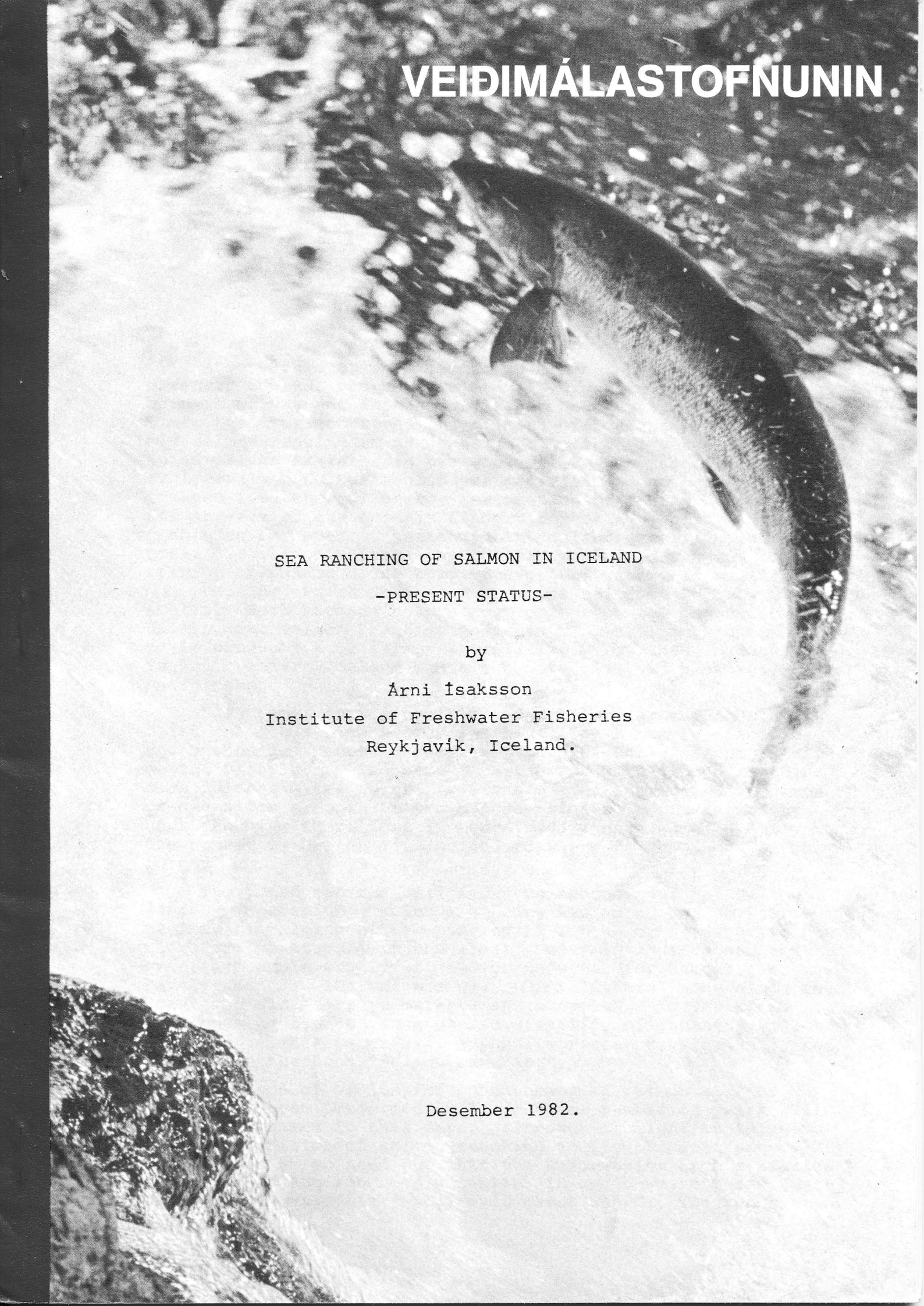

SEA RANCHING OF SALMON IN ICELAND

-PRESENT STATUS-

by

Árni Ísaksson
Institute of Freshwater Fisheries
Reykjavík, Iceland.

