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Fish researches in Vatnsá and Kerlingardalsá watershed in year 2006

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Abstract

In this report we describe results from researches done on the Vatnsá and Kerlingardalsá watershed by Veiðimálastofnun in September 2006. This is a continue of the research that started in 2004. The aim was to evaluate the status of salmonid parr populations in rivers and streams by electro fishing and also to research the fish populations in lake Heiðarvatn, but Vatnsá is an outlet stream from the lake. In this research 0^+ juveniles of brown trout were dominating in all research stations but one and the density was highest in Vatnsá. The juvenile's density was much lower in Kerlingardalsá. Salmon juveniles were found in 6 of 8 stations in Vatnsá, Kerlingardalsá and Skakká but not in Heiðará and Þorleifsá. Their density was lower than that of trout juveniles, but their density was highest in the upper reaches of Vatnsá River. In Vatnsá the salmon proportion of total density of salmonid juveniles was 22 - 31 % and had risen since 2004, when it was 9 – 18 %. Salmon parr were also found in Kerlingardalsá. In rivers and brooks that drain to Heiðarvatn 0^+ parr were dominating. In research fishing by 12 net lying over one night in Heiðarvatn the catch was 172 brown trout and 54 charr.

Most of the trout was under 40 cm in length but the bulk of charr were 24 to 33 cm. About 25 % of the trout was of hatchery origin. The main food of the trout and charr was wandering snail (*Limnea peregra*) and Sticklebacks (*Gasterosteus aculeatus*) was also an important food for trout and *Cyclops* for the charr. In the discussion part we detail the results and compare them with the research from 2004. We also discuss future enhancement.

Introduction

Vatnsá was originally a trout-fishing river (Magnús Jóhannsson 1991). Sea trout (anadromous brown trout, *Salmo trutta*) was dominating like in many other rivers in South-eastern Iceland. The salmon seem to originate from releases of juveniles in 7. to 9. decades of the last century and in the years following the catch of salmon exceeded the trout catch (Magnús Jóhannsson 1991).

In 1990 Veiðimálastofnun did a research on the salmonid juvenile population in Vatnsá and Skakká. Wild Atlantic salmon (*Salmo salar*) parr (0^+ and 1^+) was dominating and was in high densities, highest density was found in the upper part of Vatnsá (Magnús Jóhannsson 1991). In Vatnsá no brown trout was found older than 1^+. Salmon smolt age seemed to be 2-3 years. In Skakká (tributary to Vatnsá) salmonid juveniles was in much lower densities than in Vatnsá. Few arctic charr (*Salvelinus alpinus*) juveniles were found.

In the year 1990 Veiðimálastofnun also did a research on Heiðarvatn. The result showed that the fish stocks in the lake consisted of resident arctic charr and brown trout in a quite quantity, most of the arctic charr was between 200 – 300 g of weight and the brow trout between 100 – 500 g. The main food items of both species were three-spine sticklebacks (*Gasterosteus aculeatus*) (Veiðimálastofnun unpublished data).

The salmonid juvenile research in 1990 is belived to have illustrated salmon production at its peak. In the year 2004 Veiðimálastofnun did a research on the Vatnsá and Kerlingardalsá watershed. The aim was to evaluate the status of salmonid stocks in the rivers and in the lake. Electro fishing was done in the rivers and nets were put in the lake over one night on three different locations. 0^+ juveniles of brown trout were dominating in all research stations and the density was highest in Vatnsá. The juvenile's density was much lower in Kerlingardalsá. Salmon juveniles were found in 7 of 11 stations in Vatnsá and Kerlingardalsá and their tributaries but not in Heidarvatn or brooks draining to it. Their density was much lower than that of trout juveniles, but their proportion of total density of salmonid juveniles was highest in upper reaches of Vatnsá, or 18%. In rivers and brooks that drain to Heiðarvatn 0^+ parr of trout were dominating. Trout was the main catch in the research nets in Heiðarvatn Lake. About ¼ of the trout was of hatchery origin, but big quantities of trout parrs have been released in the lake in recent years. The main food of the trout was three-spine sticklebacks but wandering snail was the most important food of charr.

The research in 2006 is a continue to the one done in 2004, this time electro fishing was done on fewer stations than in 2004.

The aim of the research is to evaluate the present situation of the fish stocks in the area and see the results of enhancement activities in recent years, which have mainly been releases of juvenile trout and salmon.

Study area

Icelandic rivers and streams are different in type. They have been classified according to the origin of the water (Sigurjón Rist 1956). Many rivers have their origin in glaciers, they are turbid and are classified as glacial rivers. In the same manner water temperature responds quickly to variation in air temperature. Spring-fed rivers have a distinct origin often in a gushing spring (groundwater) and the flow often reach its full capacity not far from the headspring. Their flow is very stable all year round also is the water temperature. Most Icelandic rivers have a blended origin. Hydrology and fertility (nutrient content) of streams depends on the lands bedrocks and cover of vegetation it flows through. Lakes on the catchments area stabilize the flow and increase organic production.

The rivers and streams of the Vatnsá and Kerlingardalsá catchments area are of various types. Vatnsá is the outflow of the lake Heiðarvatn (Fig. 1), its discharge is a few m^3 and is rather steady. The river is a mixture of a spring-fed river and a direct runoff river with a lake, which stabilizes the run-off. Vatnsá is 3 km long and flows into the glacial river Kerlingardalsá 8 km above the estuary in the Atlantic Ocean. Just below Heiðarvatn the profile of Vatnsá is not steep and therefore the bottom material is mainly fine gravel. Just above Skakká is a man made waterfall, ca. 1 m high, made by embedded rocks in order to create fishing pool, created in the years 1996 to 1998 (Hafsteinn Jóhannsson pers. com.). About 1 km below the lake Vatnsá flow through a 1,5 km long low gorge. There we find pools and riffles. The bottom material is mostly rough gravel (particles 5-15 cm in diameter) covered with stream moss (*Fontinalis* sp.) Around 500 m below the lake a small stream falls to Vatnsá, Skakká. It is rather cold river with origin in the mountains north of the lake. A few years ago a branch from Kerlingardalsá have broken its way to the lower most reaches of Vatnsá. Kerlingardalsá is a glacial river with some water of runoff and spring origin. The river comes from Mýrdalsjökull. In upstream reaches gorge rapids are dominating. The water-flow in Kerlingardalsá is characterized by heavy fluctuations, and the river bottom is very unstable. The bottom material is mostly made of rough gravel. The tributary stream Heiðargilsá, meets Kerlingardalsá above Vatnsá. The stream is of glacial origin and the riverbed is rather rough (small cobble) but unstable. The fish fauna of rivers and streams in the watershed below Heiðarvatn consists of arctic charr, brown trout (mainly anadromous), Atlantic salmon, and three-spine stickleback. Heiðarvatn is a 190 ha (1,9 million m^2) lake in 72 m altitude above sea level. The average depth is 12,9 m and the maximum depth is 30 m. A few small runoff and spring fed streams flow into the lake (Fig. 1). However their flow can rise a lot when it is raining (Tómas Pálsson pers. com). The bottom substratum is mainly made from rather fine gravel.

