

Reduction of cyprinid fish populations by seining at three lakes in Åtvidaberg in autumn 2023; Bysjön, Glan and Båtsjön

General

Glan, Bysjön, Håcklasjön, Fallsjön, Getryggen and Båtsjön are adjacent tributary lakes of River Storån in Åtvidaberg municipality. The lakes suffer from unnaturally high nutrient contents. A significant portion of specially summertime nutrients and algae problems are observed or suspected to be caused by internal loading. One of the common sources for internal loading are unbalanced food-webs where cyprinid fishes with high biomasses are dominating the fish populations.

Reduction fishing of cyprinids is one of the methods, and a relatively inexpensive one, for reducing internal loading of nutrients and summertime algae problems as well as increasing water clarity. The method suits best to the lakes where the highest nutrient contents and murkiest water are observed during warmest summer months, July-August, when the feeding activity of fishes is most intense.

A Finnish seining method for cyprinid fishing has been developed during the last 30 years, starting from early 1990s. In small lakes (about <100 ha) it can be used throughout a year but especially in large lakes the technique is most cost-effective during autumn and cooling water when cyprinid fishes tend to shoal to dark refuges, i.e., deep areas of a lake, at daytime. If dark refuge is not available, the fish may also hide to rivers, brooks, even ditches, or to littoral vegetation. In cooling water cyprinid fishes can meet their needs for daily feeding during twilight and night and thus being exposed for visual predators like pike and fish-eating birds during the daytime is an unnecessary risk. The biggest cyprinids like adult bream and tench may still stay in open and illuminated water layer because their risk for predation is low.

Since 2020 the reduction fishing of cyprinids by seining has been applied to all six lakes (table 1).

Target catches for the lakes

Target catches for cyprinids per hectare were calculated according to late summer total phosphorus (g/m³) in the lake water. The target catch should be achieved in a relatively short time, usually within 1-2 years. In some Åtvidaberg lakes target was already reached during 2020-2022 (Table 1). Unlike the other lakes, Glan and Bysjön were previously seined only once, in 2022, and thus these two were now aimed for supplementary fishing. Båtsjön was picked as a third lake because it had previously been seined only in late autumn and the catches had consisted mainly big bream while smaller bream and roach had already escaped from open water.

Seining 2023 and its circumstances

The seining took place on 14th – 23rd September including 10 days of fishing and 18 seine hauls (Table 2, Figure 3). The seine used was a 314 m long and 6 m deep cyprinid bottom seine. Weather was suitable for echo sounding and seining on all days.

The autumn was exceptionally warm and water temperature was steadily about 18 °C during the fishing. Secchi depth was 180 cm at Glan, 155 cm at Bysjön and 75 cm at Båtsjön. A dark daytime refuge in deep water is generally achieved when water depth is more than twice the Secchi depth. Thus, dark refuge was now available at Båtsjön but only vaguely at Glan and Bysjön.

Catches

The total catch was 15850 kg and consisted mainly of bream (braxen 50 %) and roach (mört, 32 %). Other species noticed in the catch but with small portions were rudd (sarv), ruffe (gers), small perch (små

abborrar), bleak (benlöja), white bream (björkna), tench (sutare) and crucian carp (ruda). (Table 2, Figures 1 and 2). The average catches per seine haul and per fishing day were 880 and 1585 kg.

About 1200 kg predatory fishes were released back to the lake in good condition. They consisted of pikeperch (gös, 214 individuals, 715 kg), pike (gädda, 536 ind., 447 kg) and predatory perch (abborre >15 cm, 149 ind., 29 kg) (Table 2). The prey-predator ratio (kg/kg) in the total catch was 13.

Notices and conclusions

Despite of warm water temperature roach was shoaling intensely to restricted areas at Bysjön and Glan where secchi depths were high. At Glan shoaling could be well utilized. At Bysjön most intense shoaling occurred at the places where lake is occupied by vertical logs and bottom trees (see report 2022) and where seining was not possible. Therefore, the fishing was less efficient at Bysjön.

