

**P-04-19**

## **Oskarshamn site investigation**

### **Fish sampling in connection with geophysical measurements at Simpevarp 2003**

Alf Engdahl, Ulf Ericsson  
Medins Sjö- och Åbiologi AB

January 2004

**Svensk Kärnbränslehantering AB**

Swedish Nuclear Fuel  
and Waste Management Co  
Box 5864  
SE-102 40 Stockholm Sweden  
Tel 08-459 84 00  
+46 8 459 84 00  
Fax 08-661 57 19  
+46 8 661 57 19



ISSN 1651-4416

SKB P-04-19

## **Oskarshamn site investigation**

# **Fish sampling in connection with geophysical measurements at Simpevarp 2003**

Alf Engdahl, Ulf Ericsson  
Medins Sjö- och Åbiologi AB

January 2004

This report concerns a study which was conducted for SKB. The conclusions and viewpoints presented in the report are those of the authors and do not necessarily coincide with those of the client.

A pdf version of this document can be downloaded from [www.skb.se](http://www.skb.se)

# Contents

<b>1</b>	<b>Introduction</b>	5
<b>2</b>	<b>Objective and scope</b>	7
<b>3</b>	<b>Equipment</b>	9
<b>4</b>	<b>Execution</b>	11
4.1	Execution of sampling in the field	11
4.2	Execution of measurements	11
<b>5</b>	<b>Results</b>	13
5.1	Discussion	16
<b>Appendix 1</b>	Results in order for each seismic line	17
<b>Appendix 2</b>	Register of Perches placed in freezer	27

# 1 Introduction

This document reports the data gained when sampling fish in connection with refraction seismic measurements, which is one of the activities performed within the site investigation at Oskarshamn (Figure 4-1). The work was conducted according to activity plan AP PS 400-03-089 (SKB internal controlling document).

## 2 Objective and scope

Refraction seismic measurements, which included blasting was performed in the coastal area of Simpevarp. Since blasting in water results in unconscious and dead fish that are floating to the water surface, this opportunity was utilised to obtain data about the fish populations.

Fish sampling was performed in three different bays, south of Simpevarp and around Ävrö, along eight seismic lines (Figure 2-1 and Table 2-1). Sampling was made during the first two weeks in December 2003.

Explosive charges of approximately 50 g were placed every 25:th meter along each seismic line. The number of charges varied for each seismic line, depending on the length of the line (Table 2-1). For more detailed information of the locations of the seismic lines, see Appendix 1.

