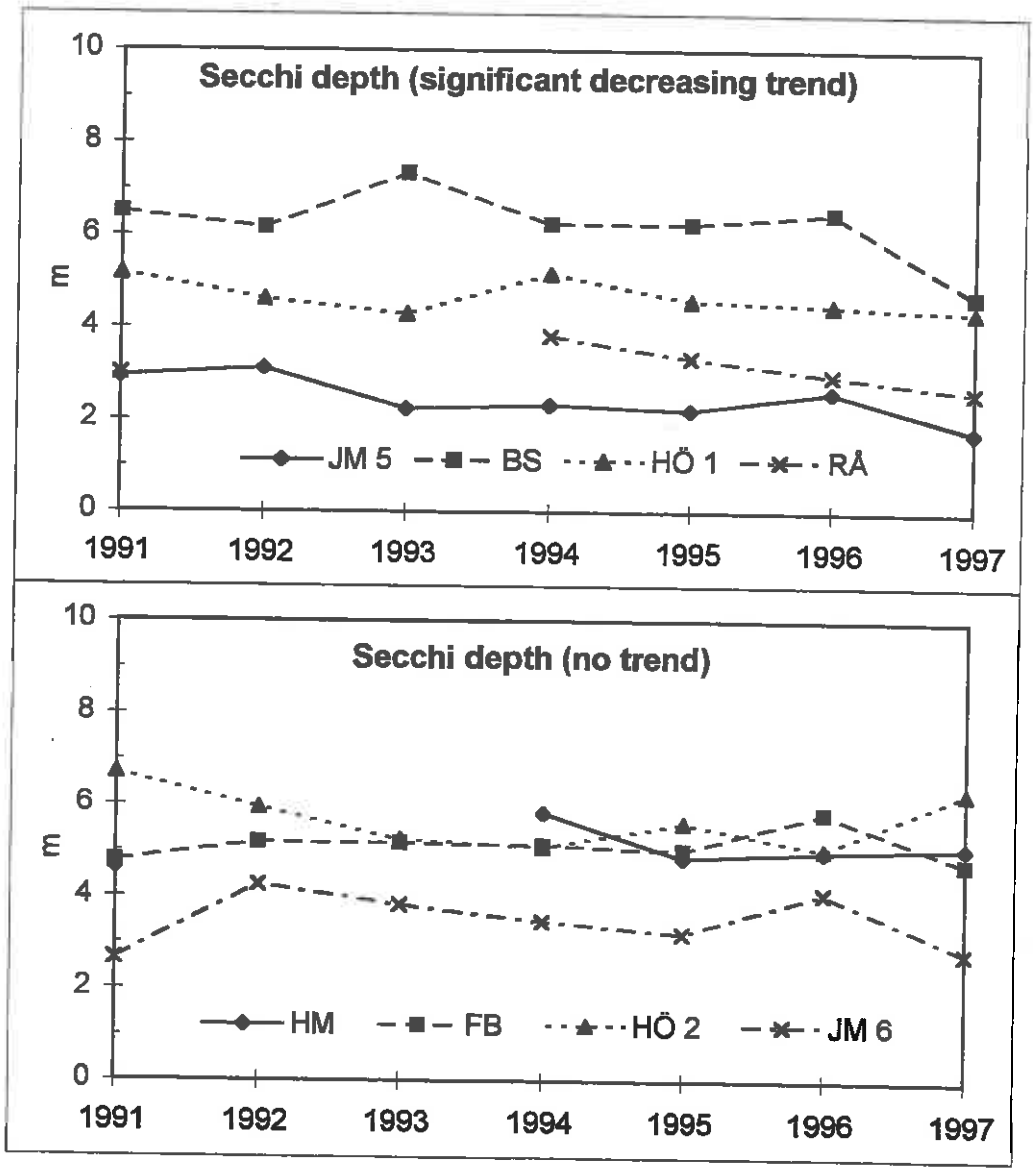

Fig. 9. The development of the Secchi depth during the period 1991 - 1997.