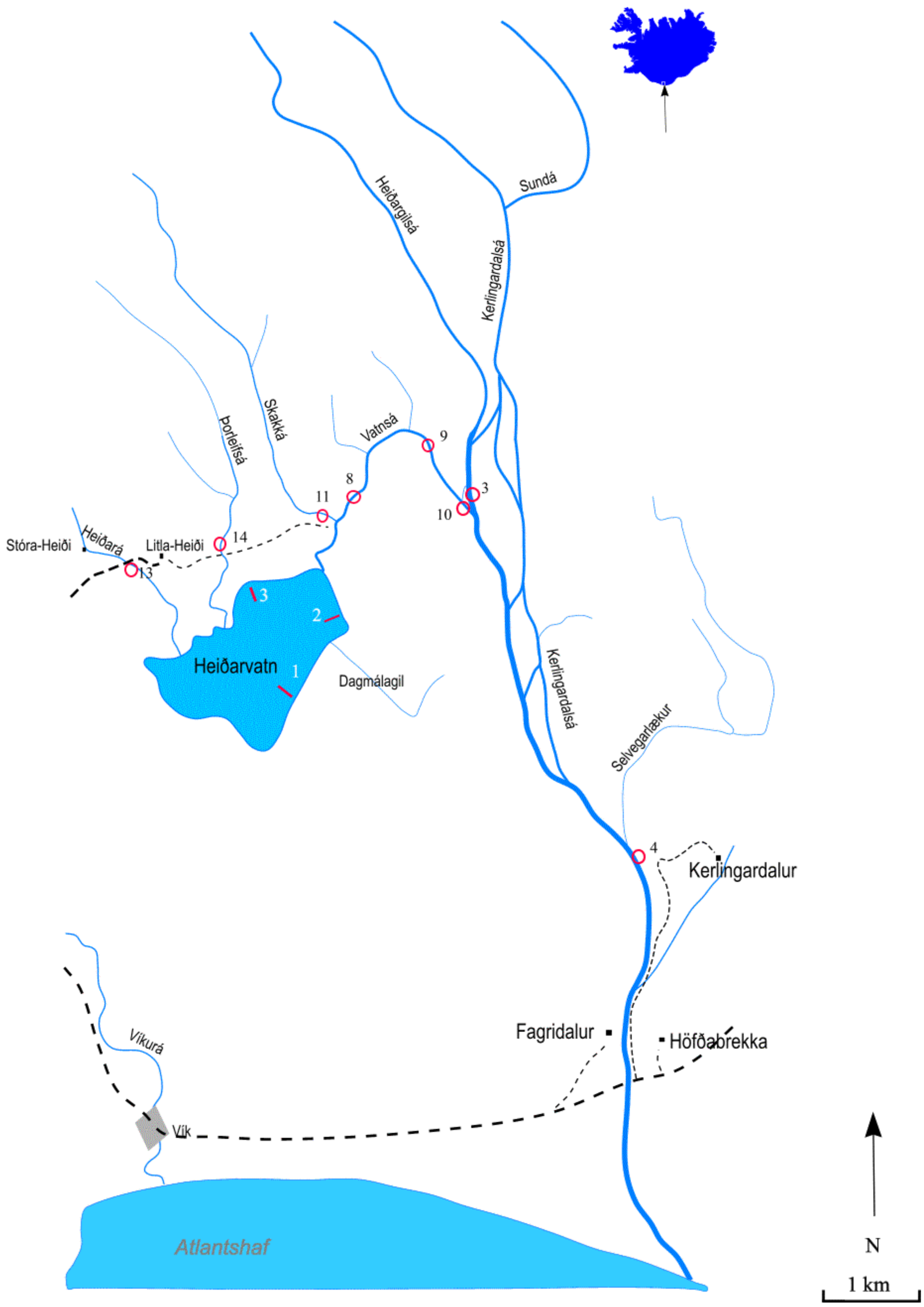

Figure 1. Vatnsá and Kerlingardalsá watershed, samplings stations in electro fishing (red squeres) and position of nets (red bars in the lake) are shown with equalent number.

The lakes fish fauna consists of resident (stationary) arctic charr, and brown trout, Atlantic salmon, anadromous brown trout (sea trout) and a three-spine stickleback. Thick layers of snow can form in the region and in winters rich of snow, the ice layer on the lake doesn't brake until late in may.

The Vatnsá River is passable from the sea to Heiðarvatn and fish can pass streams and brooks draining to the lake. Kerlingardalsá and its tributaries are also passable.

Releases of salmonid juveniles

In the middle of the seventies of the last century the first releases of salmon smolts were done in Vatnsá. Since 1979 juveniles have been released almost every year. (Table 1). Salmon parr were mainly released in Vatnsá and Skakká but also in Heiðarvatn. In the years before 1990 unknown quantities of trout juveniles were released.

Table 1. Releases of salmonid parr in Vatnsá and Kerlingardalsá in 1979 to spring 2006. In addition unknown amount of trout parr were released in the years before 1990.

Year	*Place of release*	*Species*	*Under-yearlings (0^+)*	*One year (1^+)*	*Smolt*	*Origin*
1979	Vatnsá	Salmon	1800			Kollafjörður
1980	Vatnsá	Salmon	2000			Kollafjörður
1981	Vatnsá	Salmon	8000			Kollafjörður
1981	Heiðarvatn	Salmon	9500			Kollafjörður
1981	Brooks near Kerlingardalsá	Salmon	2000			Kollafjörður
1982	Vatnsá	Salmon	9000			Kollafjörður
1982	Heiðarvatn	Salmon	10000			Kollafjörður
1983	Vatnsá	Salmon	7000			Kollafjörður
1984	Vatnsá	Salmon	1000			Kollafjörður
1985	Vatnsá	Salmon	1000			Kollafjörður
1986	Vatnsá	Salmon	5200			Vatnsá
1987	Vatnsá	Salmon	1200			Vatnsá
1988	Heiðarvatn	Salmon		2550		Vatnsá
1989	Vatnsá/Heiðarvatn	Salmon	6500			Vatnsá
1990						
1991	Vatnsá	Salmon			4500	Stóra-Laxá
1992	Vatnsá	Salmon			2400	Vatnsá
1993						
1994	Vatnsá	Salmon			2500	Vatnsá
1995	Vatnsá	Salmon			3300	Vatnsá
1996						
1997	Vatnsá	Salmon	~11000			Vatnsá
1998	Vatnsá	Salmon	~15000			Vatnsá
1999	Vatnsá	Salmon	23000			Vatnsá
2000	Vatnsá	Salmon	25000			
2001	Vatnsá	Salmon	15000			Vatnsá
2002	Vatnsá	Salmon	11500			Vatnsá
2003						
2004	Vatnsá/Heiðarvatn	Trout		14500		Vatnsá
2004	Vatnsá	Salmon			9700	Vatnsá
2004	Heiðarvatn	Trout	60000			Vatnsá
2005	Vatnsá	Trout		30000		Vatnsá
2005	Heiðarvatn	Trout		25000		Vatnsá
2005	Vatnsá	Salmon			28000	Vatnsá
2005	Heiðarvatn	Trout	12000			Vatnsá
2006	Heiðarvatn	Trout		36000		Vatnsá
2006	Vatnsá	Salmon			75000	Vatnsá

In spring 2004, 5.363 salmon smolts and 5.028 trout juveniles were micro-tagged and in the autumn 2004, 5.028 trout juveniles were micro-tagged. In the spring a part of the trout juveniles and all of the salmon smolt were released in a pond in Vatnsá. In May 2005 30.000 one-years-old trout juveniles and 28.000 salmon smolt were released in ponds in Vatnsá River and 25.000 one years old trout directly released in Heiðarvatn Lake. In autumn 2005 some 12.000 0+ trout were released in Heiðarvatn Lake. In spring 2006 a group of 75.000 salmon smolt and 36.000 trout juveniles (one year old) were released in the ponds in Vatnsá. . More information on releases is presented in an earlier report (Magnús Jóhannsson et al 2004).

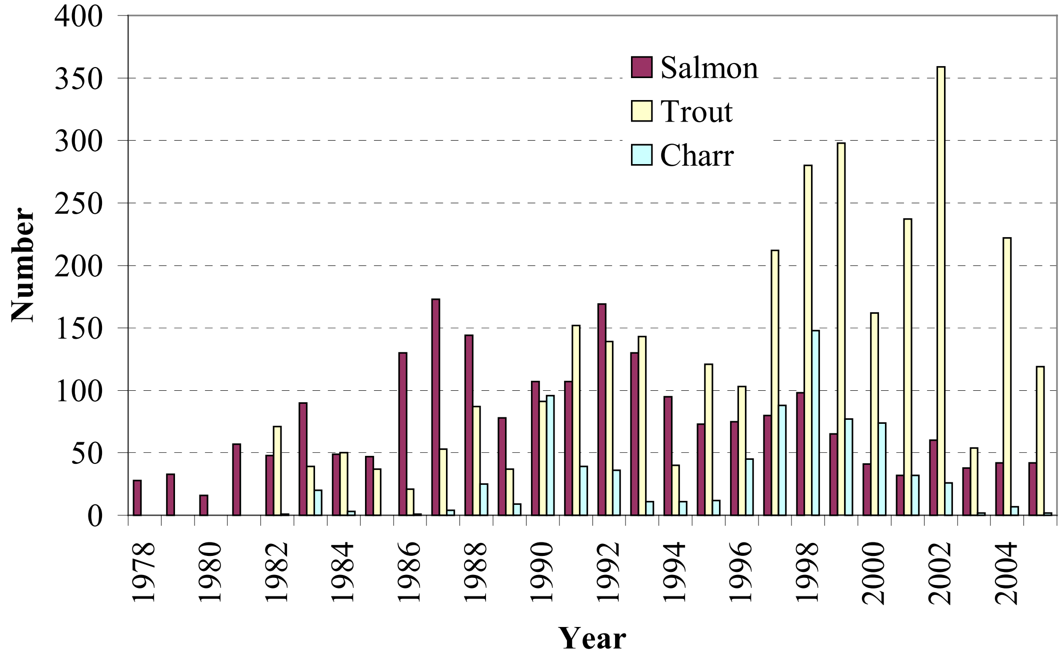

Figure 2. Angling of salmon, trout and charr in Vatnsá and Kerlingardalsá.