At Båtsjön fish were not shoaling and merely gathered loosely to certain depth zones during daytime. In such small lakes even this is enough to get good results with seining and catches were good.

The joint target catch for the six lakes is well exceeded (catch 73810 kg vs. target 31450 kg). Individual target catches were achieved well in Glan (13650 vs. 7400 kg), Bysjön (11850 vs. 9900 kg), Getryggen (3200 vs. 1800 kg), Fallsjön (14600 vs. 11500 kg) and Båtsjön (23960 vs. 17400 kg) while not in Håcklasjön (6550 vs. 7450).

The biomass of cyprinid fishes contains 0,8 % phosphorus and 2,5 % nitrogen of wet weight. Therefore, the fishing in these lakes has removed directly 590 kg phosphorus and 1845 kg nitrogen from the headwaters of River Storån. The cost for this removal is 1090 SEK/kgP and 350 SEK/kgN (just our fishing fees, without other possible costs).

The fishing cost for the catch was in 2020 about 5,8 SEK/kg (just Båtsjön), in 2021 14,3 SEK/kg (Båtsjön, Håcklasjön, Fallsjön, Getryggen, Båtsjön), in 2022 8,7 SEK/kg (Glan, Bysjön, Håcklasjön, Fallsjön, Getryggen), now in 2023 11,3 SEK/kg and altogether 8,7 SEK/kg (just our fishing fees). With these figures seining has been cost-effective and is a suitable method for reduction fishing in these lakes. After our 30 years' experience, we consider costs under 10 SEK/kg cost-effective and 10-20 SEK/kg reasonable. Prices over 20 SEK/kg are costly and with these figures one should consider changing the methods.

We suspect that the results from the fishing should be seen first of all at Glan and Bysjön (less algae problems and better secchi depths). If biomanipulation by cyprinid fishing is considered to continue, these lakes could be shifted to maintenance phase where target catches per 1-2 years could be about 30-40 kg/ha. The lakes down from the sewage water origin, ie. Håcklasjön, Fallsjön, Getryggen and Båtsjön have more resistance and need more intense effort. At least Håcklasjön, Fallsjön and Båtsjön might need continuance of intense fishing with target over 100 kg/ha per 1-2 years. Getryggen is such a small lake that it will benefit from the biomanipulation of other lakes even if itself is not manipulated.

Thanks!

Thanks again for the good organization of the project for Kenneth Winroth, Anton Sunnergren and others. And thanks for all the local people for the help and good company during the fishing.

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Good catches of bream from Bysjön (above left) and Båtsjön (under), and roach from Glan (above right).

Table 1. The target and actualized catches for the reduction fishing at five Åtvidaberg lakes in 2020-2023.
Green colour: target was exceeded
Yellow colour: target was not exceeded

Lake	Area ha	Total_P ug/l	Target catch ¹⁾		Catch kg				
			kg/ha	kg total	2020	2021	2022	2023	Total
Glan	64	40	115	7400	0	0	8450	5200	13650
Bysjön	100	30	99	9900	0	0	7900	3950	11850
Håcklasjön	40	100	185	7450	0	250	6300		6550
Fallsjön	81	60	142	11500	0	4550	10050		14600
Getryggen	15.6	40	115	1800	0	1500	1700		3200
Båtsjön	111	73	157	17400	13100	4160	0	6700	23960
				55450	13100	6300	34400	15850	73810
1) Target catch (kg/ha) = 16.9 x TP ug/l ^{0.52} ;									
Jeppesen, E. & Sammalkorpi, I. 2002. Lakes. In: Davy, A.J. & Perrow, M.R.(ed.). Handbook of ecological restoration. Vol. II. Restoration in practice. Cambridge University Press: 297-324									

Table 2. The hauls and catches in the reduction fishing of cyprinids by seining in the Åtvidaberg lakes in autumn 2023. An excel file with a more complete fishing diary has been sent separately for the client.