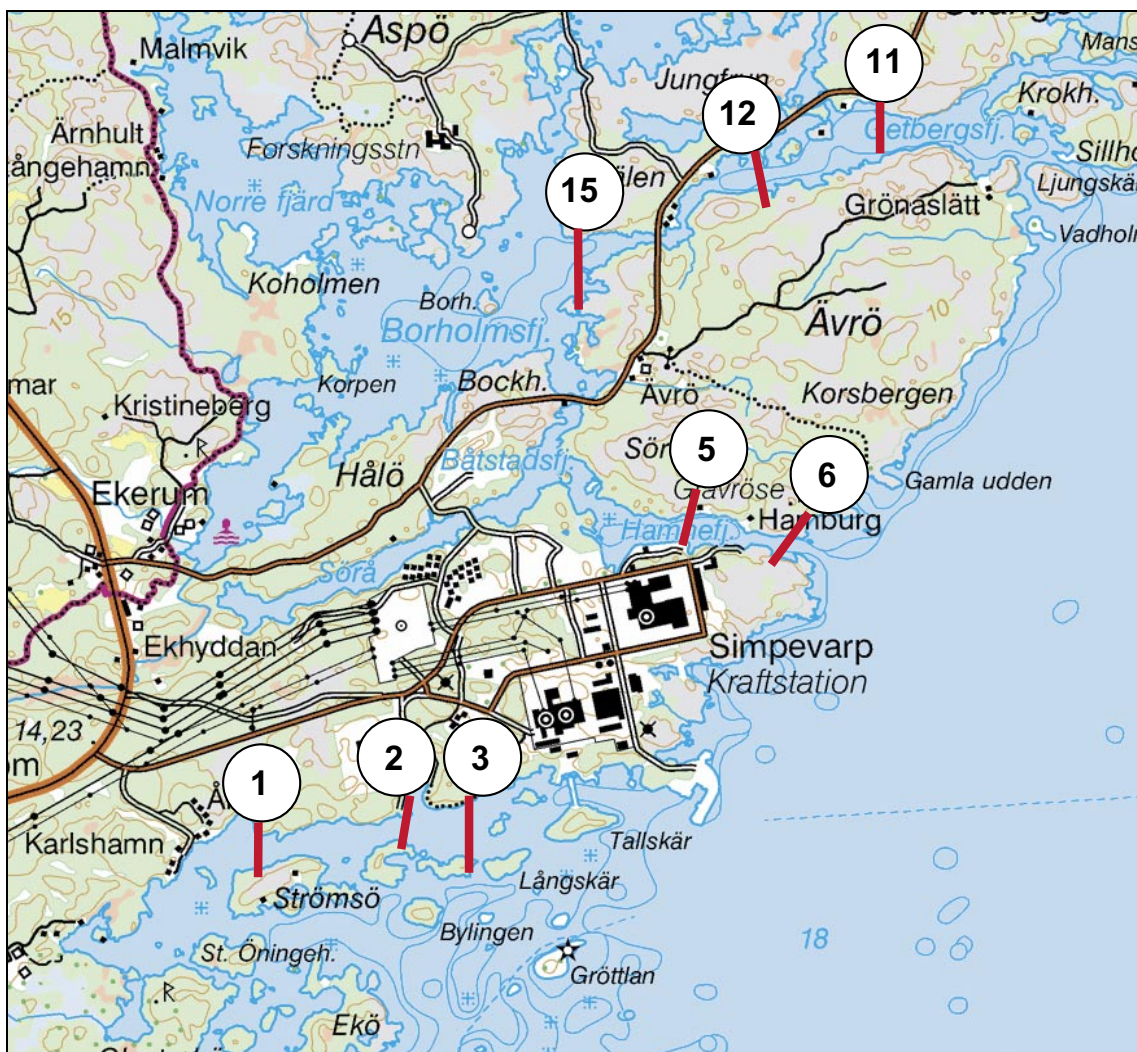


Figure 2-1. Locations of the eight seismic lines.

**Table 2-1. Data from the different seismic lines.**

<b>Line</b>		<b>Water</b>	<b>Length of line (m)</b>	<b>Number of blasts</b>	<b>Deep interval (m)</b>
1	LSM000182	South of Simpevarp	145	8	0,5–2,6
2	LSM000183	South of Simpevarp	230	10	0,3–4,6
3	LSM000184	South of Simpevarp	300	11	0,5–5,5
5	LSM000186	Hamnefjärden	93	6	0,5–5,2
6	LSM000187	Hamnefjärden	170	7	0,4–6,6
11	LSM000192	Getbergsfjärden	237	9	1–11
12	LSM000193	Getbergsfjärden	237	7	1–5,5
15	LSM000196	Getbergsfjärden	238	12	1–7,1

### **3 Equipment**

Boat, bag nets and buckets were used when sampling fish in the field. After sampling, graph paper and scales for registering of length and weight were used.

## 4 Execution

### 4.1 Execution of sampling in the field

When blasting of a whole seismic line was completed, the water surface around the line was thoroughly searched for fish. The fish was landed into buckets, separated for each seismic line. Optimally the catch of each blast would be held apart, but this was not possible due to safety aspects and interference on the seismic measurements.

### 4.2 Execution of measurements

The catch within each seismic line was registered as number of individuals, length and weight for each specimen. Lengths were determined to the nearest millimetre and weight determinations to the nearest gram. Any malformation and signs of external injury was noted down. If possible for each line, ten Perches in the length interval of approximately 15–20 cm, were deep frozen for future analysis (see Appendix 2).



*Figure 4-1. Geophysical measurements at line 2, south of Simpevarp.*



## 5 Results

Data is reported to SICADA, FN Simpevarp 260.

In this section the main results are presented. For more details see Appendix 1 where the results are presented in order for each seismic line.

Totally eleven different species were found at the eight seismic lines (Table 5-1). The highest number of species was found in Hamnefjärden at line 5. Six species were caught in Hamnefjärden and south of Simpevarp, while seven species were caught in Getbergsfjärden (Table 5-1). Ruffe was the only species found at all seismic lines. The species found are of frequent occurrence in the region and the result is consequently expected. (Four of the caught species can be seen in Figure 5-3.)

The number of individuals/blast generally varied little between the lines (Table 5-2 and Figure 5-1). The exception was line 5 in Hamnefjärden, where quite a number of Bleaks were caught and the number of Perches and Roaches were also relatively high (Table 5-2).

The weight/blast varied quite a lot between the seismic lines (Table 5-3 and Figure 5-2). The highest value could be seen at line 15 in Getbergsfjärden, where some big Pikes were caught (Table 5-3 and Appendix 1). At line 5, above all, Perch but also Roach contributed to a relatively high weight/blast (Table 5-3).

The length distributions of the most frequent species show the presence of one year juveniles for Perch and Pike and a few for Roach in some of the lines (Appendix 1).

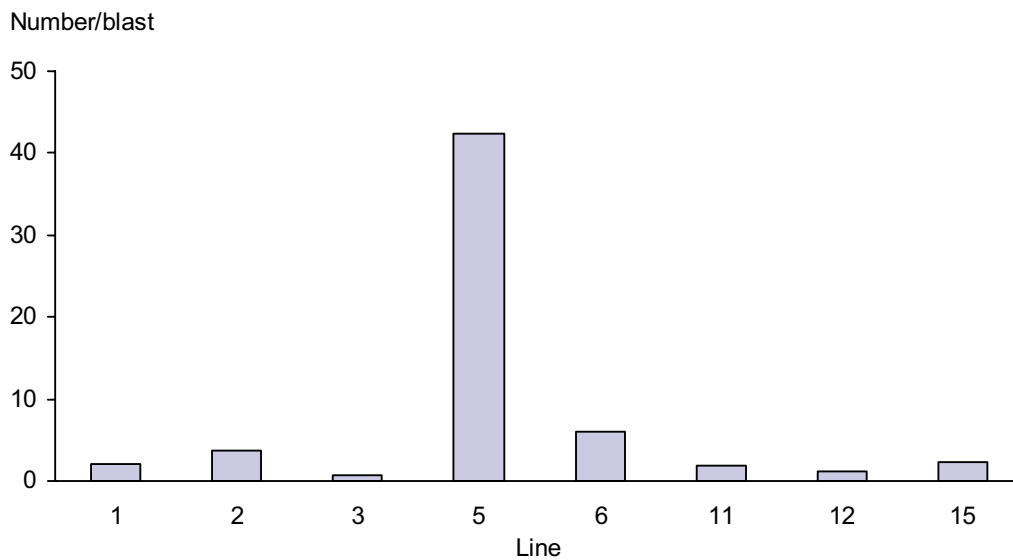
Malformation and signs of external injury was not seen in the fish caught.

