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Net mark registrations on Atlantic salmon and sea trout in  
Norwegian rivers and coastal areas 1979.

by

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Abstract.

5530 Atlantic salmon from 18 rivers, 2133 salmon from 8 sea localities, and 230 sea trout from one river were examined for net marks. The net mark frequency varied from river to river and with the size of the fish, and was highest on grilse. For grilse (< 3 kgs) and salmon larger than 7 kgs there was a significant lower net mark frequency in 1979 compared with 1978. This could be due to prohibition of setnets and licence regulation of the driftnet fishery in 1979. There was no significant decrease in the frequency of net marks on salmon in the size group 3-7 kgs. The net mark frequency on sea trout in the River Vefsna was much lower than on salmon in the same size group. On all three size groups the net mark frequency increased significantly from the outer coastal area Kvaløya/Vikna to Vefsnfjord and the River Vefsna, indicating that inshore nets (bagnets, bendnets) also make a considerable contribution in damaging salmon.

## Introduction

Hansen (1979) gave a survey of net marks on Atlantic salmon in Norwegian rivers and coastal areas 1978. This work has continued in 1979 and the results are presented in this report.

The net mark registrations can give information of the pattern of exploitation with different types of net. From 1979 setnets were forbidden in Norway and the driftnetting was licensed. These regulations could be expected to cause a decrease in the net mark frequency in 1979.

In Norwegian home waters there is little knowledge of which types of salmon gear that cause the net marks on salmon. In order to approach this problem the net mark frequency was registered at the outer coastal areas, in a fjord and in a river in the same geographical area.

## The Norwegian salmon fishery

Fig.1 shows the yield of Atlantic salmon in Norway and the Norwegian sea from 1960. Traditionally bagnets used in the fjords were the most common salmon gear. In the beginning of the sixties a driftnet fishery developed with the introduction of the new synthetic nylon material in the nets. But the drifters were only allowed to fish outside the base line. Later the setnet and bendnet fishery in the fjords increased, but the bagnet fishery was still the most important. With the introduction of monofilament material in the beginning of the seventies the driftnet, bendnet and setnet fishery increased considerably and the bagnet fishery continued to decrease. At the same time an increasing net mark frequency was registered in Norwegian rivers.

Until 1980 salmon fishing in the sea was allowed from 1. May to 1. August, with weekly close Friday 6 p.m. - Monday 6 p.m.

Fishing for salmon at the coast and in the fjords (bagnets, bend-nets) can only be carried out by owners of the ground. Until 1979 anyone could enter the driftnet fishery, but from the 1979 season driftnet fishing was licensed. In addition use of setnets was forbidden. From the 1980 season driftnets, bendnets and river fishing were not allowed to start before 1. June, while bagnets still could harvest from 1. May.

The smallest mesh size which is allowed to use for salmon is 58 mm knot to nearest knot, but the most common mesh size on driftnets and bendnets is 66 mm knot to nearest knot.

#### Material and methods

In 18 different rivers all over the country 5530 salmon were examined for net marks. In one river 230 sea trout were also examined. In addition registrations of net marks on salmon have been carried out in 8 sea localities where a total of 2133 salmon have been examined. The geographical distribution of the localities are shown in fig. 2. The registrations were carried out by controllers who had been carefully instructed in examining net marks on salmon. Whole catches have been examined in order to get the registrations as representative as possible. In rivers mostly rod catches were examined, but in River Imsa, River Ranaelv and River Vefsna the registrations were done on fish caught in a fish ladder. At the sea stations the salmon were caught in bagnets, but some fish were also caught on long line in the Vikna area.

As grilse tend to be entangled in the bagnets these were excluded from the material. But in July 1966 66 grilse entangled in small-meshed bagnets (58 mm knot to nearest knot) were examined for net marks behind the entangling point. Thus the net mark registrations on grilse in Vefsnfjord are not as reliable as other registrations.