5. Viviparous blenny - catches and reproduction performance

5. 1. Background

The viviparous blenny or eelpout (*Zoarces viviparus*) has been recommended by HELCOM and OSPARCOM as an indicator species for biological effects of toxic substances. The blenny has already been used as indicator organism in field studies at pulp mills and chemical plants (Jacobsson and Neuman 1991; Jacobsson et al. 1993; Vetemaa et al. 1997). The advantages of using the blenny as an indicator species have been reviewed by Jacobsson et al. (1986 and 1993).

1. It has a stationary behaviour (Jacobsson et al. 1993).
2. It is sufficiently large in size to provide individual samples for chemical and biochemical analyses.
3. It is easy to catch.
4. It is abundant within a large distribution area.
5. It has a sufficiently long life span, which makes it possible to integrate effects through time and to determine effects of long-term exposure.
6. It is possible to determine age, which makes it possible to analyse dose/effect and to study the population's age distribution.
7. It is possible to analyse ecologically important effects of effluent exposure not only under field conditions but also by controlled laboratory exposures.
8. It is viviparous and gives birth to the fry after a long gestation period. This makes it possible to identify brood origin and determine reproduction success among individuals.

The abundance and reproduction of viviparous blenny is monitored in all areas except Hiiumaa and Råneå. The abundance of blenny has been surveyed in the Sea of Straits and it was found that it was too rare for monitoring purposes, probably due to high summer temperatures in these shallow waters. The abundance has not yet been investigated in the archipelago of Råneå, but according to data on the distribution of this species it is rare also in the northern Bothnian Bay. Biochemical and physiological health indicators are investigated in Kvädöfjärden and Holmöarna and results have been used for comparisons with e.g. pulp mill effluent exposed populations.

Monitoring of viviparous blenny (abundance, reproduction, contaminant conentrations, biochemistry and physiology) is included in a integrated program within the Swedish national environmental monitoring. The program is carried out in Kvädöfjärden, Holmöarna and Fjällbacka on the Swedish west coast. The results presented in this report are reference values made available to investigations carried out in local pollution sites. The results are also regarded to represent the natural variations in different parts of the Baltic Sea. The longest series of data is available from Fjällbacka. The programs in the Baltic reference areas have undergone the initial testing period and the final programs will be decided within 1 or 2 years. Representative abundance data are thus not yet available from Holmöarna.

5.2. Material and methods

The blenny spawns in the beginning of September and the eggs hatch in the oviduct after 2 - 3 weeks. Inside the ovarian cavity the larvae develop into fry, which are delivered in January - March. Sampling is made in October-November when the fry are well developed, about 35 - 45 mm in size. The adult blennies are caught with small eel fyke nets at depths of 2 - 5 m. The females are kept alive and killed just before analysis. Length and weight of females are determined. The number of fry is counted and the length is registered in 2.5 mm length groups (Table 1), live, malformed and dead separately. The effect on reproduction of the blenny is studied by comparing the growth, i.e. size at capture of the fry, the share of fry with different types of disturbances, e.g. malformations and retarded development, the share of dead fry in the late development stages and by comparing the share of females with different disturbances on the reproduction (Thoresson 1996).

Table 1. Example of ranges and corresponding names of length groups (Thoresson, 1993)

Length group	34	36	39	41	44	46
Length range, mm	32.6-35.0	35.1-37.5	37.6-40.0	40.1-42.5	42.6-45.0	45.1-47.5

5.3. Results and discussion

Catch-per-unit-effort (CPUE) of viviparous blenny has mostly been about 1-2 (Table 2). Brunskär deviates by large catches in 1996 (>4 CPUE) and low catches in 1997 (0.3 CPUE). The catches in 1997 were probably influenced by strong variations of the water level combined with strong easterly winds. Apart from causing practical difficulties these conditions may also have forced the fishes to deeper waters. The sex distribution was similar, about 65 % females, in all areas (Table 2).