Desember 1982.

SEA RANCHING OF SALMON IN ICELAND

-PRESENT STATUS-

by

Árni Ísaksson
Institute of Freshwater Fisheries
Reykjavík, Iceland.

Introduction.

Aquaculture using Atlantic salmon has primarily been directed towards pen culture and has grown to a major industry both in Norway and Scotland. It has been clear for a long time, that the geography and climate of Iceland would not permit salmon rearing in sea cages due to lethal subzero temperatures of the seawater in the wintertime. It seemed logical to evolve salmon culture which uses specific advantages found in Iceland i.e. thermal energy for heating of rearing water and the absence of any oceanic fishery for salmon,which has been forbidden for over 50 years within Icelandic territorial limits. Icelandic salmon culture has therefore evolved towards pond rearing of salmon using temperate ground water, as well as salmon ranching, which only uses precious calories to grow 30 gram smolts. Both methods hold some promise for the production of salmon, but salmon ranching seems to be better suited for large scale production of salmon at relatively low cost, especially in southwestern Iceland where the potential has been well established.

This paper is basically divided into four sections. The first one deals with salmon ranching from a rearing facility and emphasizes recent developments at the Kollafjörður Experimental Fish Farm. The second part deals with salmon ranching from release sites, where smolts are adapted and fed in ponds or cages for a month or two before release. Good returns to such ranching operations in recent years have added greatly to the number of places within Iceland,where ranching can be performed

The third section will focus on nonconventional salmon ranching operations, which are being tested on the Reykjanes peninsula, relying on the pumping of fresh- or seawater, since there are no streams in the area. Possible advantages, however, are ample supply of cold groundwater for hatcheries, fairly abundant thermal energy, steep littoral zone along the coast and closeness to markets and airports. In the final section some studies on economic viability of ranching will be discussed. This paper will emphasize recent developments, not covered in the book "Salmon ranching".

Releases of smolts for enhancement of salmon streams, which have been performed in Iceland for number of years will not be discussed in this paper, although it might be included in the definition of salmon ranching in its broadest sense. It also should be pointed out,that the information herein applies primarily to the ranching potential in south-western and western Iceland, which is fairly well established. The ranching

potential on the north-coast is less certain due to limited experimentation, different grilse-salmon ratio and possibly more critical environmental conditions.

Salmon ranching facilities

Salmon ranching experiments from a site where the smolts were also reared have been conducted at the Kollafjörður Experimental Fish Farm for over 15 years. It is very important for further development of salmon ranching if it could be carried out at release sites distant from the fish farm, where the smolts are reared. Suitable rearing sites are limited and only in a few instances located close to the sea.

The salmon ranching sites discussed in this report are shown in figure 1. Ranching experiments were first tried at Lárós in the 1960's, apparently with limited success, using Carlin-tagged two-year smolts. In the early 1970's ranching was started at Súgandafjörður on a small scale, using one- and two-year smolts. Most of the smolts were untagged and success was difficult to estimate, but returns seemed to vary a lot between years and were generally low.

The smolt releases at Kollafjörður, Lárós and Súgandafjörður (figure 1) provided an excellent opportunity to study the return-rates of identical smolts to different ranching sites and observe whether there would be a reduction in the rate of return with increased distance from the home area as well as any changes that might occur in the grilse-salmon ratio and possible reasons for those changes. In this paper the 1978-80 release experiments are discussed briefly.

Methods of tagging, release and recapture.

All smolts released in the ranching experiments have been microtagged and adipose clipped. The use of this tagging technique has enabled us to try different release times and techniques and get return-rates into freshwater, which are fairly representative of those observed for untagged smolts. Initial use of microtags in Iceland is described by Isaksson and Bergman (1978).

The release methods have varied considerably from one site to another depending on the physical layout at each site (figure 2). Releases at Súgandafjörður have both been from release ponds and floating pens. Releases at Lárós have entirely been from floating pens, some of which have been in brackish water. Releases at Kollafjörður have been only from release ponds, but salinity adaption has been used as a control for freshwater release since 1979.