It has been shown that the net mark frequency varies with the

size of the fish (Hansen 1979). For this reason the salmon were divided into three size groups. 1) Less than 3 kgs. 2) 3 - 7 kgs. 3) Heavier than 7 kgs. When only fish lengths were available these were transformed to weights using a Fulton condition factor of 1.0.

### Results

Table 1 shows results of the net mark registrations in 18 rivers in 1979. Total figures for all three size groups from rivers which were examined in 1978 are also shown. The frequency of net marks varies considerably from river to river. It is extremely high in the typical grilse rivers River Ørstaelv and River Bondalselv, and in River Vefsna. The lowest frequencies were found in River Målselv, River Namsen, River Figga, River Suldalslågen and River Imsa. Evidently the net mark frequency is much higher on grilse than on larger salmon, because small grilse pass through the nets and get the typical small net mark on the dorsal fin.

At the beginning of the season the frequency is lower than later on. This can easily be seen in the rivers where the material is large, for instance River Vefsna and River Etneelv.

Compared with 1978 the net mark frequency has decreased significantly for all size groups in River Målselv, for grilse and large salmon in River Surna, for grilse in River Ranaelv, River Imsa and River Oгна (Jæren) and for large salmon in River Etneelv. Only in River Namsen was there a significant increase in the net mark frequency on grilse.

A weighted mean net mark frequency from the rivers which were controlled both in 1978 and 1979 is shown in table 2. For all size groups there was a decrease in the net mark frequency from 1978 to 1979, but Wilcoxon's paired comparison test showed that the decrease was only significant for the grilse and salmon larger than 7 kgs.

The net mark frequency on sea trout from River Vefsna was small (table 3). The size group 50-67 cm could best be compared with the grilse registrations. The net mark frequency for sea trout in this group was 7.2 % compared with 79.1 % for grilse.

Table 4 shows the net mark registrations at the different sea localities. There are some uncertainties in this material because the salmon were caught in bagnets, but it seems clear that the net mark frequencies are relatively high. However, the most reliable material is from the Vikna-Vefsnfjord area, and to examine possible changes in the net mark frequency from the outer coastal area to the river, these registrations are most suitable.

Table 5 shows a significant increase in the net mark frequency from Kvaløya/Vikna to Vefsnfjord and to River Vefsna in all three size groups suggesting that both driftnets (which are only used outside the base line) and meshed gear in the fjord contribute in causing net marks.

### Discussion

Salmon could be injured by passing through the nets with or without breaking the net thread, or the salmon could be entangled in front of the gill cover and escape without passing through. The degree of injury will vary. This is discussed in more detail by Hansen(1979) and Roald(1980).

In the present material most salmon were slightly damaged, and only a smaller part had serious injuries.

The decrease in the net mark frequency from 1978 to 1979 could be due to prohibition of setnets and licence regulation of the driftnet fishery which may have resulted in a decrease in the fishing intensity. But the relatively high net mark frequency on certain stocks in 1979 indicate a high exploitation rate in the sea.

Vikna/Kvaløya is situated close to the base line, and probably the net marks registered in this area are mainly caused by drift-nets. From Vikna/Kvaløya to River Vefsna the net mark frequency has been almost doubled, indicating that inshore nets make a considerable contribution in damaging the salmon. In the fjord both bendnets and bagnets are responsible for net marks on grilse which pass through the nets without breaking the net thread. Larger salmon caught in bagnets will have small chances to break the thick thread. The much thinner thread in the bendnets is much easier to break. This could suggest that in Vefsnfjord the bendnets are the main contributors to the increased net mark frequency on larger salmon.

#### References

- Hansen, L.P. 1979. Net mark frequencies on Atlantic salmon Salmo salar L. in Norwegian rivers and coastal areas 1978. I.C.E.S. C.M. 1979/M:13.
- Roald, S.O. 1980. Net marks on Atlantic salmon (Salmo salar) in Norwegian coastal areas. Preliminary report on gross, histological, serological and bacteriological signs. I.C.E.S. C.M. 1980/M:34.