vatten temp°C	DRAG						FÅNGST kg										total vittfisk fångst kg	ROVFISKAR			Abborre >15 cm fångst kg	rovfisk fångst kg										
	nummer	sjön	datum	längd m	ytan ha	braxen	mört	sarv	gers	<15 cm	benlöja	björkna	sutare	ruda	check	n		kg	Gädda n	kg												
18.9	1	Bysjön	14.9.	260	5.2	1120	70	0	104	105	0	0	1	0	1400	1400	0	0	12	12	6	1	13									
	2	Bysjön	14.9.	120	3.0	160	10	0	14	15	0	0	1	0	200	200	4	4	11	11	1	0	15									
18.7	3	Bysjön	15.9.	260	2.6	560	80	0	69	90	0	0	1	0	800	800	1	2	17	26	7	1	29									
	4	Bysjön	15.9.	220	4.4	100	150	0	75	75	0	0	0	0	400	400	4	8	15	23	10	2	32									
18.7	5	Bysjön	16.9.	100	2.5	20	10	0	10	60	0	0	0	0	100	100	1	3	10	20	5	1	24									
	6	Bysjön	16.9.	200	5.0	200	450	0	123	125	0	0	0	2	900	900	10	25	24	48	4	1	74									
18.3	7	Bysjön	17.9.	160	4.0	18	50	2	8	70	0	0	2	0	150	150	0	0	12	6	4	1	7									
	8	Glan	18.9.	150	3.8	250	600	0	68	70	10	0	2	0	1000	1000	0	0	55	28	19	6	33									
	9	Glan	18.9.	220	5.5	200	1200	0	30	30	40	0	0	0	1500	1500	0	0	74	37	46	9	46									
18.0	10	Glan	19.9.	230	5.8	200	200	0	50	50	0	0	0	0	500	500	4	12	62	31	4	1	44									
	11	Glan	19.9.	200	5.0	600	270	0	50	50	30	0	0	0	1000	1000	1	4	45	23	7	1	28									
17.8	12	Glan	20.9.	200	5.0	50	1000	0	50	80	20	0	0	0	1200	1200	1	3	55	28	16	3	34									
17.4	13	Båtsjön	21.9.	230	5.8	350	550	1	0	29	450	0	20	0	1400	1400	44	132	31	31	8	1	164									
	14	Båtsjön	21.9.	220	5.5	930	70	0	0	30	50	20	0	0	1100	1100	31	93	34	34	0	0	127									
	15	Båtsjön	22.9.	180	4.5	600	50	0	20	30	55	30	15	0	800	800	25	75	24	36	2	0	111									
	16	Båtsjön	22.9.	170	4.3	600	50	5	20	30	55	30	10	0	800	800	22	66	15	15	6	1	82									
18.1	17	Båtsjön	23.9.	150	3.8	450	100	9	30	40	60	10	1	0	700	700	22	66	20	30	3	0	96									
	18	Båtsjön	23.9.	210	5.3	1500	100	0	20	29	200	50	1	0	1900	1900	74	222	20	10	1	0	232									
						kg	7908	5010	17	741	1008	970	140	54	2	15850	15850	244	715	536	447	149	29	1191								
						%	49.9	31.6	0.1	4.7	6.4	6.1	0.9	0.3	0.0	100																
							Båtsjön																									
						kg	4430	920	15	90	188	870	140	47	0	6700																
						%	66.1	13.7	0	1.3	2.8	13.0	2.1	0.7	0.0	100																
							Getryggen																									
						kg	0	0	0	0	0	0	0	0	0	0																
						%	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#JAKO/0!															
							Fallsjön																									
						kg	0	0	0	0	0	0	0	0	0	0																
						%	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#JAKO/0!															
							Häcklasjön																									
						kg	0	0	0	0	0	0	0	0	0	0																
						%	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#JAKO/0!															
							Bysjön																									
						kg	2178	820	2	403	540	0	0	5	2	3950																
						%	55	21	0	10	14	0	0	0	0	100																
							Glan																									
						kg	1300	3270	0	248	280	100	0	2	0	5200																
						%	25	63	0	5	5	2	0	0	0	100																
							All six lakes 2020-2023 (412 ha)																									
							15850	kg seining 2023 (Bysjön, Glan, Båtsjön)																								
							34400	kg seining 2022 (Getryggen, Fallsjö, Häcklasjö, Bysjö, Glan)																								
							10460	kg seining 2021 (Häcklasjö, Fallsjö, Getryggen, Båtsjö)																								
							13100	kg seining 2020 (Båtsjö)																								
							73810	kg																								
							179	kg/ha																								
							Båtsjön (111 ha)																									
							6700	kg seining 2023																								
							0	no fishing 2022																								
							4160	kg seining 2021																								
							13100	kg seining 2020																								
							23960	kg																								
							216	kg/ha																								
							Getryggen (15,6 ha)																									
							0	no fishing 2023																								
							1700	kg seining 2022																								
							1500	kg seining 2021																								
							3200	kg																								
							205	kg/ha																								
							Fallsjön (60 ha)																									
							0	no fishing 2023																								
							10050	kg seining 2022																								
							4550	kg seining 2021																								
							14600	kg																								
							243	kg/ha																								
							Häcklasjön (40 ha)																									
							0	no fishing 2023																								
							6300	kg seining 2022																								
							250	kg seining 2021																								
							6550	kg																								
							164	kg/ha																								
							Bysjön (100 ha)																									
							3950	kg seining 2023																								
							7900	kg seining 2022																								
							11850	kg																								
							119	kg/ha																								
							Glan (64 ha)																									
							5200	kg seining 2023																								
							8450	kg seining 2022																								
							13650	kg																								
							213	kg/ha																								

