

Natural smolt production
of Icelandic salmon rivers

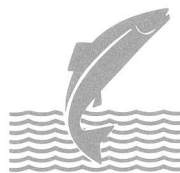
ICES working paper

Gudjonsson, S., S. M. Einarsson,
M. Johannsson and A. Isaksson 1988.

Institute of Freshwater Fisheries
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Eintak bókasafns

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VEIÐIMÁLASTOFNUN
Vistfræðideild

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Introduction

It is important to know the number of wild smolts entering the sea each year in Iceland for a number of managerial reasons. The size of the annual salmon catch depends on the number of outmigrating smolts one or two years earlier and the survival of these smolts at sea. There are two possible ways to calculate the number of smolts.

One method is to measure or estimate the production of smolts in the rivers. The production of smolts in a river system depends on the size and quality of accessible salmon rearing habitat. The quantity and the quality of salmon rearing habitat in Iceland has not been thoroughly mapped. Furthermore, utilization of the habitat from year to year varies, since age at smoltification can change from time to time and yearclasses of juveniles are of different size, depending on climatic condition and the size of spawning stock. Counting of smolts leaving a river has only been done for few rivers. Therefore, such an analysis is not feasible.

The other way is to use known exploitation rates to calculate the total run of adults returning to the river and then to use known return rate of tagged wild smolts to backcalculate the number of smolts leaving the stream. Since, exploitation rate and return rate is known for some salmon stocks in Iceland, this is possible. Ocean fishery of salmon is banned within Icelandic 200 miles fishing limits. Fishing mortality at sea is therefore most likely negligible.

This paper is an attempt to calculate the average number of salmon smolts leaving Icelandic rivers each spring using the latter method.

Biological parameters

Salmon catch

Catch records are very accurate for most Icelandic rivers. The average catch for 20 year interval was calculated for all rivers in South and Western Iceland and North and Eastern

Iceland, respectively. Standard deviation as well as 95 % confidence interval were also calculated (Table 1).

Exploitation rate

Based on known exploitation rates for some Icelandic rivers for a number of years (Þór Gudjónsson 1987, Sigurdur Gudjonsson 1988, Tumi Tomasson 1988) 50 % average exploitation rate is assumed.

Return rate

Return rate of tagged wild smolt is known for one river in Iceland, River Elliðdaar. For the 1975 smolt-migration the return rate of tagged smolt was approximately 20 % (Isaksson *et al.* 1978) and for the 1985 smolt-migration it was approximately 10 % (Jon Kristjansson 1987). Handling and tagging reduces survival somewhat so higher returns can be expected.

Ocean conditions

The ocean conditions are similar along the south and the west coasts of Iceland but are fluctuating from year to year along the north and the east coasts (Asthorsson *et al.* 1982). The time immediately after the smolts migrate to sea is most critical and survival rate depends on the conditions at that time (Hartt 1980, Scarnecchia 1984). The survival of smolts at sea is thus likely to be more fluctuating in northern and eastern salmon stocks. Return rates in ocean ranching experiments in north Iceland have in general been lower than in west Iceland. The smolt production of northern and eastern rivers is also observed to fluctuate more than in southern and western rivers as seen from electro-fishing surveys for juveniles.

Grilse-salmon ratio

Higher proportion of the run in the north and the east is salmon, whereas grilse are more common in the south and the west. The overall return rate in the north and the east is thus lower because of mortality during the second year at sea. Only known ocean fishing mortality occurs at that stage although on a negligible scale.

Assumed survival

Since survival at sea fluctuates, returns based on 10 %, 15 % and 20 % survival were calculated for both areas. However, due to the above reasons, 20 % return rates were assumed for salmon stocks from rivers in south and west Iceland, but a lower return rate, of 15 %, was assumed for northern and eastern rivers (Table 2).

Conclusions

Based on these assumptions, the average annual number of wild smolts from Icelandic rivers is approximately 580.000. Thereof approximately 375.000 smolts (\pm 10 %) are from southern and western rivers and approximately 208.000 smolts (\pm 20 %) from northern and eastern rivers (Table 2).

Modelling

A model to stimulate ideas to scientifically based approaches to management was proposed at the meeting of the study group on the Norwegian Sea and Faroese salmon fishery held in Dublin, 9-11 February 1988.

The parameters in that model for Iceland are:

P in year N, smolt production is 580.000

X, catch at high seas is close to 0

Loss to home water catch 1,6 times X is close to 0

Nominal home water catch, Y is approximately 50.000

Non-catch fishing mortality is assumed to be close to 0

Spawning escapement, W is approximately 50.000

These numbers are average annual numbers for wild smolts only.

Table 1

Total salmon catch in Icelandic rivers 1966 to 1985.

Year	South and West Iceland		North and East Iceland		
1966	23489		5255		
1967	33955		6548		
1968	32482		7780		
1969	27322		7142		
1970	39641		11533		
1971	48693		13261		
1972	47258		16479		
1973	46934		16272		
1974	36948		15200		
1975	48543		17741		
1976	40586		19047		
1977	40108		24467		
1978	52955		27623		
1979	43674		20554		
1980	35494		16643		
1981	30861		12899		
1982	27034		9818		
1983	37016		10059		
1984	26878		8106		
1985	30577		10954		
Mean	Std	37522	8324	13869	5914
Std as % of mean		22.2		42.6	
95% confid. interval		33762-41282		11101-16637	

Table 2

a) Calculated number of smolt from Icelandic rivers based on 50 % exploitation rate in the rivers and 20 % return rate from sea.

South and West Iceland		North and East Iceland	
Mean	<u>375.220</u>	Mean	138.690
Min	<u>337.620</u>	Min	111.010
Max	412.820	Max	166.370

b) Calculated number of smolt from Icelandic rivers based on 50 % exploitation rate in the rivers and 15 % return rate from sea.

South and West Iceland		North and East Iceland	
Mean	562.830	Mean	<u>208.035</u>
Min	506.430	Min	<u>166.515</u>
Max	619.230	Max	249.555

c) Calculated number of smolt from Icelandic rivers based on 50 % exploitation rate in the rivers and 10 % return rate from sea.

South and West Iceland		North and East Iceland	
Mean	750.440	Mean	277.380
Min	675.240	Min	222.020
Max	825.640	Max	332.740

Min. and max. values were calculated from 95 % confidence intervals of catches.

Underlined numbers were used to calculate the smolt production of the country.

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