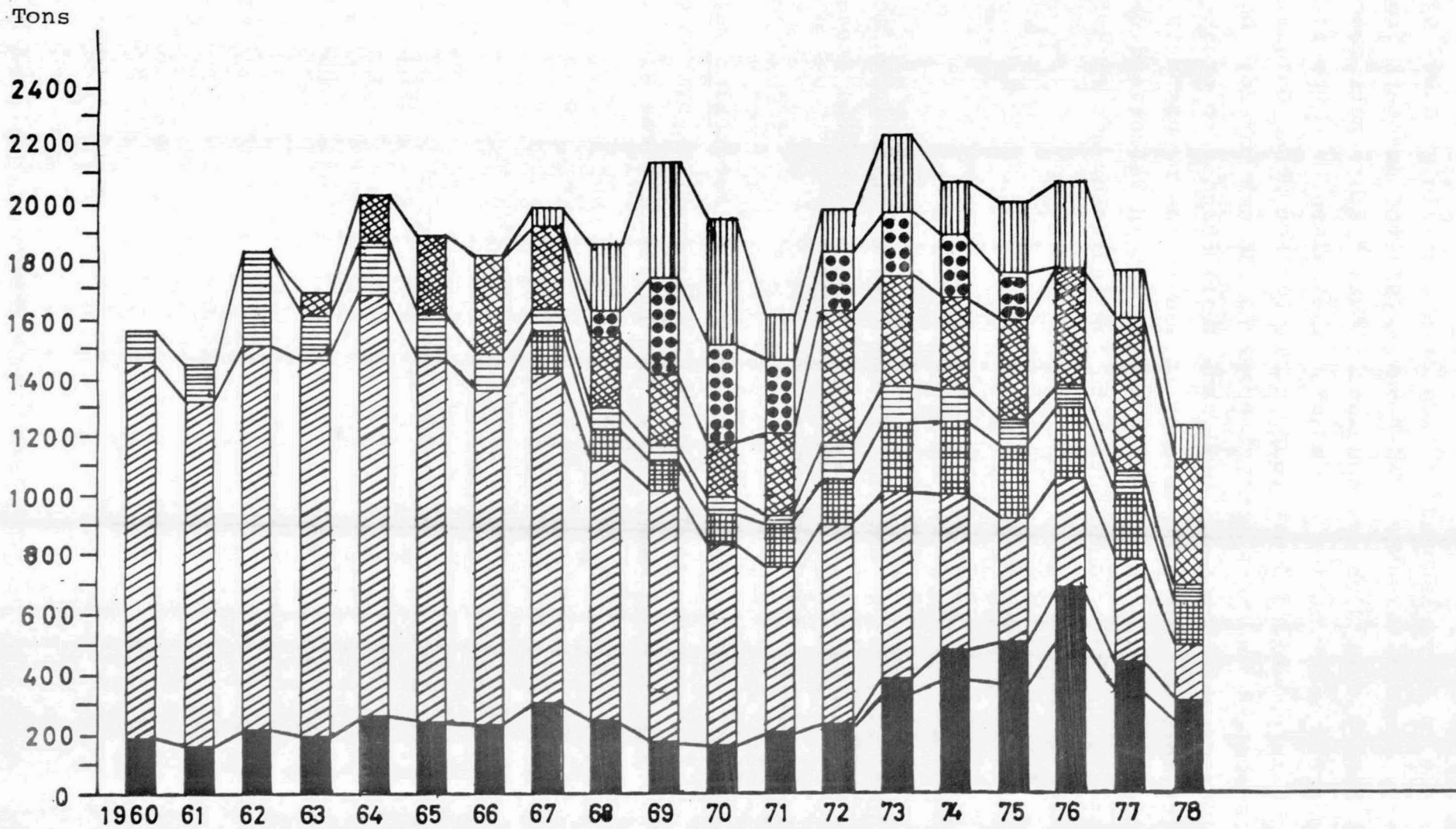
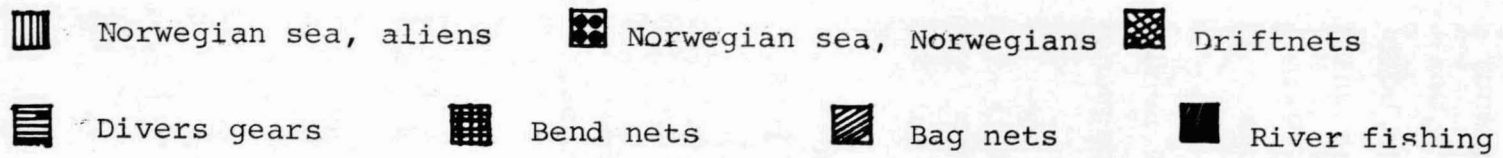