All smolts released in the experiments have been adapted and fed a dry diet for one month before release. The smolts released at Kollafjörður were put into release ponds in the middle of May and released after June 10th. Smolts released at Lárós have been trucked to the site in oxygen inflated plastic bags in early May and released in the middle of June. Smolts have been transported in plastic bags by plane to the Súganda-

fjörður site in early June and released in early July, 2-3 weeks later than at the other sites. The reason for this is a colder climate and lot of melting snow in the river used for ranching.

The returning salmon are either taken from a fish trap located at each site or seined below the structure, when water conditions discourage active migration. Microtagged salmon, recognized by the adipose-clip,are inspected with a magnetic detector and a core removed from the snout of the salmon. Microtags have been read at the Institute of Freshwater Fisheries in Reykjavík.

Salmon ranching from a rearing facility.

1. Return-rates.

Salmon ranching experiments at the Kollafjörður Experimental Fish Farm have been discussed in detail by Gudjonsson (1973), Isaksson (1976 and 1982) and Isaksson and Bergman (1978). A comprehensive overview was also presented in "Salmon ranching" (1980). It is, however, useful to give a brief account of the development of salmon ranching at the "Fish Farm".

Table 1 gives total releases of smolts at the "Fish Farm" from 1963 to 1982, combining years with similar rearing practices and release techniques. From 1963 to 1967 two-year smolts were released, which performed satisfactorily in many instances. The use of tempered water to produce one-year smolts after 1968 resulted in greatly lowered return-rates. These smolts were intensively reared in warm water throughout the rearing period and did not smoltify properly.

By speeding up hatching and rearing, it became possible to have smolt - size fish before the end of the year, preceding their release. By using proper photoperiod and temperature regimes during the winter months, the return-rates of one-year smolts greatly improved after 1972 and total returns of one- and two-year smolts exceeded 200 kilograms per 1000 smolts released. Reduced size of one-year smolts and unsuitable release conditions for such smolts were the primary reason for lowered return-rates in the 1976 and '77 release experiments. It had been noticed in the past that tagged one-year smolts were very vulnerable to fungus infection if placed in earthen ponds shortly after tagging. The distance from the release ponds to the sea also seemed to be undesirably long,especially when cool spring temperatures delayed seaward migration (figure 2).

In the spring of 1978 a release pond was built just above the estuary at the "Fish Farm" and subsequent releases have been performed in that area both from pure freshwater ponds and after salinity adaption since 1979. The new release techniques have greatly improved the returns and increased the stability of recaptures between years. The total return-rates for the period after 1978 is close to 6% and exceeding 200 kilograms per 1000 smolts released in some years. Total returns to the "Fish Farm" from approximately 680.000 released during almost 20 years of operation exceed 5%, in spite of the experimental nature of the operation.

2. Age of maturation with respect to stock, smolt age and size.

It has become evident in recent years, that there is possibly a trend towards greater proportion of two-sea-winter salmon at the Kollafjörður Fish Farm as opposed to grilse. As recently as 1974 the grilse proportion was usually over 90%, as seen in table 2. The same ratio was then observed for one and two-year smolts and seemed to be little affected by smolt size. A corresponding figure for the Kollafjörður stock in the 1978-79 tagging experiments is shown in table 3. The grilse ratio in the one-year-smolts is about 80% which is significantly lower than in earlier years. This ratio seems to be little affected by the size of the smolts. The reasons for increased ratio of older salmon are not clear, but one might be tempted to relate it to the fact that larger salmon are predominantly used for broodstock. This may, however, partly be environmentally determined. Recent data from the 1980 release experiment show reversion back to 90% grilse predominance, which may be related to very favorable spring and summer temperatures in 1980. The spring and summer temperatures in 1979 were abnormally low, which may have caused the shift from grilse towards salmon which was very pronounced in the 1979 release-groups. It should be pointed out,that two-year smolts of Kollafjörður stock have shown over 90% grilse ratio through all the years (table 3).