**Table 5-1. Species caught at each line and area.**

Species	Area:			Hamnefjärden		Getbergsfjärden			
	Line:	1	2	3	5	6	11	12	15
Ruffe ( <i>Acerina cernua</i> )		x	x	x	x	x	x	x	x
Pike ( <i>Esox lucius</i> )		x	x	x					x
Perch ( <i>Perca fluviatilis</i> )			x		x	x	x		x
Roach ( <i>Rutilus rutilus</i> )					x		x	x	x
Three-spined Stickleback ( <i>Gasterosteus aculeatus</i> )	x				x	x		x	
Nine-spined Stickleback ( <i>Pungitius pungitius</i> )			x						
Pipefish ( <i>Syngnathus typhle</i> )				x					
Rudd ( <i>Scardinius erythrophthalmus</i> )					x				
Bleak ( <i>Alburnus alburnus</i> )					x				
Smelt ( <i>Osmerus eperlanus</i> )							x		
Tench ( <i>Tinca tinca</i> )									x
<b>Number of species/line</b>		3	4	3	6	3	4	3	4
<b>Number of species/area</b>			6		6		7		
<b>Total number of species</b>					11				

**Table 5-2. Number of individuals/blast for all species and seismic lines.**

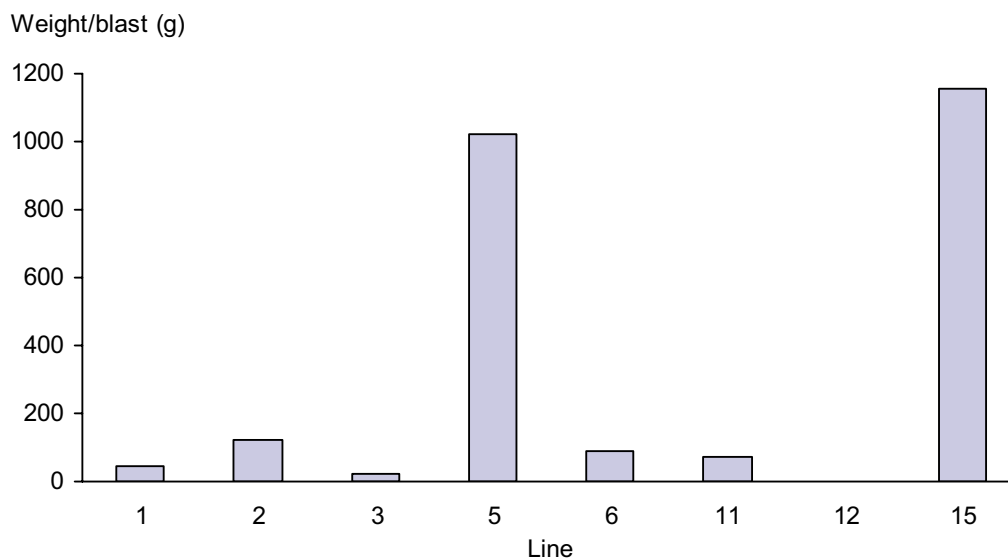
Species	Area:	South of Simpevarp			Hamnefjärden		Getbergsfjärden		
	Line:	1	2	3	5	6	11	12	15
Ruffe ( <i>Acerina cernua</i> )		0,3	0,2	0,2	1,3	1,1	0,4	0,7	0,4
Pike ( <i>Esox lucius</i> )		1,5	1,9	0,5					0,6
Perch ( <i>Perca fluviatilis</i> )			1,4		8,2	4,1	1,0		1,1
Roach ( <i>Rutilus rutilus</i> )					8,5		0,2	0,3	0,1
Three-spined Stickleback ( <i>Gasterosteus aculeatus</i> )		0,4			0,8	0,6		0,1	
Nine-spined Stickleback ( <i>Pungitius pungitius</i> )			0,2						
Pipefish ( <i>Syngnathus typhle</i> )				0,1					
Rudd ( <i>Scardinius erythrophthalmus</i> )					0,7				
Bleak ( <i>Alburnus alburnus</i> )					23,0				
Smelt ( <i>Osmerus eperlanus</i> )							0,1		
Tench ( <i>Tinca tinca</i> )									0,1
<b>Sum</b>		2,2	3,7	0,8	42,5	5,8	1,7	1,1	2,3