Fig. 1. Yield of Atlantic salmon in Norway and the Norwegian sea

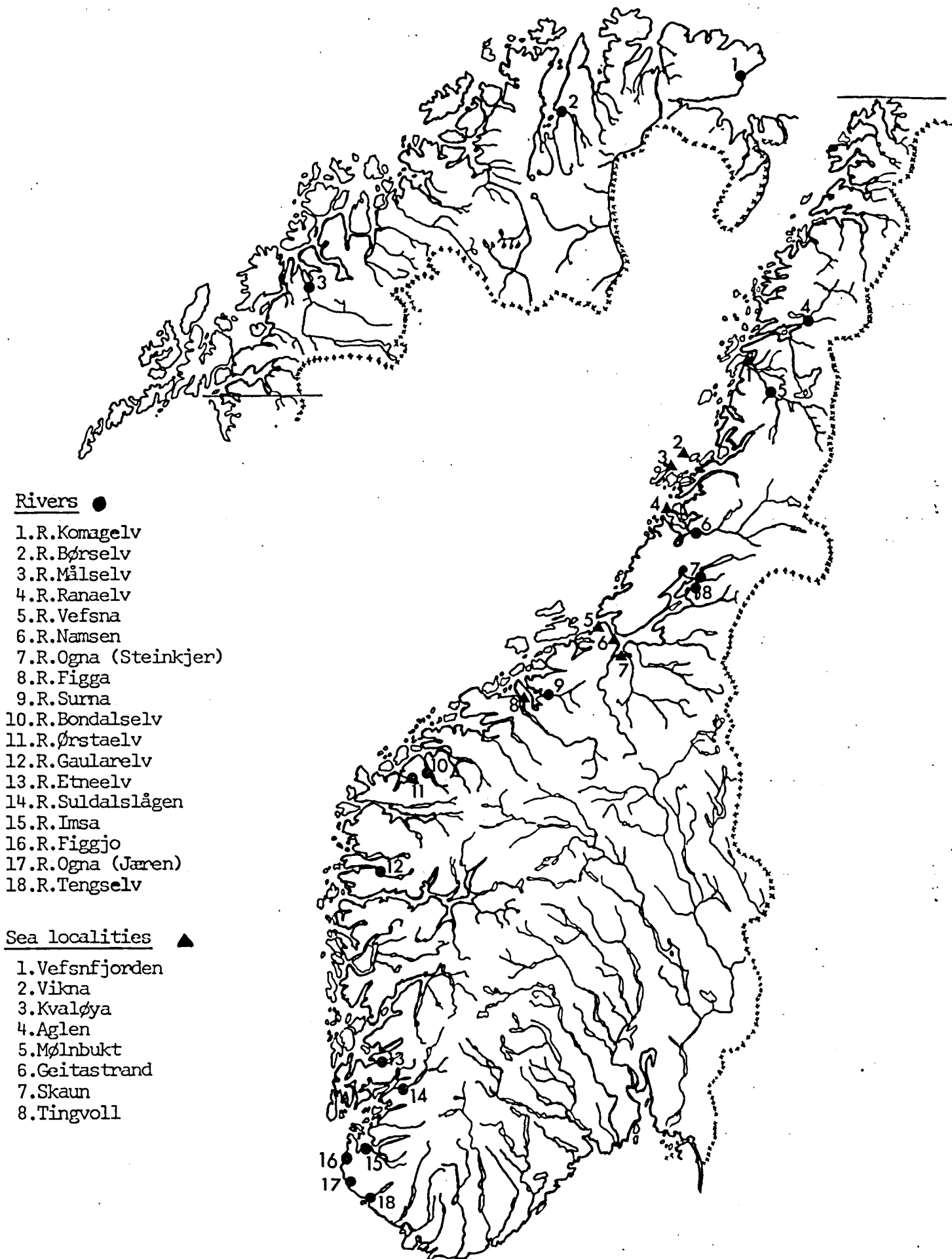


Fig. 2. Geographical distribution of the net mark registration localities.



Table 1. Percent net marked salmon 1979 compared with total net mark frequencies from 1978. N = number of controlled fish.

	<3 kg		3 - 7 kg		>7 kg		Total	
	%	N	%	N	%	N	%	N
R.Komagelv Jul 1979	59.1	66	10.0	20	50.0	2	47.7	88
" Aug 1979	48.0	25	25.0	8	0.0	2	40.0	35
" tot.1979	56.0	91	14.3	28	25.0	4	45.5	123
" tot.1978	48.1	77	20.0	10	25.0	4	44.0	91
	$x^2 = 1.0$ n.s.							
R.Børselv Jun 1979	75.0	4	50.0	2	36.4	11	47.1	17
" Jul 1979	65.4	26	54.5	11	60.0	5	61.9	42
" Aug 1979	40.0	15	33.3	3	0.0	4	31.8	22
" tot.1979	57.7	45	50.0	16	35.0	20	50.6	81
" tot.1978	59.3	27	38.9	18	51.4	35	51.3	80
	$x^2 = 0.02$ n.s.		$x^2 = 0.4$ n.s.		$x^2 = 1.3$ n.s.			