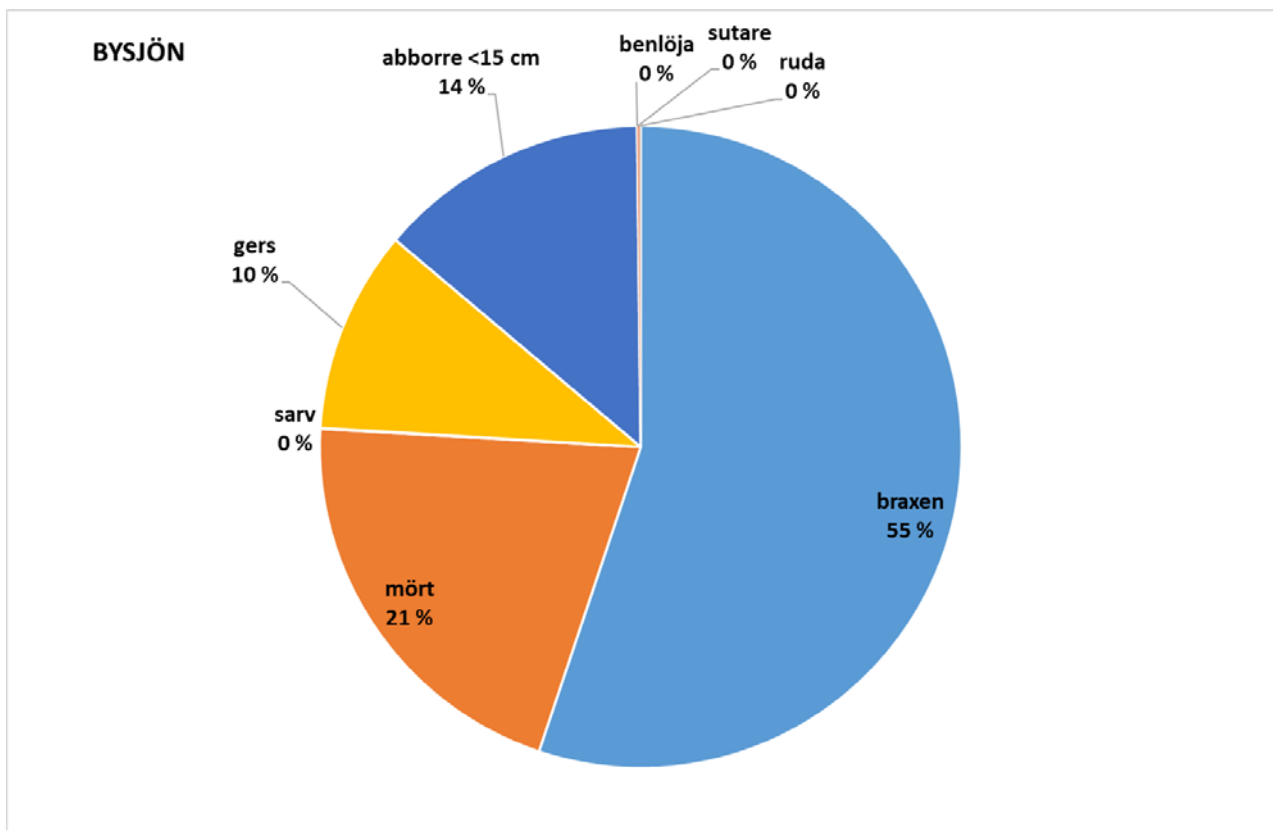