**Figure 5-1.** Total number of individuals/blast for all species at the eight seismic lines.

**Table 5-3. Weight/blast (gram) for all species and seismic lines.**

Species	Area:	South of Simpevarp			Hamnefjärden		Getbergsfjärden		
	Line:	1	2	3	5	6	11	12	15
Ruffe ( <i>Acerina cernua</i> )		4,1	2,4	0,4	25,8	15,7	2,8	0,7	2,6
Pike ( <i>Esox lucius</i> )		38,3	98,9	21,6					1048,0
Perch ( <i>Perca fluviatilis</i> )			20,2		586,0	72,6	70,4		100,4
Roach ( <i>Rutilus rutilus</i> )					268,0		0,2	0,3	0,5
Three-spined Stickleback ( <i>Gasterosteus aculeatus</i> )		0,4			0,8	0,9		0,1	
Nine-spined Stickleback ( <i>Pungitius pungitius</i> )			0,2						
Pipefish ( <i>Syngnathus typhle</i> )				0,1					
Rudd ( <i>Scardinius erythrophthalmus</i> )					30,5				
Bleak ( <i>Alburnus alburnus</i> )					109,5				
Smelt ( <i>Osmerus eperlanus</i> )							1,3		
Tench ( <i>Tinca tinca</i> )									4,7
<b>Sum</b>		42,8	121,7	22,1	1020,6	89,2	74,7	1,1	1156,2



**Figure 5-2. Total weight/blast for all species at the eight seismic lines.**

## 5.1 Discussion

The method to use bursting when sampling fish is primarily used for studies of abundance and growth of one-year juveniles. The seismic lines and places of charges in this investigation were not chosen for this purpose. Therefore it is not likely that the results give a complete picture of the fish fauna at these locations. However, it can be used as a blunt instrument to estimate the number of occurring species, number of individuals and biomass.

One big source of error is the time delay between bursting and fish sampling, since bursting of the entire seismic line had to be performed without disturbance. This was most significant in Hamnefjärden (lines 5 and 6), where the water is streaming due to the use of cooling water from the nuclear power station. The losses were here estimated to be in the size of 20–30 % and at the other lines 10–20 %. In the other lines the problem with streaming water was smaller but significant losses were observed due to sinking of some specimens. A number of Pikes were observed lying on the bottom at lines 1–3 and line 15.

The high number of individuals caught in Hamnefjärden is most likely due to the discharge of cooling water from the nuclear power station.



**Figure 5-3.** The four different species found at line 2. From top; Pike, Ruffe, Perch and Nine-spined Stickleback.

## Appendix 1

**Results in order for each seismic line**

# The bay south of Simpevarp

## Water area information

Water: South of Simpevarp County: Kalmar Topogr. map: 6H SV  
 Place: Line 1 (LSM 000182) Municipality: Oskarshamn Altitude: 0 m  
 Co-ordinates: start: 6365126/1550638 stop: 6364987/1550660 Depth interval: 0,5-2,6 m  
 Depth average: 1,8 m

## Sampling information

Date: 2003-12-04 Purpose: site investig. Surf. temp.(°C): 8,9  
 Fishermen: Alf Engdahl Method: bursting Turbidity: clear  
Robert Andersson No. of blasts: 8 Colour: clear  
 Organization: Medins Expl. charge size: ca 50 g Trophic level: mesotrophic

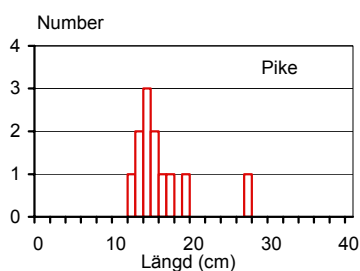
## Miscellaneous

Weather conditions: Cloudy Air temp. (°C): 7,8  
 Wind conditions: Gentle breeze from west Chem. sampl: no  
 Other observations: -

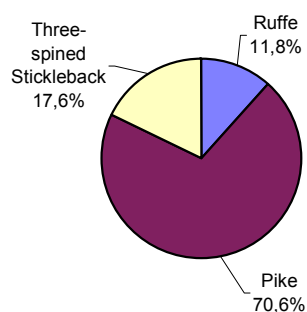
## Results

Species	Number			Weight			Length interval (mm)	Average length (mm)	Average weight (g)
	Total	Percentage (%)	Catch/blast	Total (g)	Percentage (%)	Catch/blast (g)			
Ruffe	2	11,8	0,3	33	9,6	4,1	49-133	91	17
Pike	12	70,6	1,5	306	89,5	38,3	121-265	157	26
Three-spined Stickleback	3	17,6	0,4	3	0,9	0,4	42-58	48	1
Sum	17	100,0	2,2	342	100,0	42,8			

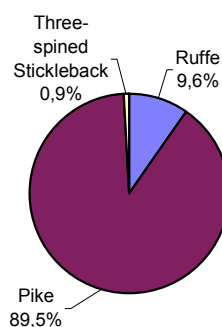
## Length distribution



## Number distribution



## Weight distribution



# The bay south of Simpevarp

## Water area information

Water: South of Simpevarp County: Kalmar Topogr. map: 6H SV  
 Place: Line 2 (LSM 000183) Municipality: Oskarshamn Altitude: 0 m  
 Co-ordinates: start: 6365234/1551258 stop: 6365052/1551275 Depth interval: 0,3-4,6 m  
 Depth average: 2,2 m