R.Målselv Jun 1979		0	33.3	3	11.5	52	12.7	55
" Jul 1979	42.2	33	7.1	56	14.5	69	17.7	158
" Aug 1979	43.8	16	19.0	21	20.0	20	26.3	57
" tot.1979	42.9	49	11.3	80	14.2	141	18.5	270
" tot.1978	68.6	86	86.4	22	78.5	93	75.1	201
	$x^2=8.5$ $p<0.05$		$x^2=48.8$ $p<0.05$		$x^2=96.7$ $p<0.05$			
R.Ranaelv Jul 1979	43.8	16	66.7	12	100.0	3	58.1	31
" Aug 1979	35.6	59	50.0	14	18.2	11	35.7	84
" Sep 1979	37.5	8	45.5	11	50.0	4	43.5	23
" Oct 1979	42.9	7	40.0	5	0.0	2	35.7	14
" tot.1979	37.8	90	52.4	42	35.0	20	41.4	152
" tot.1978	57.5	134	53.8	78	60.4	48	56.9	260
	$x^2=8.3$ $p<0.05$		$x^2=0.02$ n.s.		$x^2=3.6$ n.s.			
R.Vefsna Jun 1979	100.0	2	0.0	3	34.8	23	35.7	28
" Jul 1979	79.9	593	45.5	77	46.0	161	70.2	831
" Aug 1979	78.5	144	55.0	40	47.4	38	68.9	222
" Sep 1979	57.1	21	40.0	5	13.3	15	39.0	41
" tot.1979	79.1	760	47.2	125	43.0	237	67.9	1122

Table 1 cont.