Also shown in table 3 are returns of one and two-year smolts, taken as eggs from the northeastern and southern part of Iceland. Most of these are reared at the Kollafjörður Fish Farm. Despite the fact, that the number of returning adults for the Northern stock are few, there is indication,that the stock has innate tendencies to produce salmon rather than grilse. This trait is even more pronounced in the southern stock, but both these stocks return primarily as two-year salmon to their home streams.

A direct comparison of these stocks to the Kollafjörður stock is made in figure 3. Both the wild stocks showed very high return-rates to the "Fish Farm" when released as one-year smolts, with considerably higher proportion of two-sea-winter fish than the Kollafjörður stock. Two-year smolts of these same stocks, however, show a strong grilse dominance, quite comparable to the Kollafjörður stock. In general one can say that the data at hand supports Canadian observations which suggest that two-year hatchery smolts return in greater proportion as grilse than one-year-smolts (Ritter and Carey 1980). The data furthermore suggests,that increased smolt age and size may mask genetic tendencies towards two-sea-winter salmon observed in younger smolts.

Salmon ranching from release facilities.

In 1978 the Nordic Council granted some funds to conduct salmon ranching experiments in Iceland. Initially experimental releases were only done at Kollafjörður and Súgandafjörður as well as at more distant release sites on the north and east coast of Iceland,where proper facilities for ranching were not available and harvest of salmon had to be done by seining.

In 1980 the Lárós site was added into the program with funding from the Economic Development Institute which has taken over the funding of the project after 1981.

1. Total returns.

Figure 4 shows the total returns of smolts of Kollafjörður stock to various ranching sites in the 1978-81 release experiments. Figures for 1981 release experiment are preliminary, since they only include grilse.

The figure shows that smolts of Kollafjörður stock have 5-9% return-rate, when released in the home area, which corresponds to ca 200 kg. per 1000 smolts released. Comparable smolts released at Súgandafjörður have 2-4% returns or ca 100 kg. per 1000 released. Comparable returns to the Lárós ranching site averaging the two years is 9% which amounts to almost 250 kg. per 1000 released smolts.

It is very encouraging for those involved in salmon ranching at release sites in Iceland to see, that return-rates can be realized, which are considerably better than those obtained in the home-stream 50-100 km away. It is difficult to explain this difference, but it may either be due to difference in the abundance of predators feeding on the smolts after release or in the feeding conditions for the smolts when they enter the sea. It should also be noticed that the smolts leaving the Lárós area, are entering relatively open and deep sea, but the smolts leaving Kollafjörður have to migrate out through a narrow passage, sometimes over a shallow beach on the low tide.

2. Difference between release methods.

Return-rates for different release methods used at Kollafjörður and Lárós are shown in figure 5. At Kollafjörður the smolts were both released from a freshwater release pond and after salinity adaption period of approximately one month. At Lárós three release methods were tested. One involved a months adaption period in a floating pen in freshwater, another group got similar adaption in saltwater and the third group got no adaption or feeding and was released directly into the lake after transport.

Looking at the different release techniques used at Kollafjörður for the three years (figure 5), it seems clear that salinity adaption does not have any advantages over conventional releases in freshwater, but it must be considered a useful comparison of the other release method. Especially, since the observed return-rates for various groups correspond quite closely, in spite of the vastly different release techniques. In the case of salinity adaption all smolts enter the sea during a 24-48 hour period but in the case of freshwater release they may take weeks to leave freshwater.

The results for the two years of experimentation at Lárós do not agree, where release methods are concerned. In the 1980 release experiment there was no difference between smolts released from floating pens in freshwater and seawater.

Smolts, however, released without adaption had less than half the return-rate of the adapted groups. Results in the 1981 release experiment, on the other hand, showed lowest returns in the groups adapted in seawater but minor differences between the other groups (figure 5). Judging from other similar experiments in Iceland (Ísaksson, Rasch and Poe, 1978) this outcome is probably an exception rather than rule and adaption at any rate must be considered a sensible step towards improved returns.