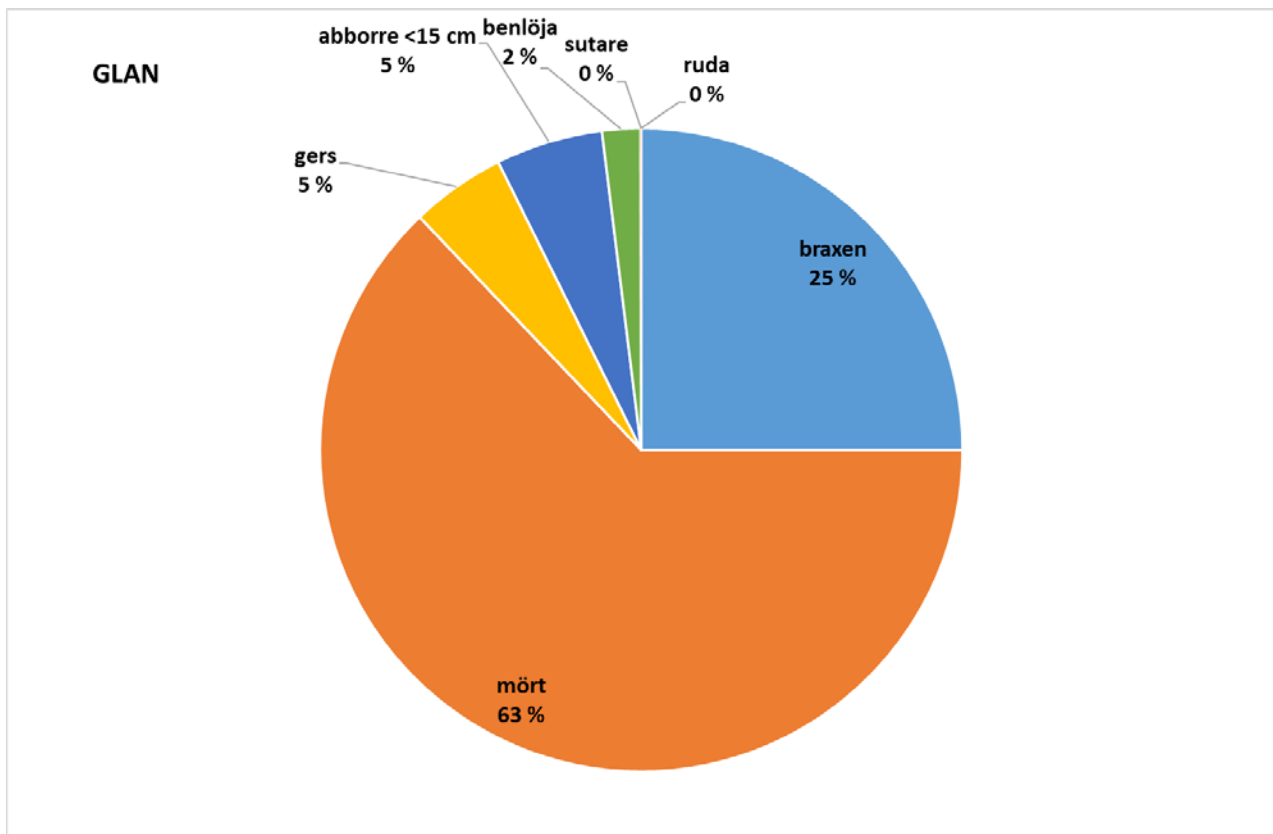