	< 3 kg		3 - 7 kg		> 7 kg		Total	
	%	N	%	N	%	N	%	N
R.Namsen Jun 1979	41.2	17	28.6	21	25.3	91	27.9	129
" Jul 1979	48.8	82	28.3	46	22.2	126	31.9	254
" Aug 1979	36.0	25	9.1	11	10.5	19	21.8	55
" tot.1979	45.2	124	25.6	78	22.5	236	29.5	438
" tot.1978	30.3	155	24.6	175	24.0	125	26.4	455
	$\chi^2=6.5$ p<0.05		$\chi^2=0.03$ n.s.		$\chi^2=0.1$ n.s.			
R. Oгна (Steinkjer)								
" May 1979		0		0	0.0	3	0.0	3
" Jun 1979	33.3	94	20.0	20	18.2	11	30.4	125
" Jul 1979	47.9	259	10.0	20	0.0	4	44.5	283
" Aug 1979	50.0	36	16.7	6	0.0	4	41.3	46
" tot.1979	44.7	389	15.2	46	9.1	22	40.0	457
R.Figga May 1979	0.0	1	7.7	26	0.0	22	4.1	49
" Jun 1979	46.7	15	0.0	1	0.0	2	38.9	18
" Jul 1979	33.3	36	50.0	2		0	34.2	38
" Aug 1979	0.0	3		0		0	0.0	3
" tot.1979	34.5	55	10.3	29	0.0	24	20.4	108
R. Surna May 1979	100.0	1		0		0	100.0	1
" Jun 1979	21.2	33	42.9	14	9.5	21	22.1	68
" Jul 1979	37.1	35	29.2	24	18.8	16	30.7	75
" Aug 1979	61.5	26	25.0	20	25.0	16	40.3	62
" tot.1979	38.9	95	31.0	58	17.0	53	31.1	206
" tot.1978	58.3	168	30.0	30	40.0	30	52.2	228
	$\chi^2=9.1$ p<0.05		0.01 n.s.		$\chi^2=5.3$ p<0.05			
R.Bondalselv								
" May 1979		0	0.0	1		0	0.0	1
" Jun 1979	58.8	17		0		0	58.8	17
" Jul 1979	74.0	50		0		0	74.0	50
" Aug 1979	70.8	48	0.0	1		0	69.4	49
" Sep 1979	75.0	8		0		0	75.0	8
" tot.1979	70.7	123	0.0	2		0	69.1	125
" tot.1978	70.6	34	33.3	3		0	67.6	37
	$\chi^2=0.003$ n.s.							

Table 1 cont.

	< 3 kg		3 - 7 kg		>7 kg		Total	
	%	N	%	N	%	N	%	N
R. Ørstaelv								
May 1979		0	0.0	1		0	0.0	1
" Jun 1979	67.2	64		0		0	67.2	64
" Jul 1979	87.0	100	100.0	1		0	87.1	101
" Aug 1979	100.0	7	100.0	1		0	100.0	8
seine "25/6 "	62.5	40		0		0	62.5	40
" "26/6 "	69.6	23		0		0	69.6	23
" "28/6 "	76.0	25		0		0	76.0	25
" " 9/7 "	91.9	37		0		0	91.9	37
" "10/7 "	84.5	207		0		0	84.5	207
" "12/7 "	83.3	36		0		0	83.3	36
total 1979	81.3	539	66.7	3		0	80.8	542
total 1978	83.5	425	50.0	4		0	83.2	429
	$x^2=1.0$ n.s.							
R.Gaularelv								
May 1979		0	16.7	6	18.2	11	17.6	17
" Jun 1979	61.5	26	4.4	45	13.6	22	22.6	93
" Jul 1979	75.0	116	48.1	27	27.3	11	66.9	154
" Aug 1979	78.9	95	33.3	6	100.0	1	76.5	102
" total 1979	75.1	237	21.4	84	20.0	45	56.0	366
R. Etneelv								
May 1979		0	0.0	8	8.3	24	6.3	32
" Jun 1979	66.7	12	9.4	32	7.7	52	15.6	96
" Jul 1979	63.3	109	23.8	21	8.0	25	49.0	155
" Aug 1979	68.1	191	23.8	21	13.3	15	60.4	227
" Sep 1979	58.7	92	7.1	14	16.7	6	50.0	112
"total 1979	64.6	404	14.6	96	9.0	122	46.0	622
"total 1978	66.1	348	23.6	110	23.1	52	52.5	510
	$x^2=0.2$ n.s.		$x^2=2.6$ n.s.		$x^2=6.2$ p<0.05			

Table 1 cont.