## Sampling information

Date: 2003-12-04 Purpose: site investig. Surf. temp.(°C): 9,1  
 Fishermen: Alf Engdahl Method: bursting Turbidity: clear  
Robert Andersson No. of blasts: 10 Colour: clear  
 Organization: Medins Expl. charge size: ca 50 g Trophic level: mesotrophic

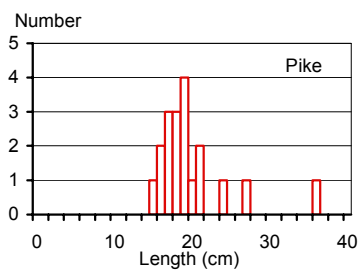
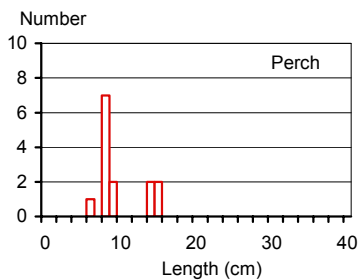
## Miscellaneous

Weather conditions: Cloudy Air temp. (°C): 7,5  
 Wind conditions: Gentle breeze from west Chem. sampl: no  
 Other observations: -

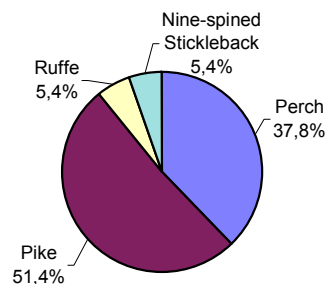
## Results

Species	Number			Weight			Length interval (mm)	Average length (mm)	Average weight (g)
	Total	Percentage (%)	Catch/blast	Total (g)	Percentage (%)	Catch/blast (g)			
Perch	14	37,8	1,4	202	16,6	20,2	63-148	98	14
Pike	19	51,4	1,9	989	81,3	98,9	154-355	198	52
Ruffe	2	5,4	0,2	24	2,0	2,4	55-116	86	12
Nine-spined Stickleback	2	5,4	0,2	2	0,2	0,2	45-55	50	1
Sum	37	100,0	3,7	1217	100,0	121,7			

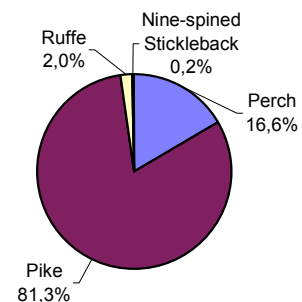
## Length distribution



## Number distribution



## Weight distribution



# The bay south of Simpevarp

## Water area information

Water: South of Simpevarp County: Kalmar Topogr. map: 6H SV  
 Place: Line 3 (LSM 000184) Municipality: Oskarshamn Altitude: 0 m  
 Co-ordinates: start: 6365260/1551528 stop: 6365033/1551493 Depth interval: 0,5-5,5 m  
 Depth average: 2,9

## Sampling information

Date: 2003-12-08 Purpose: site investig. Surf. temp.(°C): 8,4  
 Fishermen: Ulf Ericsson Method: bursting Turbidity: clear  
Robert Andersson No. of blasts: 11 Colour: clear  
 Organization: Medins Expl. charge size: ca 50 g Trophic level: mesotrophic

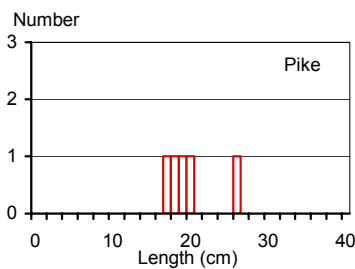
## Miscellaneous

Weather conditions: Clear Air temp. (°C): 7,3  
 Wind conditions: No wind Chem. sampl: no  
 Other observations: -

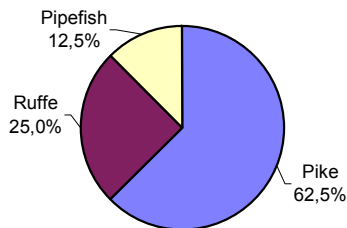
## Results

Species	Number			Weight			Length interval (mm)	Average length (mm)	Average weight (g)
	Total	Percentage (%)	Catch/blast	Total (g)	Percentage (%)	Catch/blast (g)			
Pike	5	62,5	0,5	238	97,9	21,6	173-256	201	48
Ruffe	2	25,0	0,2	4	1,6	0,4	52-58	55	2
Pipefish	1	12,5	0,1	1	0,4	0,1	105-105	105	1
Sum	8	100,0	0,8	243	100,0	22,1			

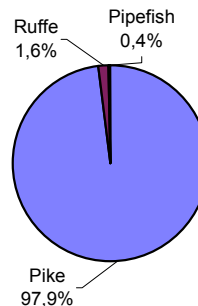
## Length distribution



## Number distribution



## Weight distribution





# Hamnefjärden

## Water area information

Water: Hamnefjärden County: Kalmar Topogr. map: 6H SV  
 Place: Line 5 (LSM 000186) Municipality: Oskarshamn Altitude: 0 m  
 Co-ordinates: start: 6366266/1552260 stop: 6366354/1552249 Depth interval: 0,5-5,2 m  
 Depth average: 3,0 m