Catch of salmon, trout and charr

As written before Vatnsá was sea trout-fishing river before releases of salmon juveniles. However a salmon occasionally was caught but the catch of sea trout was much more than later on (Magnús Jóhannsson 1991). In Kerlingardalsá an intense drift net fishing was operated and it is possible that over fishing have caused a decline in the population. In recent time angling is the only fishing in Vatnsá and Kerlingardalsá. The average catch in the years 1996-2005 was 57 salmon and the maximum catch (1987) was 173 salmon (Fig. 2). Since 1992 the trend in catch of salmon is downward. The average catch of brown trout (1996-2005) was 205 fish. The catch of trout increased until 2002 when 359 trout were caught but has decreased in later years (Fig. 2) (Guðni Guðbergsson 2006). The exploitation rate was much lower from the year 2003 than in the years before. The average catch of charr is 50 fish. Resident trout and charr are not reported separately, but the bulk of the trout is sea trout, the charr are mostly resident. The migration of salmon is late in the season, the first salmon often arrive in late July. According to anglers, many salmon, and specially sea trout, migrate through Vatnsá almost without resting in pools, but stops in Heiðarvatn and stays there until autumn, they go down to the river to spawn. Most of the Vatnsá salmon has stayed one year at sea (grilse). Information about the catch In Heiðarvatn to the year 2003 can be seen in a report (Magnús Jóhannsson et al. 2004) but has been unreported since.

Methods and materials

Survey of juveniles

Electro fishing was done to measure density, length distribution, age and distribution of different species. Density was presented as juveniles index, which is, caught fish in an area of 100 m^2. This is not the total density of parr, because only 30 to 60 % of the total population in each area is caught (Finnur Garðarsson 1983). Fishing was done on 8 stations in five different rivers, three in Vatnsá, two in Kerlingardalsá, one in Skakká, one in Heiðará and one in Þorleifsá (Fig. 1). All fish were determined to species, its length measured (fork length) and some were inspected for stomach content and scales and otoliths sampling for determination of age. Proportion of volume of each food item was determined by eye. The stage of fullness of the stomach was presented as 0 to 5 where 0 is no food and 5 is full. Food of parr was presented separately for Kerlingardalsá River, Vatnsá River and Skakká River but because of few stomach food samples from Heiðará River and Þorleifsá River they are pulled together. On sampling stations survey was done on the stream bottom substrate and the water temperature and electric conductivity of the water were measured. Conductivity is a good indicator of the total chemical content of the water and the higher the conductivity (to a certain degree) the higher is the fertility. Electro fishing was done in 25. and 26. September 2006.

Experimental fishing by gill nets

Experimental fishing in Heiðarvatn was performed with 11 gillnets (Fig. 1) that lay in the lake over one night (from the evening 25. of September to the morning 26. of

September). The nets were with bar mesh size 12 (2 net) – 16,5 – 19,5 – 21,5 – 24 – 30 – 33 – 45 – 50 and 60 mm. Each net was 25 m long and 1,5 m deep.

All fish was weighted and their fork-length measured, but in addition samples were taken for determination of age (otoliths and scales), sex, degree of maturity and parasites. Age of fish in its second year of life was presented as 1^+, and that of fish in its third year as 2^+ etc.

Condition factor (K) were calculated as: K = weight*100 / length^3 (cm)

The factor is an indication of the fish condition with 1,0 as a normal condition for salmonids (Bagenal and Tesch 1978).

Stage of maturity was estimated according to Dahl (1943). Fish that would not be mature in the same autumn got stage 1 and 2 and fish that would be mature in the same autumn got stage 3, 4 or 5. Mature fish got the state 6.

Fish were examined for parasites for cestods (*Diphyllobothrium* spp. and *Eubothrium salvelini*). The intensity of infection was divided in 3 stages (1-3), were 1 is very low intensity, but stage 3 is high.

The stage of fullness of the stomach was presented as 0 to 5, where 0 is no food and 5 is full.

Proportion of volume of each food item was determined by eye. Proportional volume for group of fishes was calculated as:

$$\sum \text{(proportional volume x stage of fullness)} / \sum \text{(stage of fullness)}$$

In this way stage of fullness is important as well as proportional volume of items.

Results

Survey of juveniles

The dominating bottom substratum on sampling stations in the juveniles survey was gravel and small cobble. The upper reaches of Kerlingardalsá and Vatnsá had the coarsest substratum (Table 2). Water temperature was highest 9,8 °C in Vatnsá but lowest in Þorleifsá 7,0°C. The conductivity was from 74 µS/cm to 91 µS/cm, lowest in upper reaches of Kerlingardalsá but highest in Vatnsá.

Table 2. Position of electro fishing stations dominating substratum, water temperature and conductivity, data were collected in 25. - 26. September 2006.

		Position				
River/stream	***St. nr.***	***N****	***W****	***Dominating substratum *****	***Water temperature °C / time.***	***Conductivity µS/cm***
Kerlingardalsá	3	63.28.787	18.56.656	Gravel - small cobble	6,6 / morning	74
Kerlingardalsá	4	63.26.752	18.54.574	Small cobble	7,3/afternoon	89
Vatnsá	8	63.28.627	18.58.061	Small cobble	9,8 /morning	91
Vatnsá	9	63.28.958	18.56.979	Gravel - small cobble	9,4 / 13:15	
Vatnsá	10	63.28.597	18.56.713	Small cobble	9,0 / 12:05	91
Skakká	11	63.28.484	18.58.344	Gravel – small cobble	7,9 / 14:00	78
Heiðará	13	63.28.233	19.00.615	Gravel – small cobble	8,0 / 12:53	91
Þorleifsá	14	63.28.321	18.59.645	Gravel – small cobble	8,2 / 13:20	91

* Position is in degrees and minutes (3 decimals) according to WGS84.
**Class of substratum particles seize are; gravel < 7 cm, small cobble 7-20 cm and boulders > 20 cm.

Index of juveniles densities

Trout parr were dominating in all river stations but one in Kerlingardalsá River (st. 3). Index of trout density was highest in Vatnsá, 89,3 parr/100 m^2 at st. 9 and 68,9 in Skakká at st. 11. Density was also high in Þorleifsá 48,8 parr/100 m². The 0+ parr were dominating (Table 3, Fig. 3.- 4.). One-year-old parr (1^+) were found in five stations, in Vatnsá, Heiðará and Þorleifsá, but in much lower densities. Two-year-old trout parr were found in one station (Vatnsá st. 8) at low quantities. . Salmon parr were found at 6 of 8 sampling stations in Vatnsá, Skakká and Kerlingardalsá but not in the streams draining to Heiðarvatn. They were in highest densities in upper reaches in Vatnsá, 28,0 parr/100 m^2 (st. 9) and 11,4 parr/100 m² (st. 8). The salmon proportion of total density of salmonids in Vatnsá was 22,2 % - 30,6 %. In Skakká (st. 11) parr of salmon was found in densities 6,6 /100 m². 0^+ salmon had the major proportion of salmon parr in station 9 and 10 in Vatnsá, but other places age group 1^+ was in higher densities. Two years old salmon parr was found in two stations, in Vatnsá (st. 10), where one 9 cm parr was found and in Kerlingardalsá (st. 4), where one 6,1 cm parr was found. Charr were not found in any of the researched stations.

Table 3. Index of parr density in Vatnsá and Kerlingardalsá watershed, numbers are fished parr in 100 m², in one round in electro fishing. Line in column means that no parr were found.

		Species:	***Salmon***	***Salmon***	***Salmon***	***Trout***	***Trout***	***Trout***	***Trout***	***Salmonids***
		Age:	0^+	1^+	2^+	0^+	1^+	2^+	5^+	***total***
River/stream	***St. nr.***	***Area m²***								
Kerlingardalsá	3	85	-	1,2	-	-	-	-	-	1,2
Kerlingardalsá	4	60	-	1,7	1,7	10,0	-	-	-	13,3
Vatnsá	9	75	26,7	1,3	-	85,3	4,0	-	-	117,3
Vatnsá	10	75	2,7	1,3	1,3	10,7	1,3	-	-	17,3
Vatnsá	8	70	4,3	7,1	-	34,3	4,3	1,4	-	51,4
Skakká	11	45	2,2	4,4	-	68,9	-	-	-	75,6
Heiðará	13	104	-	-	-	26,0	1,9	-	-	27,9
Þorleifsá	14	84	-	-	-	46,4	1,2	-	1,2	48,8

Age and length

Length of salmon parr in their first year of life was 3,4 – 5,7 cm and one years old 5,7 – 10,9 cm (Table 4, Fig. 3-4). Trout 0^+ parr were 3,1 to 6,7 cm, 1^+ 6,1 to 9,3 cm. Underyearlings were smallest in Heiðará.

Table 4. Average length (AL, mm), standard deviation (SD) and number of parr by art and age electro fished in Vatnsá and Kerlingardalsá watershed.