	< 3 kg		3 - 7 kg		> 7 kg		Total	
	%	N	%	N	%	N	%	N
<b>R. Suldalslågen</b>								
Jun 1979		0	0.0	1	0.0	12	0.0	13
" Jul 1979	17.6	17	26.7	15	23.3	30	22.6	62
" Aug 1979	90.9	10	50.0	6	33.3	9	60.0	25
" Sep 1979	0.0	10	0.0	18	0.0	21	0.0	49
" Oct 1979	0.0	9	0.0	1	0.0	3	0.0	13
"total 1979	26.1	46	17.1	41	13.3	75	17.9	162
<b>R. Imsa</b>								
Jul 1979	33.3	3	0.0	2		0	20.0	5
" Aug 1979	42.1	19	16.7	6	0.0	3	32.1	28
" Sep 1979	0.0	27	50.0	4	0.0	1	6.3	32
" Oct 1979	22.2	9	0.0	1		0	20.0	10
" Nov 1979	0.0	4	0.0	4		0	0.0	8
" Dec 1979	0.0	4	0.0	2		0	0.0	6
" total 1979	16.7	66	15.8	19	0.0	4	15.7	89
" total 1978	47.1	70	50.0	2		0	47.2	72
	$\chi^2=14.4$ $p<0.05$							
<b>R. Figgjo</b>								
Jun 1979	0.0	3	0.0	10	0.0	1	0.0	14
" Jul 1979	0.0	1	37.5	8	0.0	2	27.3	11
" Aug 1979	40.7	140	27.0	37	0.0	2	37.4	179
" Sep 1979	56.5	62	6.7	15	0.0	2	45.6	79
" total 1979	44.7	206	20.0	70	0.0	7	37.5	283
<b>R. Oгна (Jæren)</b>								
Jul 1979	57.9	19	100.0	1		0	60.0	20
" Aug 1979	35.6	191	15.4	13		0	34.3	204
" Sep 1979	28.7	115	12.5	8	0.0	1	27.4	124
"total 1979	34.5	325	18.2	22	0.0	1	33.3	348
"total 1978	53.6	28		0		0	53.6	28
	$\chi^2=4.0$ $p<0.05$							
<b>R. Tengs</b>								
Jul 1979	66.7	18	0.0	2	0.0	1	57.1	21
" Aug 1979	50.0	24	0.0	1	0.0	0	48.0	25
" Sep 1979	0.0	5		0		0	0.0	5
"total 1979	51.1	47	0.0	3	0.0	1	47.1	51
"total 1978	75.0	24	40.0	5	0.0	1	66.7	30
	$\chi^2= 3.7$ n.s.							

Table 2. Percent net marked salmon in the same rivers in 1978 and 1979

(weighted mean). For grilse: R. Komagelv, R. Børselv, R. Målselv, R. Ranaelv, R. Namsen, R. Surna, R. Bondalselv, R. Ørstaelv, R. Ørstaelv, R. Etneelv, R. Imsa, R. Oгна og R. Tengs.

For size group 3 - 7 kg: R. Komagelv, R. Børselv, R. Målselv, R. Ranaelv, R. Namsen, R. Surna og R. Etneelv.

For size group larger than 7 kg: R. Børselv, R. Målselv, R. Ranaelv, R. Namsen, R. Surna og R. Etneelv.

Only groups with at least 10 salmon are included.

N = Number of rivers and  $T_s$  is the Wilcoxon statistic.