3. Grilse-salmon ratio.

The 1978 and 1979 releases revealed some interesting differences in grilse-salmon ratio between Kollafjörður and Súgandafjörður ranching sites, when comparable smolts of Kollafjörður stock were released (figure 6). As a rule in Iceland there is a reduction in the fraction of the population returning as grilse, as one goes further north. It can be speculated that these differences might be partly due to colder ocean temperatures, later sea-ward migration of smolts as well as slower freshwater growth in the north. Salmon stocks with genetic tendencies towards high ocean age are found both in southern and northern Iceland (Ísaksson 1982).

As can be seen in figure 6, there seems to be a tendency towards a higher ratio of salmon vs. grilse at Súgandafjörður compared to Kollafjörður in the 1978 and 1979 release experiments. Due to relatively small numbers returning at Súgandafjörður it seemed important to check how consistent these trends were in replicate groups released. Chi-square analysis indicated that the replicates were similar enough to be pooled for the comparison (Ísaksson 1982).

The differences in grilse-salmon ratio observed between the two release sites support the hypothesis that the increased ratio of salmon in the 1979 release experiment at Kollafjörður was in fact related to the cold spring and summer of 1979. Furthermore Scarnecchia (1982) found strong correlation with ocean temperature when comparing grilse-salmon ratios in northern and southern parts of Iceland. These data also confirm the observations of Saunders et.al. (1983) which suggested that ocean temperature was a major environmental component influencing grilse-salmon ratio.

Recent developments in ranching.

There are at the present time 8 rearing stations in Iceland which are at least partly engaged in smolt production. The estimated production in 1982 was 800.000 smolts, whereof approximately 400.000 were released in ranching operations. Almost 300.000 were released in western Iceland but over 100.000 on the north coast. One should therefore see a considerable increase in the quantity of ranched salmon returning in Iceland in 1983.

Reykjanes peninsula in the vicinity of Reykjavik has attracted lot of interest as a potential large scale ranching area. It is mostly composed of young lavas and is thus very

porous and rich in ground-waters, both fresh and saline, which can be used for smolt rearing. The upper layers which are fresh are only 4°C but further down one can in many places get temperate saline water at 10°C which is e.g. being used for salmon rearing at Eldi Inc. in Grindavík. High-energy thermal areas are also on the peninsula which only partly have been tapped for central heating.

No rivers as such are on the peninsula and smolts have to be released directly from the hatcheries after salinity adaption. The depth of the sea drops off fairly sharply along the coast in that area, which is an advantage when maximum tidal differences approach 4.5 meters. It should be fairly easy to build a salmon recapture facility which would be accessible to salmon 24 hours a day, despite the great tidal difference. Similar conditions are rarely found in the shallow southwestern fjords.

Experience of Pólarlax hatchery, which had their first returns in 1982 (figure 4), indicates that salmon are very reluctant to enter a freshwater flow, entirely composed of hatchery run-off and not affected by rain. The alternative seems to be the pumping of pure seawater, which seems to function well for Pacific salmon. Such a method will be tested at the ranching site of Vogar in 1983 but 20.000 smolts were released there in 1982. It seems that any large scale salmon ranching operation in Iceland depends largely on relatively smooth and continuous fishing of the recapture facilities. Due to great tidal fluctuations and relatively shallow inlets these conditions are not met at existing freshwater ranching facilities. Active migration e.g. at Kollafjörður Fish Farm depends to a large extent on favourable tidal conditions and increase in flow due to rain.

The experience at Pólarlax Fish Farm during the summer of 1982 demonstrates well the problems associated with migratory behaviour of salmon, which arise in salmon ranching operations. The total recaptures at Pólarlax were ca 2000 grilse. The first fish were seen jumping in the sea, in front of the hatchery, in mid-July, a normal time for grilse rivers in southern Iceland. The main concentration of salmon was in the vicinity of a small wooden fish ladder, enclosing the run-off from the hatchery, amounting to 80-100 liters per second. The salmon were seen schooling in that area for the whole of July but none entered the fish-ladder. Heavy rains were experienced in late July, which resulted in very active migration into recapture facilities at Kollafjörður Fish Farm 25 kilometers away, but the rain, as expected, had no effect on flows or migration at Pólarlax.