		Species:	*Salmon*	*Salmon*	*Salmon*	*Trout*	*Trout*	*Trout*	*Trout*
River/Stream	*St. nr.*	*Age years:*	0^+	1^+	2^+	0^+	1^+	2^+	5^+
Kerlingardalsá	3	AL		80					
		SD							
		N	0	1	0	0	0	0	0
Kerlingardalsá	4	AL		57	61	48			
		SD				5			
		N	0	1	1	6	0	0	0
Vatnsá	9	AL	42	75		48	87		
		SD	4			7	8		
		N	20	1	0	64	3	0	0
Vatnsá	10	AL	48	75	90	50	85		
		SD	13			7			
		N	2	1	1	8	1	0	0
Vatnsá	8	AL	41	98		55	75	91	
		SD	6	10		7	3		
		N	3	5	0	24	3	1	0
Skakká	11	AL	43	73		46	0	0	
		SD		1		6	0	0	
		N	1	2	0	31	0	0	0
Heiðará	13	AL				38	67		
		SD				4	8		
		N	0	0	0	27	2	0	0
Þorleifsá	14	AL				44	78		350
		SD				8			
		N	0	0	0	39	1	0	1

Food

The food of parr is shown in Fig. 5. In Kerlingardalsá food was dominated by chironomid larvae, but flies were also observed. In Vatnsá simuliidae larvae was the only food observed in the salmon parr stomach and was also important for the trout parr. Trout was also eating stonefly nymphs (*Plecoptera*), chironomid larvae and unidentified food particles. In Skakká River one 7,2 cm one years old salmon parr was feeding on chironomid- and simuliidae-larvae. In Þorleifsá and Heiðará chironomid larvae was the dominant food item. One 4,9 cm trout parr in Skakká was eating oligochaetes, diptera larvae, chironomid larvae and pupae.

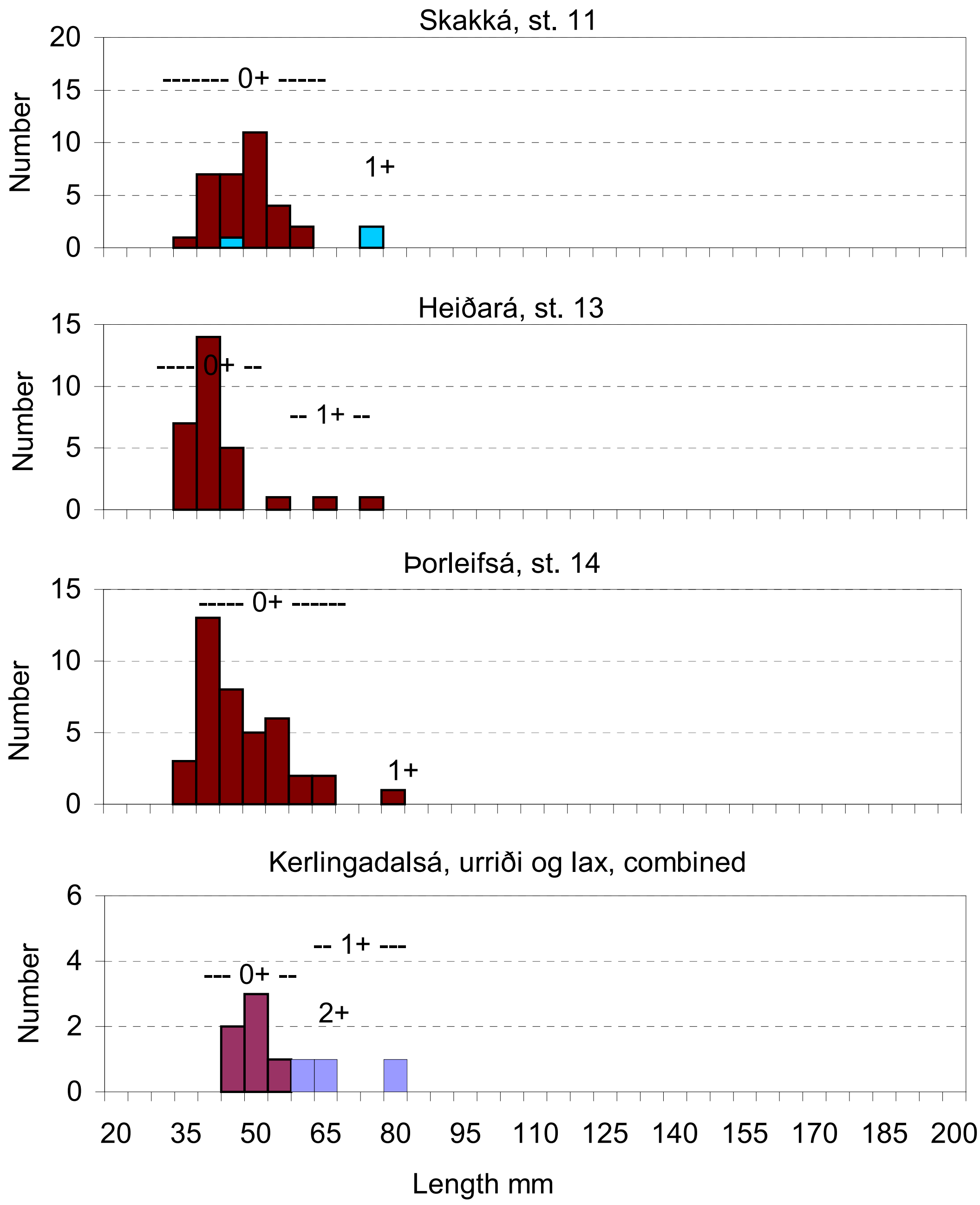

Figure 3. Length distribution and age of brown trout- (brown) and salmon-parr (blue) in Skakká, Heiðará, Þorleifsá and Kerlingardalsá rivers.

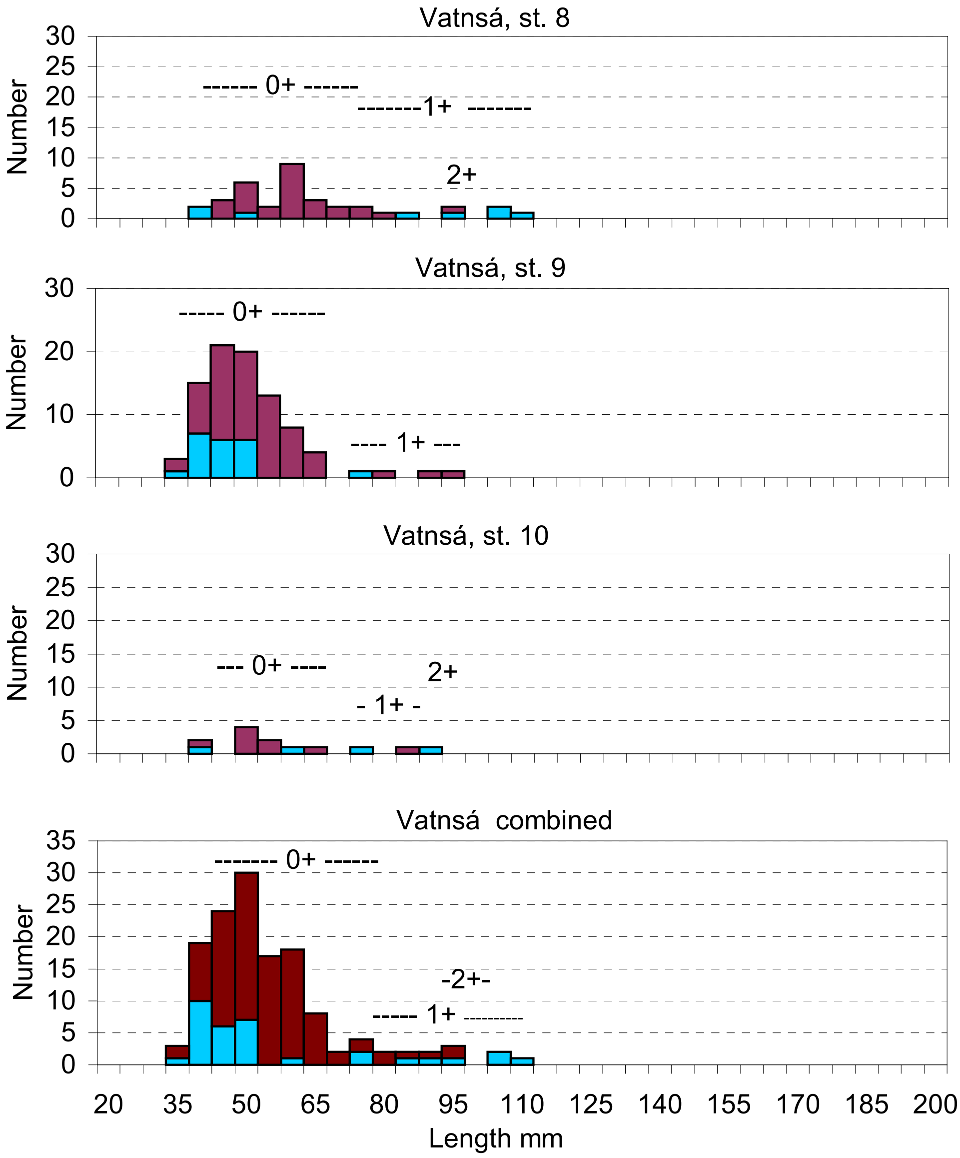

Figure 4. Length distribution and age of brown trout- (brown) and salmon-parr (blue) in Vatnsá river.