Table 2. Catch per unit effort (CPUE) and the share of females in the catches of viviparous blenny in reference areas.

	no. of efforts		no. of blenny		CPUE total		Share (%) of females	
Area	1996	1997	1996	1997	1996	1997	1996	1997
Kvädöfjärden	202	272	372	226	1.84	0.83		66
Brunskär	36	80	149	25	4.14	0.31	68	65
Finbo	60	112	84	156	1.40	1.39	66	64
Holmöarna			144	46			66	65

The largest females were found at Kvädöfjärden and the smallest at Holmöarna (Table 3). The most frequent fry length groups were similar at Kvädöfjärden, Brunskär and Holmöarna and smaller at Finbo (Table 3, reproduction index 1). The sampling at Holmöarna was carried out 4 - 5 weeks later and the data were hence not fully comparable with the other areas. The shares of retarded fry were low in all areas, mostly between 2 - 5 % (Table 3, reproduction index 2). The shares of late dead fry were about 1 - 2 % (Table 3, reproduction index 3). The shares of females carrying late dead fry varied strongly both between areas and years.

Table 3. Results from investigations of viviparous blenny collected in reference areas in the Baltic sea. Number of investigated females, their mean length and standard deviation (s.d.) are presented. The reproduction performance was indicated by: 1. the most frequent length group of developed fry, 2. the share (%) of retarded fry, 3. the share (%) of dead fry larger than 15 mm (late dead fry) of the total number of fry per fry brood, 4. the share (%) of females carrying late dead fry of the total number of pregnant females.

					Reproduction index							
	no. of females		mean length (mm)		1		2		3		4	
Area	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Kvädöfjärden	50	49	236	229	44	41	3.9	2.7	2.0	1.6	8	20
s.d.			*34*	*22*			*3.0*	*5.0*	*12*	*5.1*		
Brunskär	40	14	218	224	41	41	1.3	4.7	2.2	0	29	0
s.d.			*29*	*19*			*4.9*	*8.8*	*5.2*	-		
Finbo	46	50	226	218	39	36	2.4	2.6	1.6	0.3	20	11
s.d.			*29*	*33*			*4.6*	*7.6*	*4.5*	*1.1*		
Holmöarna	51	29	202	191	41	41	4.4	6.5	3.4	0.1	22	7
s.d.			*34*	*40*			*9.1*	*33*	*11*	*0.4*		

A complete analysis of station selection, catch levels etc. is still too early to perform. A catch value of >0.5 CPUE gave 60-70 females per 100 efforts, which is enough for reproduction analyses. The analyses showed in general low shares of retarded and dead fry and there were no indications of disturbed reproduction.

6. Conclusions

The programs for monitoring of warm water fish communities are now running according to guidelines in all areas. Many time series are sufficiently long for performing trend analyses and to predict stock development. Trends have been observed for both perch and roach. The data from Kvädöfjärden, Brunskär, Finbo and Holmöarna, including basic temperature recordings for interpretation of inter-year variations, have been used for catch predictions of perch. The results have also been published in fishery organisation journals in Sweden and Finland. The monitoring program has detected and documented overexploitation of the local perch stock in Hiiumaa and should also be expected to have the capacity to detect an eventual recovery of the population. Trends have been recorded for the Secchi depth measurements indicating a continued increase of the eutrophication of the coastal waters. The monitoring of viviparous blenny is still not fully developed in all areas. Established programs will probably be working within 1 - 2 years in the areas where the species is sufficiently abundant.