## Sampling information

Date: 2003-12-04 Purpose: site investig. Surf. temp.(°C): 16  
 Fishermen: Alf Engdahl Method: bursting Turbidity: clear  
Robert Andersson No. of blasts: 6 Colour: clear  
 Organization: Medins Expl. charge size: ca 50 g Trophic level: mesotrophic

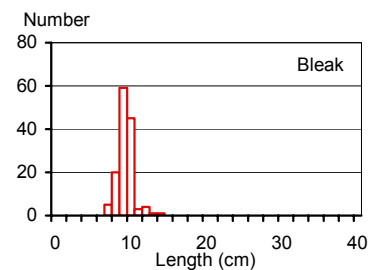
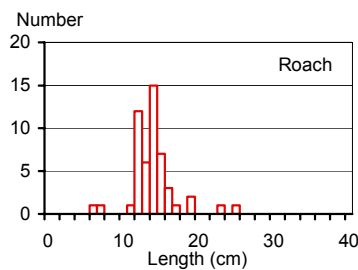
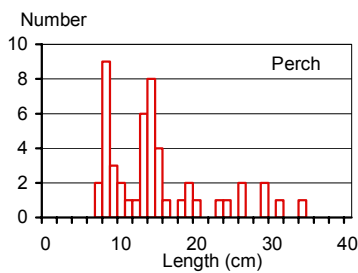
## Miscellaneous

Weather conditions: Clear Air temp. (°C): 7,2  
 Wind conditions: Light breeze Chem. sampl: no  
 Other observations: -

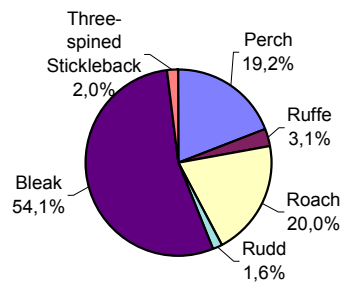
## Results

Species	Number			Weight			Length interval (mm)	Average length (mm)	Average weight (g)
	Total	Percentage (%)	Catch/blast	Total (g)	Percentage (%)	Catch/blast (g)			
Perch	49	19,2	8,2	3516	57,4	586,0	67-342	147	72
Ruffe	8	3,1	1,3	155	2,5	25,8	87-162	112	19
Roach	51	20,0	8,5	1608	26,3	268,0	64-245	138	32
Rudd	4	1,6	0,7	183	3,0	30,5	146-165	157	46
Bleak	138	54,1	23,0	657	10,7	109,5	70-140	92	5
Three-spined Stickleback	5	2,0	0,8	5	0,1	0,8	32-46	39	1
Sum	255	100,0	42,5	6124	100,0	1020,6			

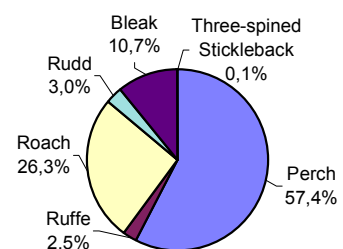
## Length distribution



## Number distribution



## Weight distribution



# Hamnefjärden

## Water area information

Water: Hamnefjärden County: Kalmar Topogr. map: 6H SV  
 Place: Line 6 (LSM 000187) Municipality: Oskarshamn Altitude: 0 m  
 Co-ordinates: start: 6366212/1552639 stop: 6366284/1552704 Depth interval: 0,4-6,6 m  
 Depth average: 2,7 m

## Sampling information

Date: 2003-12-05 Purpose: site investig. Surf. temp.(°C): 17  
 Fishermen: Alf Engdahl Method: bursting Turbidity: clear  
Robert Andersson No. of blasts: 7 Colour: clear  
 Organization: Medins Expl. charge size: ca 50 g Trophic level: mesotrophic

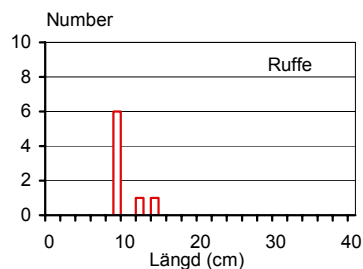
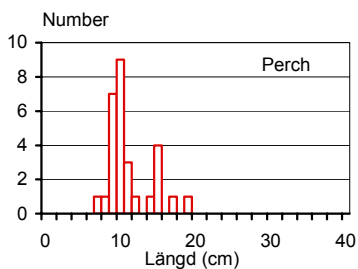
## Miscellaneous

Weather conditions: Clear Air temp. (°C): 6,1  
 Wind conditions: No wind Chem. sampl.: no  
 Other observations: -

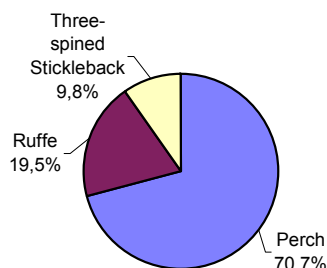
## Results

Species	Number			Weight			Length interval (mm)	Average length (mm)	Average weight (g)
	Total	Percentage (%)	Catch/blast	Total (g)	Percentage (%)	Catch/blast (g)			
Perch	29	70,7	4,1	508	81,4	72,6	71-186	110	18
Ruffe	8	19,5	1,1	110	17,6	15,7	85-143	99	14
Three-spined Stickleback	4	9,8	0,6	6	1,0	0,9	27-65	49	2
Sum	41	100,0	5,8	624	100,0	89,2			