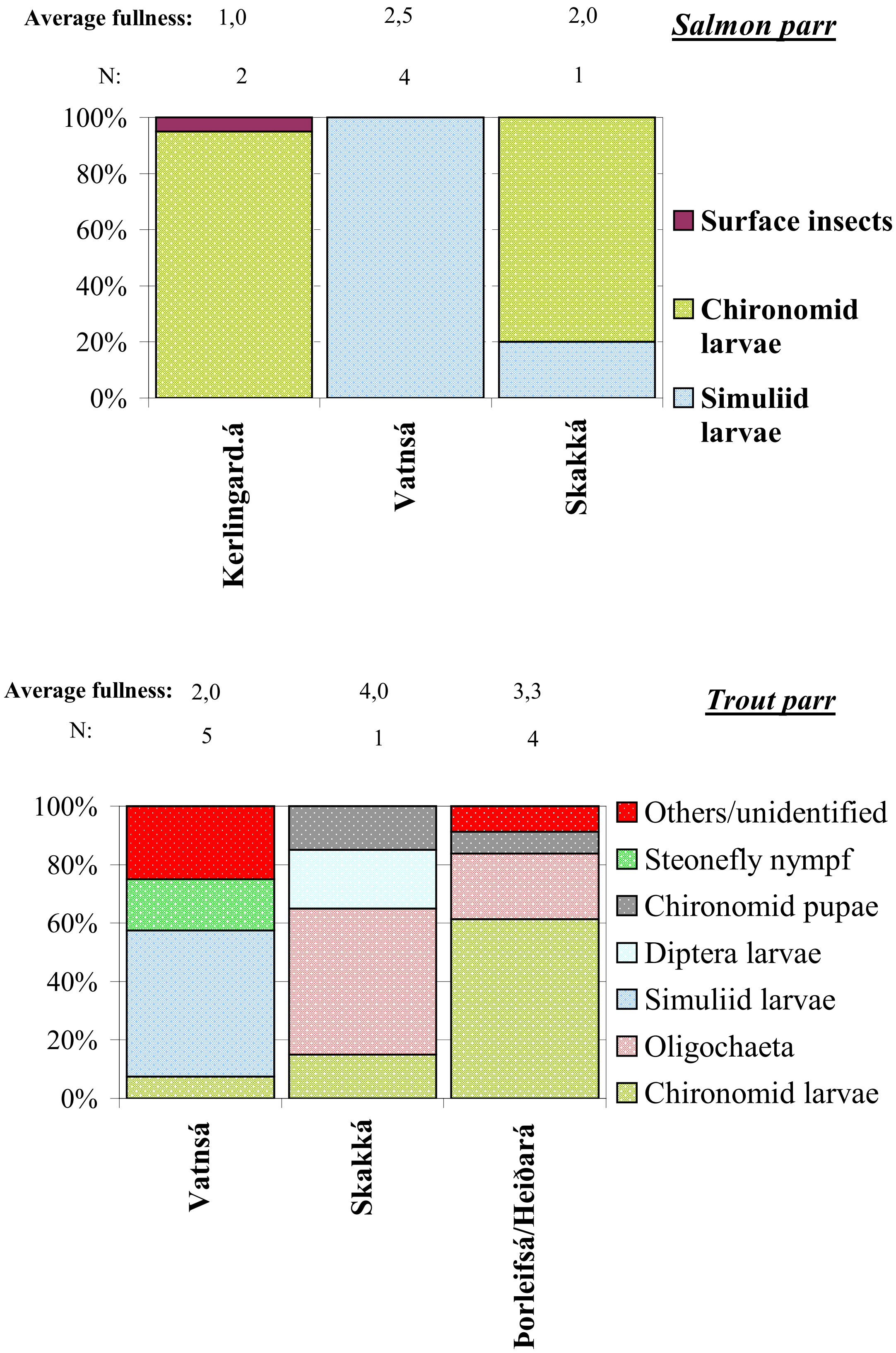

Figure 5. Proportion by volume, of food items of salmon- and trout parr, stomach fullness and number of parr inspected (N)

Experimental fishing by gill nets

The total catch in the gill nets in Heiðarvatn was 172 trout and 54 charr (Table 5). Most number of charr was caught in nets with mesh size 24 and 30 mm and trout in nets with smaller mesh than 24 mm.

Table 5. Number of trout and charr fished in each gill net with different mesh size.

Mesh size (mm)	*Trout number*	*Charr number*
12,0	28	9
16,5	31	5
19,5	20	0
21,5	22	5
24,0	13	10
30,0	16	14
33,0	17	6
45,0	5	3
50,0	6	1
60,0	6	0
not known	8	1
Total	172	54

The trout was from 10,2 to 60,3 cm in length (Fig. 6), but the majority was under 40 cm. The charr were from 16,7 to 44,9 cm long, but most of them were in the length interval 24 to 33 cm (Fig. 7). Growth was not seen to drop with age, both for trout and charr (Fig. 8 and Fig. 9). The age of charr was 2 – 8 years but trout was 1 to 12 years and 25% of them were determined as of hatchery origin. The trout of hatchery origin had the length interval 17 to 25 cm and one 60 cm and 1,8 kg female trout that was also carrying a spaghetti tag and had spawned in autumn 2005 and been tagged in December 2004, when it was weighing 2,6 kg. Three trouts had been micro-tagged, one 19,2 cm and 86 g had been tagged in October 2004 as 0^+ and released in the lake. We have not yet got informations of the origin of the other two. Four sea trouts were caught and they had migrated as 3 – 5 years of age as smolt to the sea and had stayed 1 – 3 summers in the sea. The sea trouts had the length interval 32 – 60,3 cm (Figs. 6 and 8) and 0,4 – 2,5 kg.

Most of the charr that were near sexual maturity (maturity stage 3-5) at age 4 or older (Table 6), but the smallest mature one was 17 cm (Fig. 10). Wild trouts were close to maturity at age 5 and older (Table 6 and Fig. 11).

The most important food item in the stomach of charr was wandering snail but the planktonic crustacea *Cyclops* was also of importance. The main diet of the trout was also wandering snail, but three spine sticklebacks were also important. Some of the biggest trouts had eaten charr (Fig. 12).

Infection of *Diphyllobothrium* was high, 66 % of the trout was carrying the parasite and the severity of the ifection was intense. *Diphyllobothrium* infected 33 % of the charr but most of them had low infection (Table 7). *Eubothrium* infected 10 % of charr and trout, but there the intensity of infection was low. Most of the trout of hatchery origin were without parasites.

The charr were in good condition (Fig. 13) and the charr over 30 cm in length had excellent condition. The condition factor for trout tells a different story (Fig. 13), where most of the bigger trouts (35 – 50 cm) was obviously in bad condition.

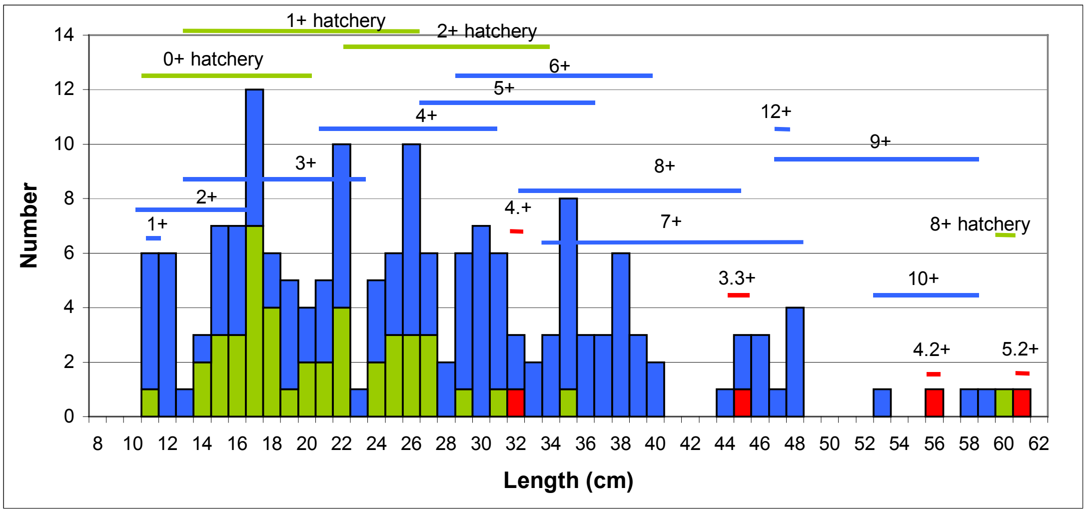

Figure 6. Length distribution of trout in Heiðarvatn. The figure shows the length interval of different age groups, green bars are trout of hatchery origin (n=44) and sea trout with red bars (n=4).