In early August the schools of salmon started to concentrate in the bay of Straumsvík, where there is considerable outflow of 4°C well water, amounting to 2000-3000 liters per second. This stream is subterranean, except for the last 200 meters above the estuary, but the underground part is not accessible for large fish. Occasional salmon started ascending the stream in early August, but after mid-August a mass migration was observed and most of the 2000 grilse caught were gill-netted in the stream immediately following high tides in late August. It should be borne in mind, that the stream is less than a

kilometer from the hatchery and the spring water pumped for the hatchery is of the same origin as the water in the subterranean stream. The hatchery run-off, however, is different in character due to food particles, excrements, salmon smell (pheromones) and temperature which is 10-12°C.

The Pólarlax operators are trying to solve their problem in two ways. Firstly, they intend to build a recapture facility on the stream at Straumsvík. Secondly, they are building a seawater lagoon in front of their facility, with a small gate to the open sea, which can be closed during low tide for the purpose of trapping salmon. The third alternative of pumping seawater has not been seriously applied in this case.

It is interesting to note, that there were no apparent strays between Pólarlax and Kollafjörður 25 kilometers away. No tags from Kollafjörður were observed at Pólarlax and any massive straying of untagged salmon to Kollafjörður would have been noticed.

Economic viability.

In 1979 a study was done concerning the profitability of salmon ranching (B.Andrésson 1979). The study took into account the building and running costs of a fish farm producing 200.000 smolts and one producing million smolts. It was assumed that the farm had to expend considerable capital on piping for hot and cold water as well as a borehole for hot water. The results of the study are presented in figure 7. The figure shows,that break-even for the smaller fish farm lies at 7% returns assuming that 90% of the run return as grilse. The break-even for the larger hatchery, however, is close to 3.5% returns. The difference between the two sizes of fish farms lies primarily in the fact that expenditure for energy and cold water harnessing is relatively higher in a small hatchery, whereas manpower is better utilized in a larger hatchery.

It seems likely that ocean ranching in Iceland will be more successful in large operations than small ones,assuming that the scaling up does not adversely affect the quality of smolts. Suitable locations for fish farms and ranching sites are limited and must be well utilized, transport of smolts to distant release sites is costly and production cost per smolt can be kept down in larger units.

In conclusion one can say,that salmon ranching as an industry is underway in Iceland. Future development will depend on, how sensibly the existing companies will manage their hatcheries. Unfortunately there are already signs,that managers may try to carry out ranching without proper consideration for the life history of the salmon. Releases have been practiced as late as October and as early as April, although natural smolt migrations in Iceland are primarily in June through August. Densities tend to be too high in the hatcheries, with consequent degradation of smolt quality and ultimately return-rate. If the companies have the fortune to walk the narrow road to success, I have no doubts that salmon ranching will be a thriving business in Iceland within a short time.

References.

Andrésson, B. (1979). Ræktun lax með hafbeitaraðferð, M.S. University of Iceland.

Gudjonsson, T. (1973). Smolts rearing techniques, stocking and tagged adult salmon recapture in Iceland. Int. Atlantic Salmon Found., Spec. Pub. Ser. 4 (1), 227-235.

Isaksson, A. (1976a). The results of Tagging Experiments at the Kollafjörður Experimental Fish Farm from 1970 through 1972. J. Agr. Res. Iceland 8 (1-2), 3-13.

Isaksson, A. (1976b). Preliminary results from the 1973 tagging experiments at the Kollafjörður Experimental Fish Farm. J. Agr. Res. Iceland 8 (1-2), 14-18.

Isaksson, A. (1976c). The improvement of returns of one-year-smolts at the Kollafjörður Fish Farm 1971-1973. J. Agr. Res. Iceland 8 (1-2), 19-26.

Isaksson, A. and Bergman, P.K. (1978). An evaluation of two tagging methods and survival rates of different age and treatment groups of hatchery-reared Atlantic salmon smolts. J. Agr. Res. Iceland 10 (2), 74-99.