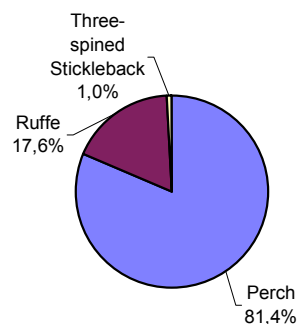
## Length distribution



## Number distribution



## Weight distribution



# Getbergsfjärden

## Water area information

Water: Getbergsfjärden County: Kalmar Topogr. map: 6H SV  
 Place: Line 11 (LSM 000192) Municipality: Oskarshamn Altitude: 0 m  
 Co-ordinates: start: 6366212/1552639 stop: 6367928/1553084 Depth interval: 1-11 m  
 Depth average: 7,3 m

## Sampling information

Date: 2003-12-08 Purpose: site investig. Surf. temp.(°C): 7,9  
 Fishermen: Ulf Ericsson Method: bursting Turbidity: clear  
Robert Andersson No. of blasts: 9 Colour: clear  
 Organization: Medins Expl. charge size: ca 50 g Trophic level: mesotrophic

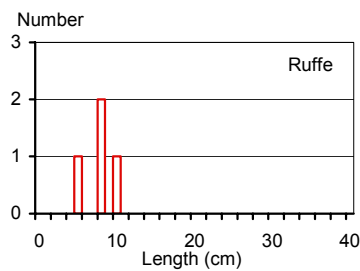
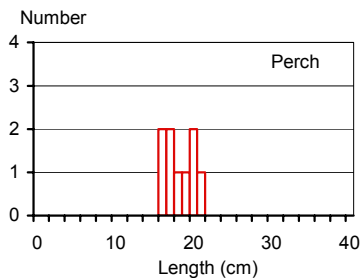
## Miscellaneous

Weather conditions: Clear Air temp. (°C): 9  
 Wind conditions: No wind Chem. sampl: no  
 Other observations: -

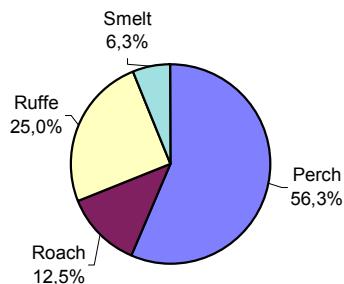
## Results

Species	Number			Weight			Length interval (mm)	Average length (mm)	Average weight (g)
	Total	Percentage (%)	Catch/blast	Total (g)	Percentage (%)	Catch/blast (g)			
Perch	9	56,3	1,0	634	94,2	70,4	157-208	181	70
Roach	2	12,5	0,2	2	0,3	0,2	53-56	55	1
Ruffe	4	25,0	0,4	25	3,7	2,8	54-96	77	6
Smelt	1	6,3	0,1	12	1,8	1,3	135-135	135	12
Sum	16	100,0	1,7	673	100,0	74,7			

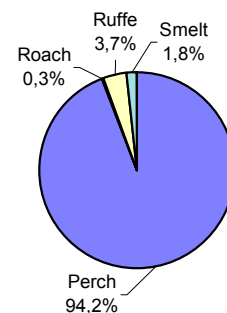
## Length distribution



## Number distribution



## Weight distribution



# Getbergsfjärden

## Water area information

Water: Getbergsfjärden County: Kalmar Topogr. map: 6H SV  
 Place: Line 12 (LSM 000193) Municipality: Oskarshamn Altitude: 0 m  
 Co-ordinates: start: 6367655/1552659 stop: 6367798/1552617 Depth interval: 1-5,5 m  
 Depth average: 3,5 m

## Sampling information

Date: 2003-12-08 Purpose: site investig. Surf. temp. (°C): 7,8  
 Fishermen: Ulf Ericsson Method: bursting Turbidity: clear  
Robert Andersson No. of blasts: 7 Colour: clear  
 Organization: Medins Expl. charge size: ca 50 g Trophic level: mesotrophic

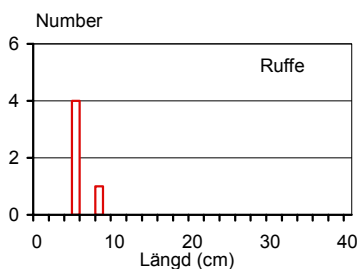
## Miscellaneous

Weather conditions: Clear Air temp. (°C): 8,8  
 Wind conditions: No wind Chem. sampl: no  
 Other observations: -