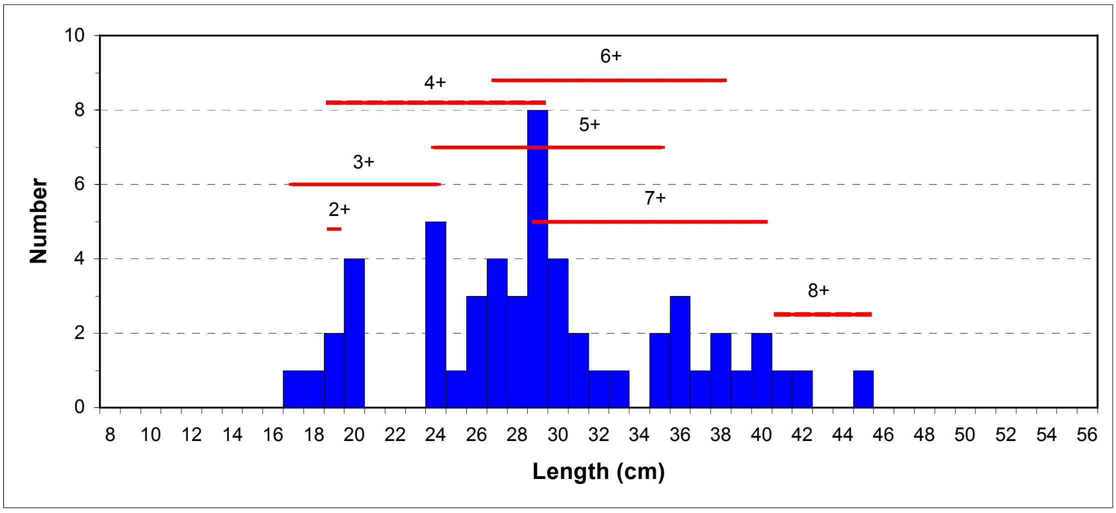

Figure 7. Length distribution of charr in Heiðarvatn. The figure shows the length interval of different age groups.

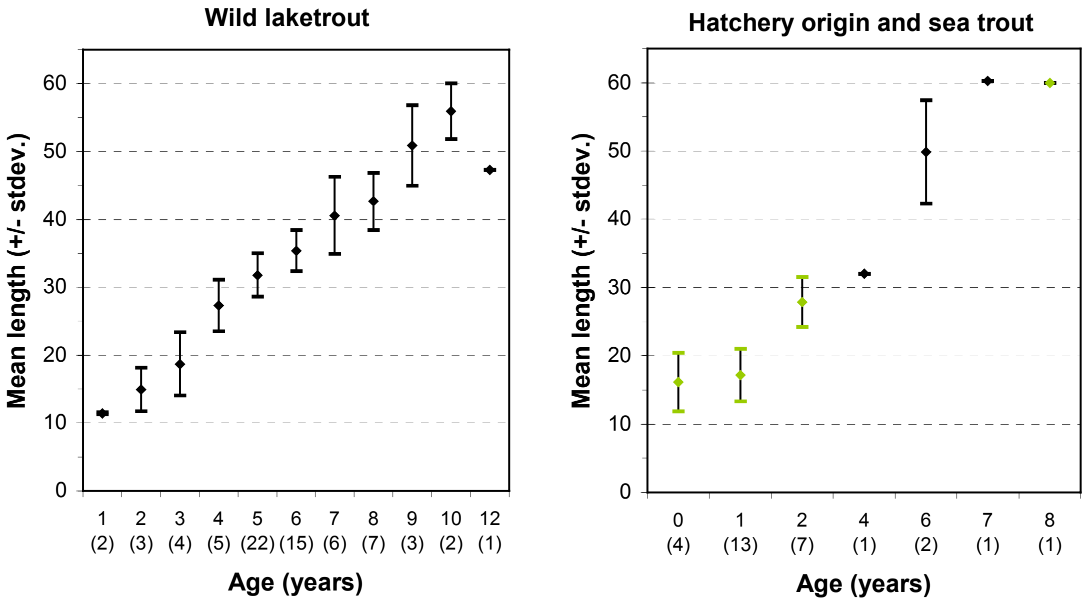

Figure. 8. The average length of trout from Heiðarvatn, of wild- and hatchery-origin and sea trouts by age and origin (+/- 1 standard deviation). Number in parenthesis is the number of fish. Green dots represent hatchery origin.

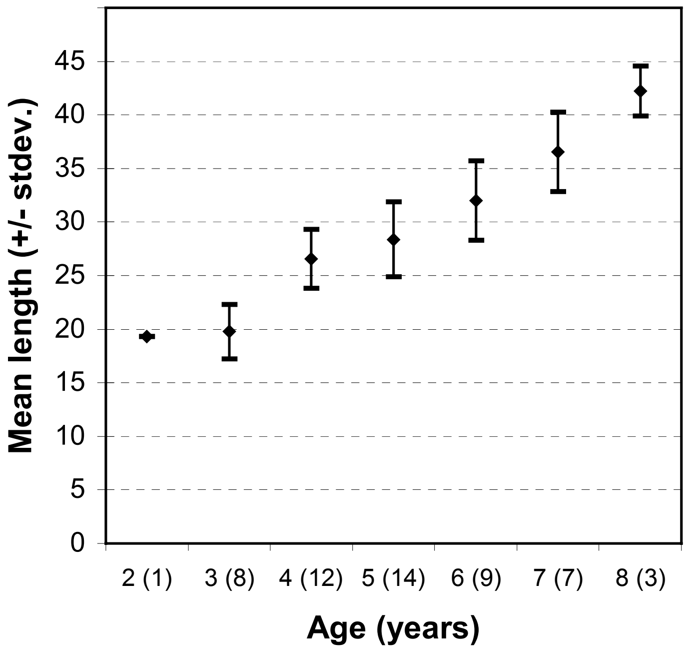

Figure. 9. The average length of charr in Heiðarvatn by age (+/- 1 standard deviation). Number in parenthesis is the number of fish behind the average.

Table 6. Number of males and females in each stage of sexual maturity (1-5), by age groups and species.

	Age	Males					Females				
Species	(years)	1	2	3	4	5	1	2	3	4	5
	1										
	2	1									
	3				2		5	1			
Charr	4	6					1	1		1	3
	5	3	1	1		3				3	3
	6	1			2	1					4
	7	1				3					
	8					3					
	0	3									
	1	7					6				
	2	4			1		2	2		1	
	3	2					2				
	4	2					2	2			
Trout	5	8				4	2	8			
	6	7	1	1		1		6	1		
	7	3						1			2
	8	1						4	1		
	9	2				1					
	10				1						
	12										

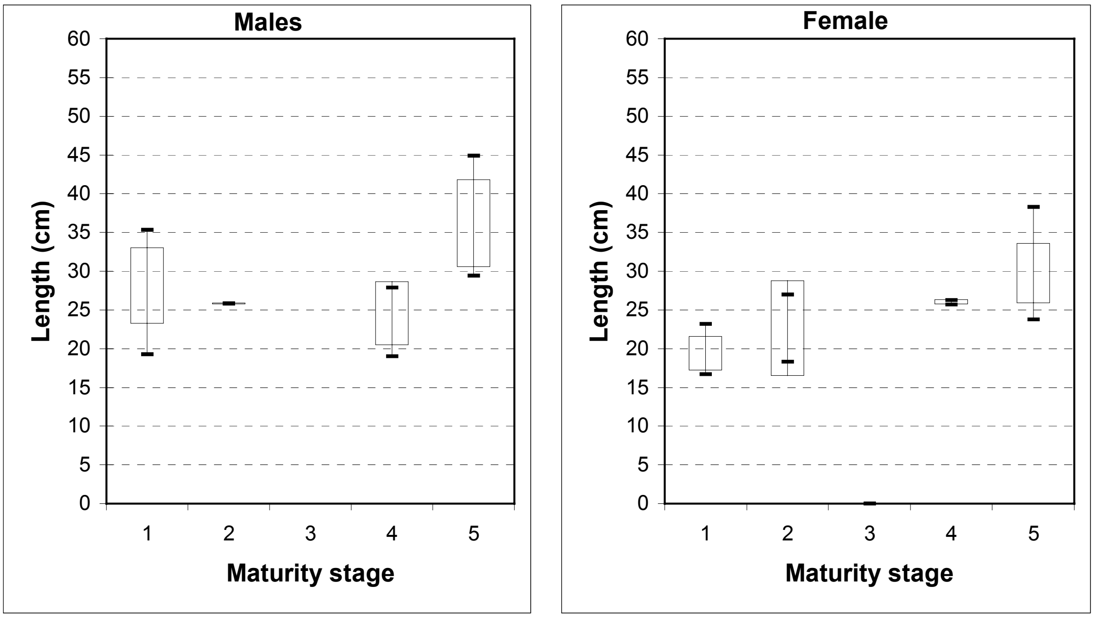

Figure 10. Charr length at different stages of maturity. Boxes show upper and lower limits of average lengths with +/- 1 standard deviation, and vertical lines with horizontal bars on their ends show min and max length at that stage of maturity.