	< 3 kg		3 - 7 kg		> 7 kg	
	%	N	%	N	%	N
1978	59.8	12	39.6	7	46.2	6
1979	49.8	12	28.5	7	22.1	6
	$T_s = 12$ $p < 0.05$		$T_s = 9$ $p > 0.05$		$T_s = 0$ $p < 0.05$	

Table 3. Percent net marked sea trout, R. Vefsna 1979.

N = Number of controlled fish.

	< 50 cm		50 - 67 cm		> 67 cm		Total	
	%	N	%	N	%	N	%	N
Vefsna Jun 1979		0	0.0	1		0	0.0	1
" Jul 1979	3.4	58	7.2	125	0.0	3	5.9	186
" Aug 1979	0.0	12	7.7	26	0.0	5	4.7	43
" total 1979	2.9	70	7.2	152	0.0	8	5.7	230

Table 4. Percent net marked bagnet and longline caught salmon 1979.

N = number of controlled fish.

	< 3 kg		3 - 7 kg		> 7 kg		Total	
	%	N	%	N	%	N	%	N
Vefsnes- May 1979				0	60.0	10	60.0	10
fjord " Jun 1979			29.8	104	32.1	187	31.3	291
" Jul 1979			29.6	135	30.1	83	29.8	218
" total 1979			29.7	239	32.5	280	31.2	519
Vikna caught on long line								
" May 1979	0.0	2		0	0.0	2	0.0	4
" Jun 1979	41.7	36	0.0	3	0.0	1	37.5	40
" Jul 1979	100.0	2		0		0	100.0	2
" total 1979	42.5	40	0.0	3	0.0	3	37.0	46
Kvaløya								
May 1979			40.0	5	25.0	24	27.6	29
" Jun 1979			19.6	56	20.0	50	19.8	106
" Jul 1979			26.7	30	13.6	22	21.2	52
" total 1979			23.1	91	19.8	96	21.4	187
Aglen								
May 1979			0.0	8	7.7	26	5.9	34
" Jun 1979			4.5	67	30.7	127	21.6	194
" Jul 1979			28.4	81	50.8	65	38.4	146
" total 1979			16.7	156	33.9	218	26.7	374
Mølnbukt								
May 1979			0.0	1	2.4	42	2.3	43
" Jun 1979			15.4	26	14.3	91	14.5	117
" Jul 1979			9.1	11	36.0	25	27.8	36
" total 1979			13.2	38	14.6	158	14.3	196
Geitastrand								
May 1979			0.0	1	0.0	11	0.0	12
" Jun 1979			16.7	6	35.0	20	30.8	26
" Jul 1979			35.3	17	11.1	9	26.9	26
" Aug 1979			0.0	1		0	0.0	1
" total 1979			28.0	25	20.0	40	23.1	65

Table 4 cont.

	< 3 kg		3 - 7 kg		> 7 kg		Total	
	%	N	%	N	%	N	%	N
Skaun May 1979			86.7	15	26.9	108	34.2	123
" Jun 1979			68.6	70	26.9	212	37.2	282
" Jul 1979			38.3	81	14.7	95	25.6	176
" total 1979			55.4	166	24.1	415	33.1	581
Ting- May 1979				0	33.3	3	33.3	3
voll," Jun 1979			27.6	29	29.5	61	28.9	90
" Jul 1979			37.5	24	52.6	38	46.8	62
" Aug 1979			80.0	5	60.0	5	70.0	10
"total 1979			36.2	58	39.3	107	38.2	165

Table 5. Percent net marked salmon in the South Helgeland area.

N = number of controlled fish.

	< 3 kg			3 - 7 kg			> 7 kg		
	%	N	$\chi^2$	%	N	$\chi^2$	%	N	$\chi^2$
Vikna/Kvaløya	42.5	40	6.77 p<0.05	23.1	91	1.44 n.s.	19.8	96	5.58 p<0.05
Vøfsnfjord	68.2	66	4.23 p<0.05	29.7	239	10.94 p<0.05	32.5	280	6.09 p<0.05
R. Vøfsna/ Laksfors	79.1	760		47.2	125		43.0	237	