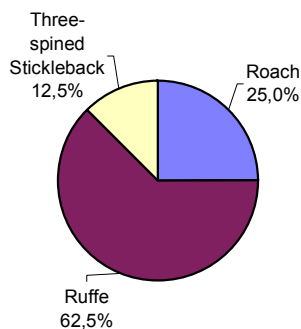
## Results

Species	Number			Weight			Length interval (mm)	Average length (mm)	Average weight (g)
	Total	Percentage (%)	Catch/blast	Total (g)	Percentage (%)	Catch/blast (g)			
Roach	2	25,0	0,3	2	25,0	0,3	31-41	36	1
Ruffe	5	62,5	0,7	5	62,5	0,7	45-75	55	1
Three-spined Stickleback	1	12,5	0,1	1	12,5	0,1	52-52	52	1
Sum	8	100,0	1,1	8	100,0	1,1			

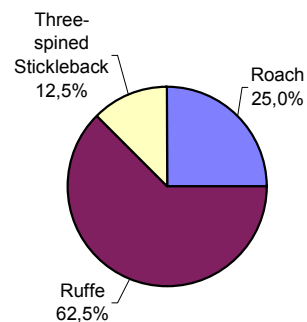
## Length distribution



## Number distribution



## Weight distribution



# Getbergsfjärden

## Water area information

Water: Getbergsfjärden County: Kalmar Topogr. map: 6H SV  
 Place: Line 15 (LSM 000196) Municipality: Oskarshamn Altitude: 0 m  
 Co-ordinates: start: 6367224/1551892 stop: 6367447/1551848 Depth interval: 1-7,1 m  
 Depth average: 3,5 m

## Sampling information

Date: 2003-12-08 Purpose: site investig. Surf. temp.(°C): 8,1  
 Fishermen: Ulf Ericsson Method: bursting Turbidity: clear  
Robert Andersson No. of blasts: 12 Colour: clear  
 Organization: Medins Expl. charge size: ca 50 g Trophic level: mesotrophic

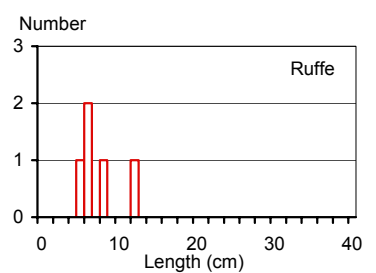
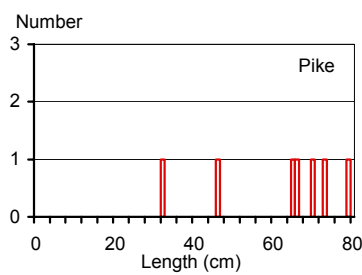
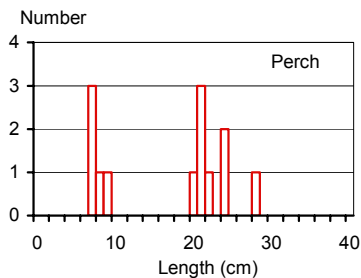
## Miscellaneous

Weather conditions: Clear Air temp. (°C): 9  
 Wind conditions: No wind Chem. sampl: no  
 Other observations: -

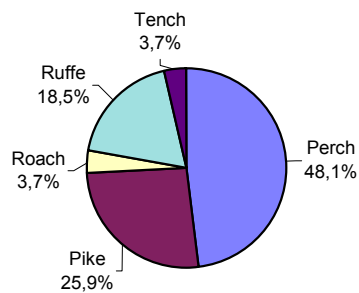
## Results

Species	Number			Weight			Length interval (mm)	Average length (mm)	Average weight (g)
	Total	Percentage (%)	Catch/blast	Total (g)	Percentage (%)	Catch/blast (g)			
Perch	13	48,1	1,1	1205	8,7	100,4	66-280	167	93
Pike	7	25,9	0,6	12576	90,6	1048,0	321-790	615	1797
Roach	1	3,7	0,1	6	0,04	0,5	98-98	98	6
Ruffe	5	18,5	0,4	31	0,2	2,6	54-117	73	6
Tench	1	3,7	0,1	56	0,4	4,7	155-155	155	56
Sum	27	100,0	2,3	13874	100,0	1156,2			

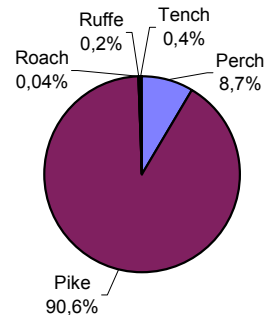
## Length distribution



## Number distribution



## Weight distribution



### Register of Perches placed in freezer

#### Register of Perches placed in freezer for further analyses

**Line:** 5, Hamnefjärden

**Date:** 2003-12-04

No	Length (mm)	Weight (gram)
1	145	34
2	154	38
3	144	35
4	150	38
5	156	39
6	142	32
7	152	36
8	187	75
9	187	76
10	182	66

**Line:** 11, Getbergsfjärden

**Date:** 2003-12-08

No	Length (mm)	Weight (gram)
1	170	56
2	190	76
3	157	42
4	208	106
5	195	83
6	202	102
7	158	43
8	172	57
9	178	69

**Line:** 6, Hamnefjärden

**Date:** 2003-12-05

No	Length (mm)	Weight (gram)
1	166	52
2	154	39
3	148	34
4	144	26
5	151	35
6	187	73
7	153	40

**Line:** 15, Getbergsfjärden

**Date:** 2003-12-08

No	Length (mm)	Weight (gram)
1	202	97
2	206	98
3	224	136
4	209	98
5	213	120