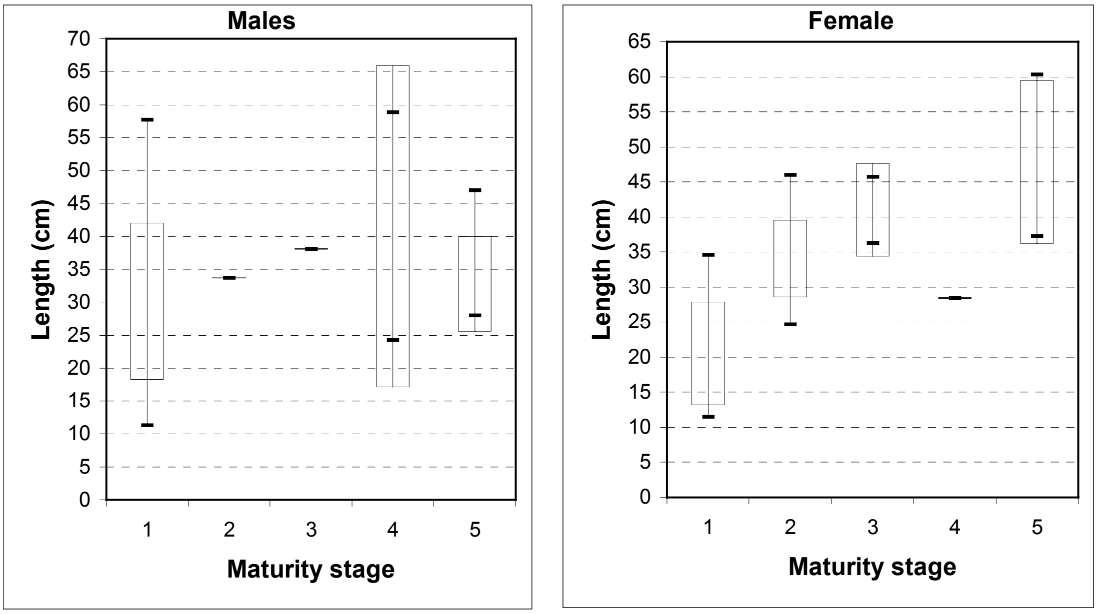

Figure 11. Trout length of different stages of maturity. Boxes shows upper and lower limits of average lengths with +/- 1 standard deviation, and vertical lines with horizontal bars on their ends show min and max length at that stage of maturity.

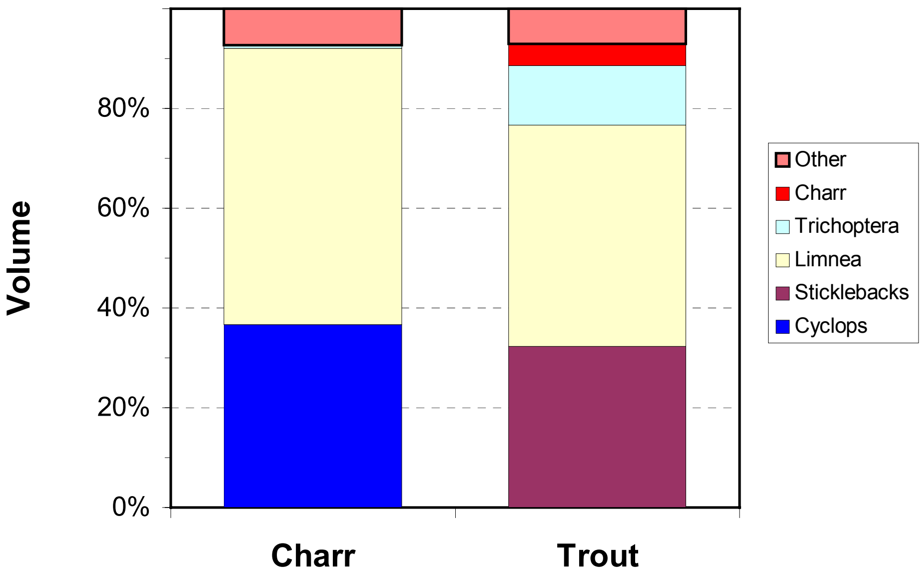

Figure 12. Food content of charr and trout in Heiðarvatn, as volume percentage of each food item. Volume percentage is treated with the stomach stage of fullness. The average stage of fullness of charr was 3,2 and that of trout was 1,5. Of 57 charr inspected, 52 contained food in stomach (96,3 %), but of 100 trout 70 had food (70 %).

Table 7. Number of charr and trout of each intensity stage of infection by the parasites *Diphyllobothrium* and *Eubothrium*. The intensity of infection was divided in 3 (1-3) stages, were 1 is very low intensity, but stage 3 is high.

	Diphyllobothrium		*Eubothrium*	
	Charr	Trout	Charr	Trout
Not found	36	34	49	90
Infection stage 1	10	12	2	7
Infection stage 2	6	14	3	2
Infection stage 3	2	40	0	1

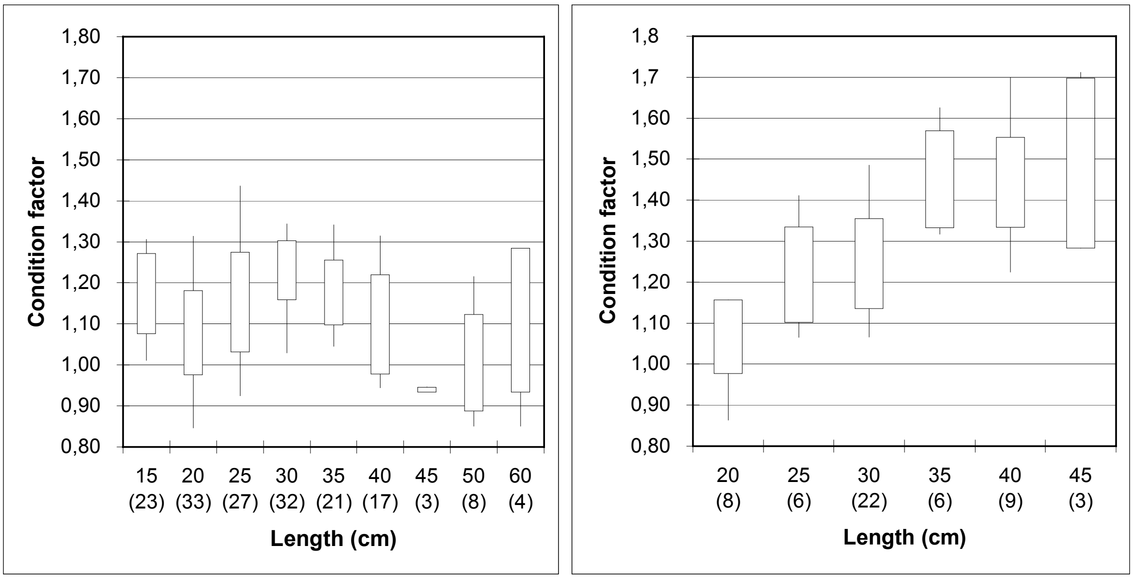

Figure 11. Condition factor of trout and charr of different length interval. Boxes shows upper and lower limits of condition factor with +/- 1 standard deviation, and vertical lines show min and max condition factor at that length interval.

Discussion

The watershed in Heiðardalur and Kerlingardalur is of variable origin. Vatnsá is the most fertile (higest in conductivity) and Kerlingardalsá on the other hand the most unfertile. Fish life opportunity in streams and rivers is variable within rivers and between rivers and depends for example on the fertility of the water and the water temperature. The amount of food and fish production increases with fertility and water temperature. Environmental factors that have most influence on fish life opportunity in streams and rivers are, the substrate of the bottom, water depth, water velocity, amount of food and turbidity. The conductivity of the rivers in the area was measured this year to be 74 - 91 µS/cm that is similar to the results in the same rivers in 2004 (65 – 92 µS/cm). This is higher conductivity than in the research 1990 (63-68 µS/cm). Increase in water conductivity since 2004 was seen in Skakká and Heiðará (Table 2).

Juvenile survey in the rivers showed that trout parr was usually dominating. The highest density was in Vatnsá, which confirms its importance as trout nursery area. As reported earlier (Magnús Jóhannsson et al 2004) it is likely that most of the parr in Vatnsá and Kerlingardalsá are sea trout parr, but it is not possible to identify if the parr is of stationary trout origin at the parr stage. The trout parr were dominated by underyearlings (0^+) and very few were older than one year. This is similar to results from other watersheds where underyearlings are most likely to be caught by electro fishing. The reason is that older trout parr can exist in pools were they are not vulnerable to electro fishing, it is also possible that they have migrated to lower reaches in the watershed. No charr were caught in the electro fishing survey this time, but in 2004 it was found in three stations including Þorleifsá and Heiðará rivers. There are no reasons to make conclusions from this but it is advised to watch over how the distribution of charr evolves in the future. There are evidence that stationary-charr-stocks have decreased significantly at the south- and westcoast of Iceland. This decrease is possibly related to a global climate change, rising temperature (Antonsson Þ. and Guðbergsson G. 2006). It is important to document the fishery report properly, for all species. This helps to notice changes in fish diversity and distribution.