Figure 1. The composition of catch in the reduction fishing of cyprinids by seining in Lake Glan and Lake Bysjön in autumn 2023

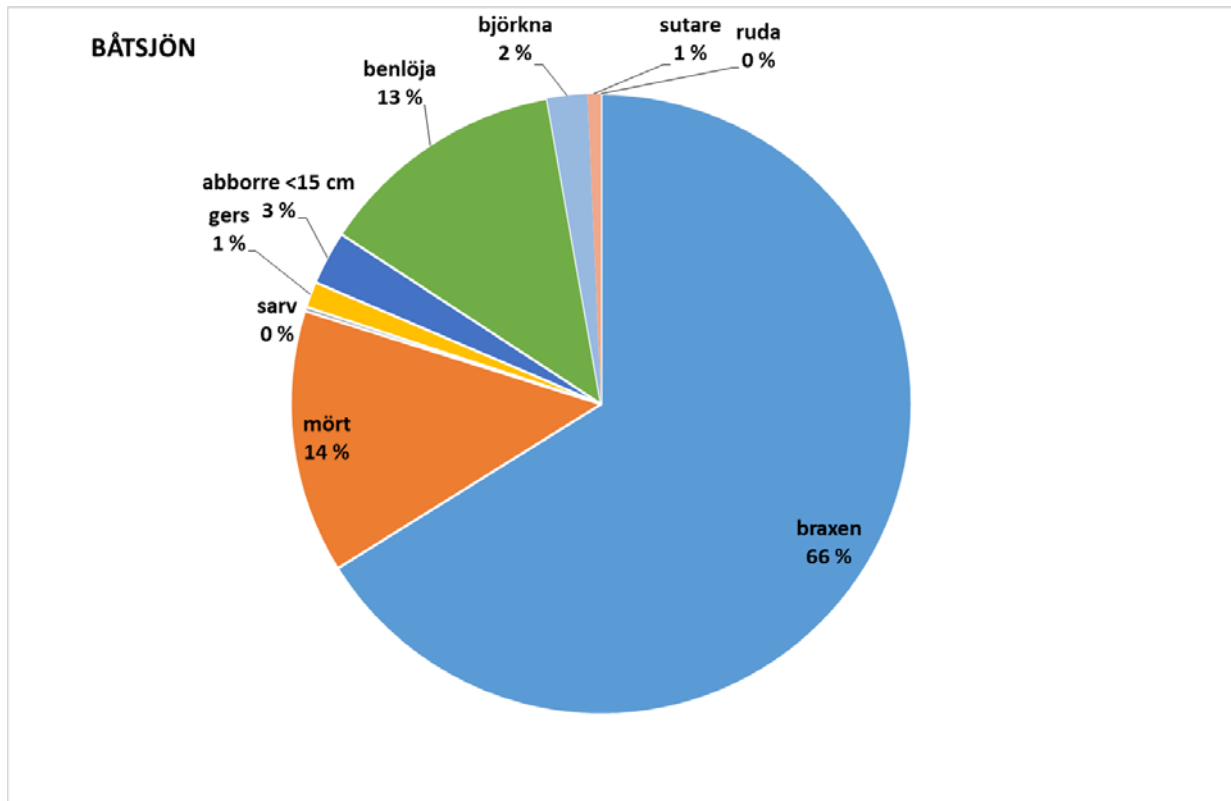


Figure 2. The composition of catch in the reduction fishing of cyprinids by seining in Lake Båtsjön in autumn 2023