7. Acknowledgements

The field work requires the efforts of many persons and cooperation partners. We thank the Finnish Forest and Park Service for cooperation and financial contribution to the test fishing in Brunskär reference area and the Hiiumaa Islets State Landscape Reserve for successful cooperation 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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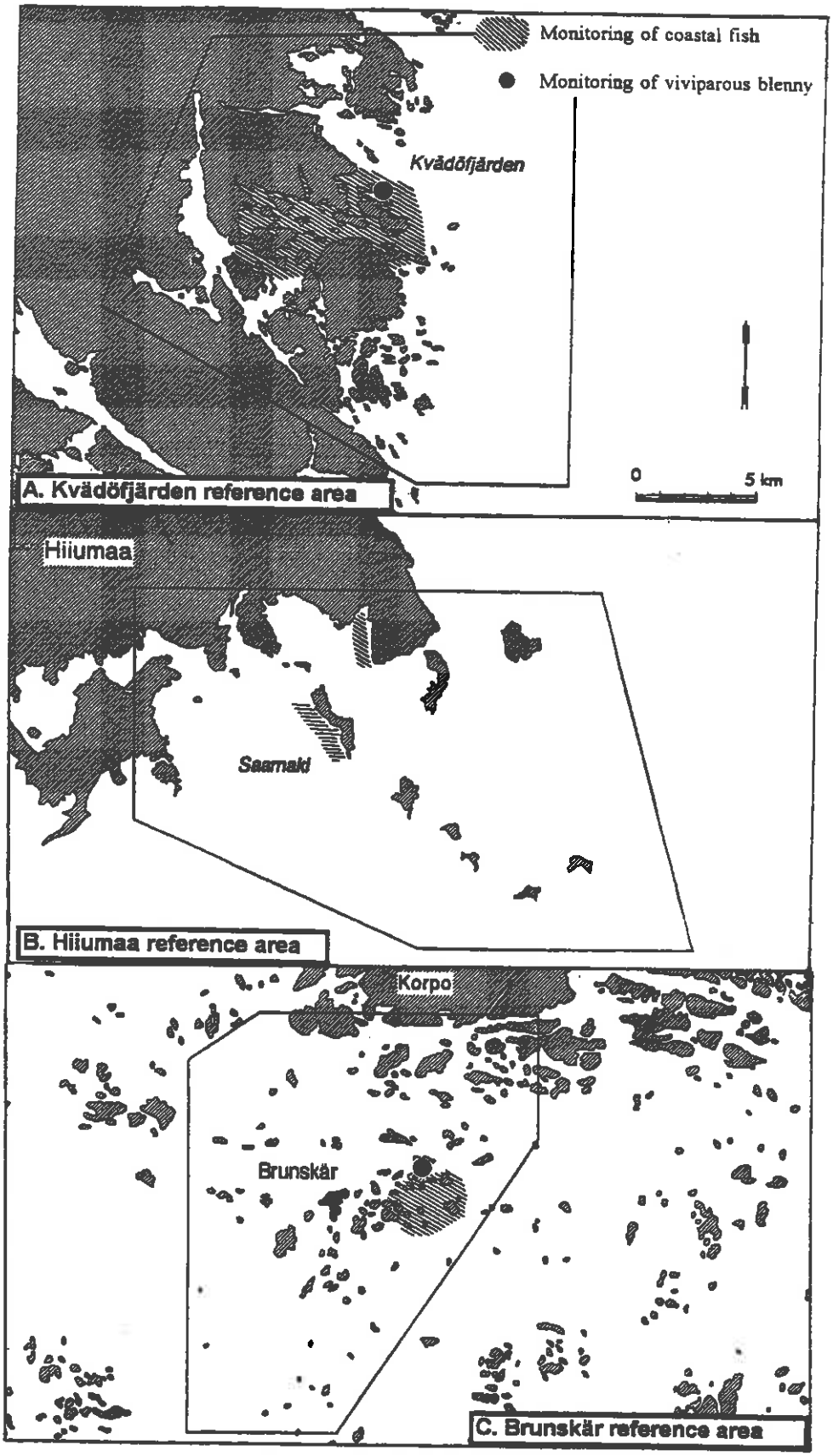
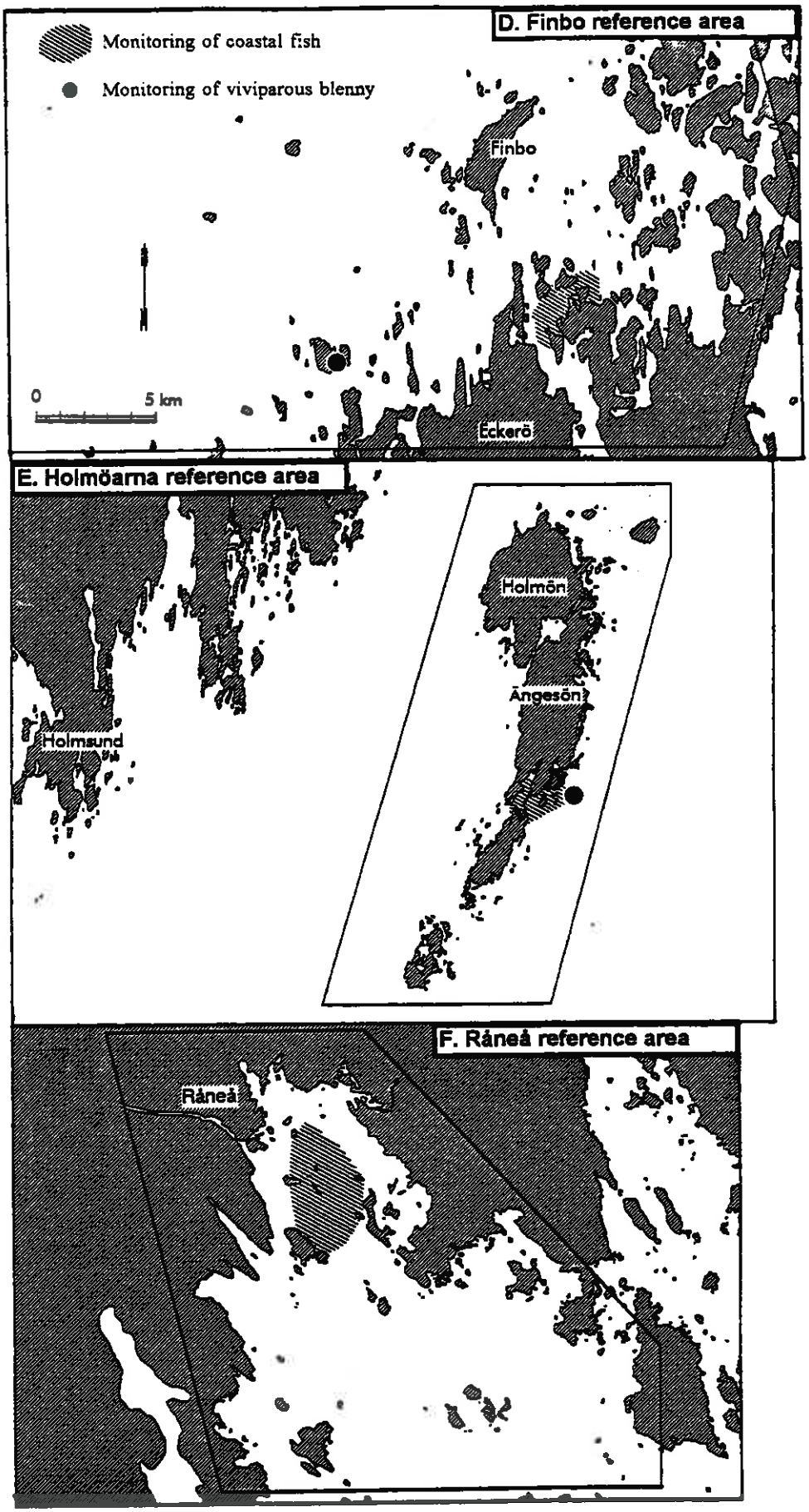


Appendix 1. International reference areas with recommended borders (solid lines) and monitoring localities for coastal fish and viviparous blenny.



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