Salmon parr were found in 6 of 8 sampling stations in rivers below Heiðarvatn. Their abundance was highest in Vatnsá (st. 9 and 8; 28,0 and 11,4 parr/100m^2). In Vatnsá the proportion of salmon parr of the total density of salmoids was 22 - 31 %, in Skakká 8 % and at the upper station in Kerlingardalsá 100 %, where the only catch was one salmon parr. One-year-old salmon parr was found in all of the six stations and underyearlings in Vatnsá and Skakká, but not in Kerlingardalsá. Salmon parr was not found in the rivers that drain to Heiðarvatn, which confirms that salmon doesn´t spawn there. The proportion of salmon parr is higher now than it was in 2004 (9 – 18 %) but much lower than in 1990 (75 – 86 %) (Magnús Jóhannsson et al 2004). Higher proportion of salmon parr this year is probably related to successful smolt releases of last years which have resulted in more spawning of salmon of hatchery origin. It has been concluded from earlier researches that proportion of salmon parr in nursery areas tend to drop unless salmon juveniles are released (Magnús Jóhannsson et al 2004). In 1990, at station 10, the proportion of salmon parr was 76,5 %, in 2004 it was down to 11,1 % and in this research it had risen again up to 30,8 %. As a conclusion it is possible that this proportion will continue to rise with continuing smolt releases in Vatnsá. It is of interest that salmon parr was found in both stations in Kerlingardalsá, it was also the result in 2004. The salmon parr was small compared with age, which demonstrates slow growth and low fish production of the river. The coloured-glacial-water, low temperature and fluctuating turbitity have this effort on the growth, however large nursery areas with sutable bottom material due to the big squere and the length of the river should produce salmon in some quantities. It would be interesting to make a salmonid habitat survey in the whole watershed to acquire a better understanding in the amount of production for each river, including Kerlingardalsá. In Þjórsá river, the gigantic glacier river in southern Iceland, there is a large stock of salmon. It has been estimated, based on such a survey, that 83 % of the fish production takes place in the glacial water itself and 17 % in the tributaries (Magnús Jóhannsson et al 2002). By mapping the nursery areas and their quality within a watershed, information is gained to the evalueate different parts of rivers for fish production. With combination of salmonid habitat survey and electro fishing a base is laid to evaluate how fish production is divided to different rivers or riverparts. This evaluation requires knowledge of habitat selection of each fish species and mapping of bottom material, depth, current, turbitity, water temperature and fertility of the water.

There was a difference in food selection between salmon- and trout parr. When the salmon parr was eating simuliidae larvae or chironomid larvae, the trout parr was taking more variable food particles. This is similar to what is seen in other rivers, as the trout is more of a opportunistic feeder and the salmon more specific. This research, as the earlier ones confirm the importance of simuliidae larvae as a food source in Vatnsá River.

If we look at the combination of fish species in Heiðarvatn lake proportion of charr is still lower than it was in 1990. That year the charr in the research nets (11 nets with mesh size 21,5 – 45 mm) were 53,3 % of the number of cought fish. In the research 2004 it had dropped down to 28,4 % (Magnús Jóhannsson et al 2004) but in 2006 it had risen slightly up to 34,2 %. This could demonstrate that the charr stock in the lake is smaller now then it was before 1990, but it must be considered that a large number of trout has been released to the lake during the last years which has affected natural balance between the two species. If looked at the trout catch it was estimated that 25,6 % of them was of hatchery origin, almost the same percentage as in 2004. If this amount of trout is subtracted, the proportion of the charr rises to 41,2 %. This also suggests that the charr population has decreased since 1990, but is higher than it was in 2004, when it was estimated 36 % calculated with the same method. The main diet of charr and trout was wandering snail, but other important food items for the charr were a planktonic *Cyclops* of class *Maxillopoda* and subclass *Copepoda*. In 2004 a different kind of plankton was important for the charr, namely *Daphnia* of class *Branchiopoda*, subclass *Phyllopoda* and order *Cladocera*. Stickleback was important for the trout but was not found in the diet of charr. Charr were found in the diet of the biggest trouts.

66 % of the cought trout was infected with the parasite *Diphyllobothrium,* where most of the infected fish had serious infection, stage 3. This is a higher infection rate than it was in 2004, when about half of the total catch was infected, but then most of the fish was on infection stage 1. This situation is alarming, it is known that a high parasite burden decreases growth and can cause sexual immaturity. The rate of parasite burden

for charr was low, when ⅓ of the charr was infected with *Diphyllobothrium*, which is a lower frequency than in 2004. Most of the infected charr were on stage 1. This rise of parasite burden of trout is possibly caused by the increased number of trout in the lake in connection with frequient releases of hatchery trout parr. It was not seen that growth of the trout decreases with age, the condition factor of some of the bigger trout was on the other hand low. This brings one to the conclusion that available food in the lake is already the limiting factor for the growing number of trout in the lake. To fight against this it is reccomended to stop all releases of fish into the lake for some time, also to increase fishing intensity of the lake.

Large number of salmon smolt has been released in Vatnsá River over the last two years. If the releases have been successful a rising number of salmon return is expected. To accuire such a success it is important to practise of quality all the way from catching the broodfish to the release.

Rod fishing of trout and charr in Heiðarvatn lake can be increased. If on the other hand the goal is to increase fish migration to the rivers it is reccomended to release salmon and trout smolt, with no further releases to Heiðarvatn as suggested before. To evaluate the success of releasing it is neccesary to tag the juveniles. Micro tags are the most suitable tags for that purpose. It is also neccesary to inspect all fish in catch for tags. Usually the adipose fin is removed as a sign of a hidden micro tag in the nose. It would also be interesting to install a fish counter in Vatnsá river. This counter would gather information on number of migrating fish, their size and time of migration. The experience of Icelandic counters from Vaki-DNG is good, the newest version of this counter gives the possibility to see if adipose fin is lacking and the species through automatic photographing. To make counting possible a fence that guides all fish to the counting gate is needed. At the same time trap could be connected to the fence to catch fish migrating up. The trap could also be used to take brood stock. The trap and the counter need monitoring. The reporting of rod fishery has been good in the watershed, but it is necessary to promote recording of the fishery in Heiðarvatn. Proper fishery reports are very important, both for landowners to report their resources and as data for all advice in enhancement and fishery management. In the new salmonid fisheries act it is demanded that landholders/fishing-associations have to make an utilisation-plan for exploitation of fishing rights.

An interesting idea has been formed how to control where Kerlingardalsá river flows. The idea is to steer the river with a rocky revetment, this possibility should be researched further. If this is done it could be possible to keep Vatnsá separated from the glacial water for longer distance, this would be beneficial for the fish production in Vatnsá. The bottom substrate is suitable but the mixing of glacial water has limited production to this day. By doing a salmonid habitat survey for this specific part of the river it could be weighed how much could be added to the fish production. It is important to construct the revetment well because Kerlingardalsá is known for it´s huge floods. The construct must be designed to withstand such floods without braking. There is a lot of know how within institutions such as Vegagerðin and Landgræðslan and we suggest that they should be contacted for further evaluation of the idea. It is important to get permitions that are needed for this kind of activity.

This research is a continue to the 2004 one, it has given some interesting results conserning the status of fish population in the watershed. It would be of benefit if this would still be continued and we suggest that a similar survey should be done every two years, the next in the year 2008. It would also be interesting to do a gene testing on the salmon stock that inhabits the rivers in the present. This is beneficial to be able to measure later how the influense of releasing affects the genome. Live history, including migration of the sea trout, is still unclear for the region, scale sampling and data storage tagging (DST-tags) should give useful information. In addition salmonid habitat survey is needed. Such a study comes in use when making register of dividends. Data logging of water temperature in Vatnsá, Heiðará, Þorleifsá, Heiðarvatn and Kerlingardalsá would be useful to evaluate the potencial for salmonid enhancement and for researches of the freshwater life in common.

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Literature

Bagenal, T. B. and F. W. Teach. 1978. Age and growth. Í: Bagenal, T. [ritstj.] Methods for assessment of fish production in fresh waters. IBP handbook No 3. Blackwell Scientific Publication, Oxford. 365 s.

Dahl, K. 1943. Ørret og ørretvann . J. W. Cappelens Forlag. Oslo. 182 s.

Finnur Garðarsson 1983. Tetthet, vekst og produksjon av laksyngel (Salmo salar L) i elvene Elliðaár og Hólmsá pa Island. Essay at University of Oslo, 75 s.

Guðni Guðbergsson 2006. Lax og silungsveiðin 2005. Veiðimálastofnun, VMST-R/0606. 26 s.

Magnús Jóhannsson 1991. Fiskrannsóknir í Vatnsá 1990. Veiðimálastofnun, VMST-S/91005X. 14 s.

Magnús Jóhannsson, Ingi Rúnar Jónsson og Benóný Jónsson 2004. Fiskrannsóknir á vatnasvæði Vatnsár og Kerlingardalsár árið 2004. Veiðimálastofnun, VMST-S/04010. 29 bls.

Sigurjón Rist. 1990. Vatns er þörf. Bókaútgáfa Menningarsjóðs, Reykjavík: 248 s.

Þórólfur Antonsson og Guðni Guðbergsson 2006. Áhrif loftslagsbreytinga á fiskistofna í ferskvatni. Rit Fræðaþings landbúnaðarins 2006: 95-101.