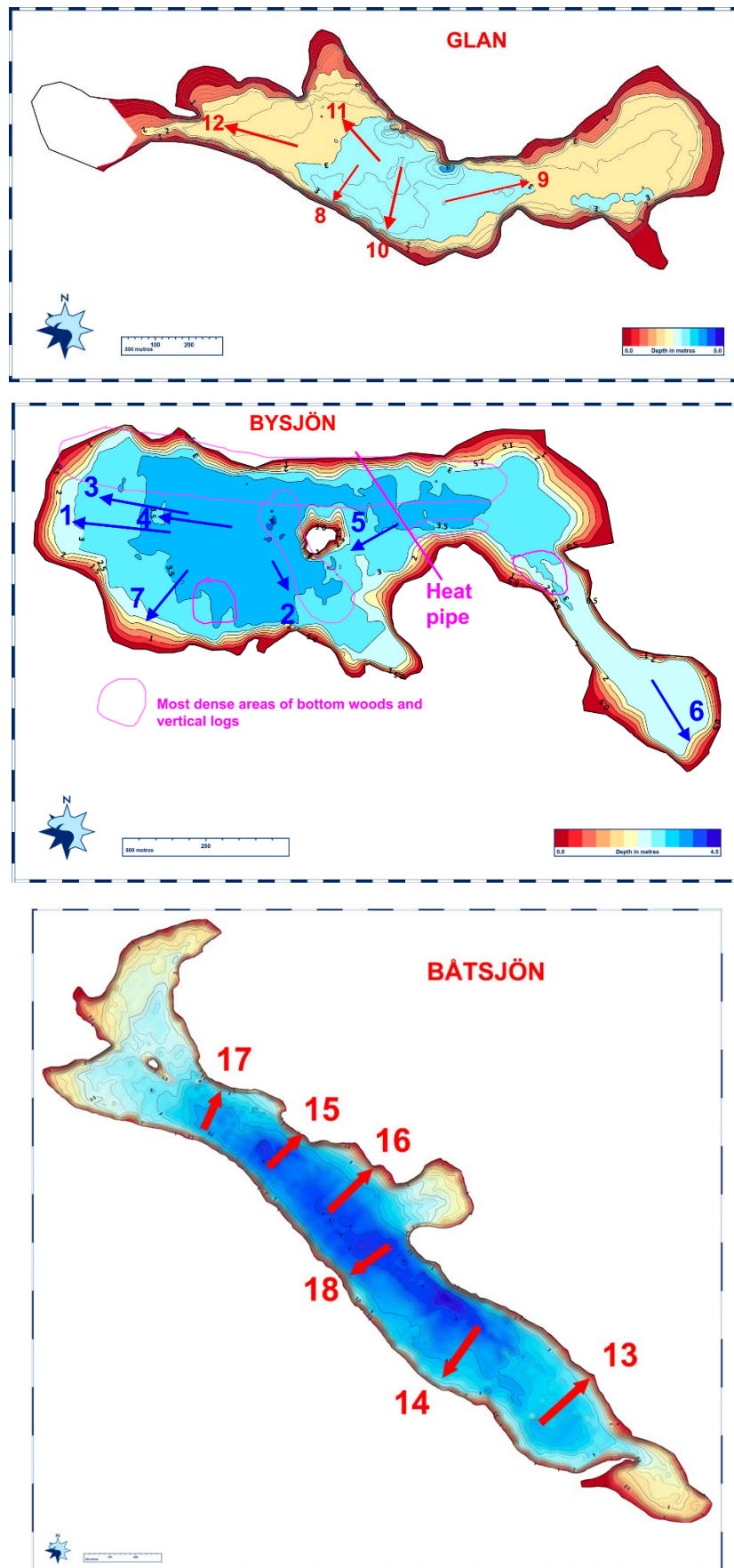


Figure 3. The locations of the hauls made in the reduction fishing of cyprinids by seining at Lakes Glan, Bysjön and Båtsjön in autumn 2023.