Isaksson, A., Rasch, T. and Poe, P. (1978). An evaluation of smolt releases into a salmon and a non-salmon producing stream using two release methods. J.Agr. Res. Iceland 10 (2), 110-113.

Isaksson, A. (1980). Salmon ranching in Iceland in "Salmon ranching" (ed. John Thorpe), Academic press, 131-155.

Isaksson, A. (1982). Returns of microtagged Atlantic salmon (Salmo salar) to the Kollafjörður Experimental Fish Farm in 1976-79 Tagging Experiments, ICES C.M. 1982/M:34

Isaksson, A. (1982). Returns of microtagged Atlantic Salmon (Salmo salar) of Kollafjörður stock to three different salmon ranching facilities, ICES C.M. 1982/M:35

Ritter J.A. and Carey T.G. 1980. Salmon ranching in the Atlantic Maritime Provinces of Canada, in "Salmon ranching", (ed. John Thorpe), Academic press, 131-155.

Saunders R.L., Henderson E.B., Glebe B.D. and Loudenslager E.J. (1983). Evidence of a major environmental component in determination of the grilse-large salmon ratio in Atlantic Salmon (Salmo salar), Aquaculture (in press).

Scarnecchia D.L. 1982, Age at sexual Maturity in Icelandic stocks of Atlantic salmon (Salmo salar) M.S. Institute of Freshwater Fisheries, Reykjavik.

Table 1. Total releases and returns to the Kollafjörður Experimental Fish Farm from 1963 to 1982, combining years with similar rearing practices and release techniques.

Year of release	Number of smolts released	Number of adult return	% return	Returns kg/1000 smolts	Type of smolts and release technique
1963-1967	36.350	1.578	4,3	113 kg	Two-year-smolts. Release ponds at hatchery
1968-1971	254.200	5.647	2,2	55 kg	Intensively reared one-year smolts. Release ponds at hatchery
1972-1975	146.300	14.035	9,5	250 kg	Large one and two-year-smolts. Release ponds at hatchery
1976-1977	77.500	2.507	3,2	100 kg	Cross-section of the hatchery production of one-year smolts. Release ponds at the hatchery
1978-1981	163.380	9.469	5,8	170 kg	Cross-section of the hatchery production of one-year smolts. Release ponds close to the sea
Total	677.730	33.236	5.0	133 kg	

Table 2. Maturation age of microtagged one-and two-year smolts of Kollafjörður stock returning to the Kollafjörður Experimental Fish Farm in the 1974 tagging experiment.

Stock	Type of smolts	Number released	Size of smolts (cm)	Return as grilse	Return as salmon	Grilse component %
Kolla-fjörður	One-year smolts, concrete raceways	1000	12.2	69	5	93%
		2000	14.9	129	2	98%
	Two-year smolts, concrete raceways	1100	12.7	132	16	89%
		1900	14.5	207	13	94%
	Two-year smolts, earthen ponds	1000	12.7	76	12	86%
		1000	13.5	70	2	97%
		4000	15.3	290	21	93%
		2000	17.4	221	7	97%

Table 3. Maturation age of microtagged one-and two-year smolts of varied origin returning to the Kollafjörður Experimental Fish Farm in the 1978-79 tagging experiments.

Stock	Age of smolts	Size of smolts (cm)	Return as grilse	Return as salmon	Grilse component %
Kollafjörður stock reared at Kollafjörður	One-year	< 13.5	986	324	75%
		13.5 <	187	46	80%
	Two-year	< 13.5	58	5	92%
		13.5 <	216	12	95%
North-coast stock reared at Laxamýri 1)	One-year	12.8	19	27	41%
	Two-year	14.6	17	1	94%
North-coast stock reared at Kollafjörður	One-year	14.3	13	8	62%
	Two-year	13.4	18	8	69%
South-coast stock reared at Kollafjörður	One-year	12.8	33	53	38%
	Two-year	16.6	76	14	84%

1) Hatchery in Northeastern Iceland.

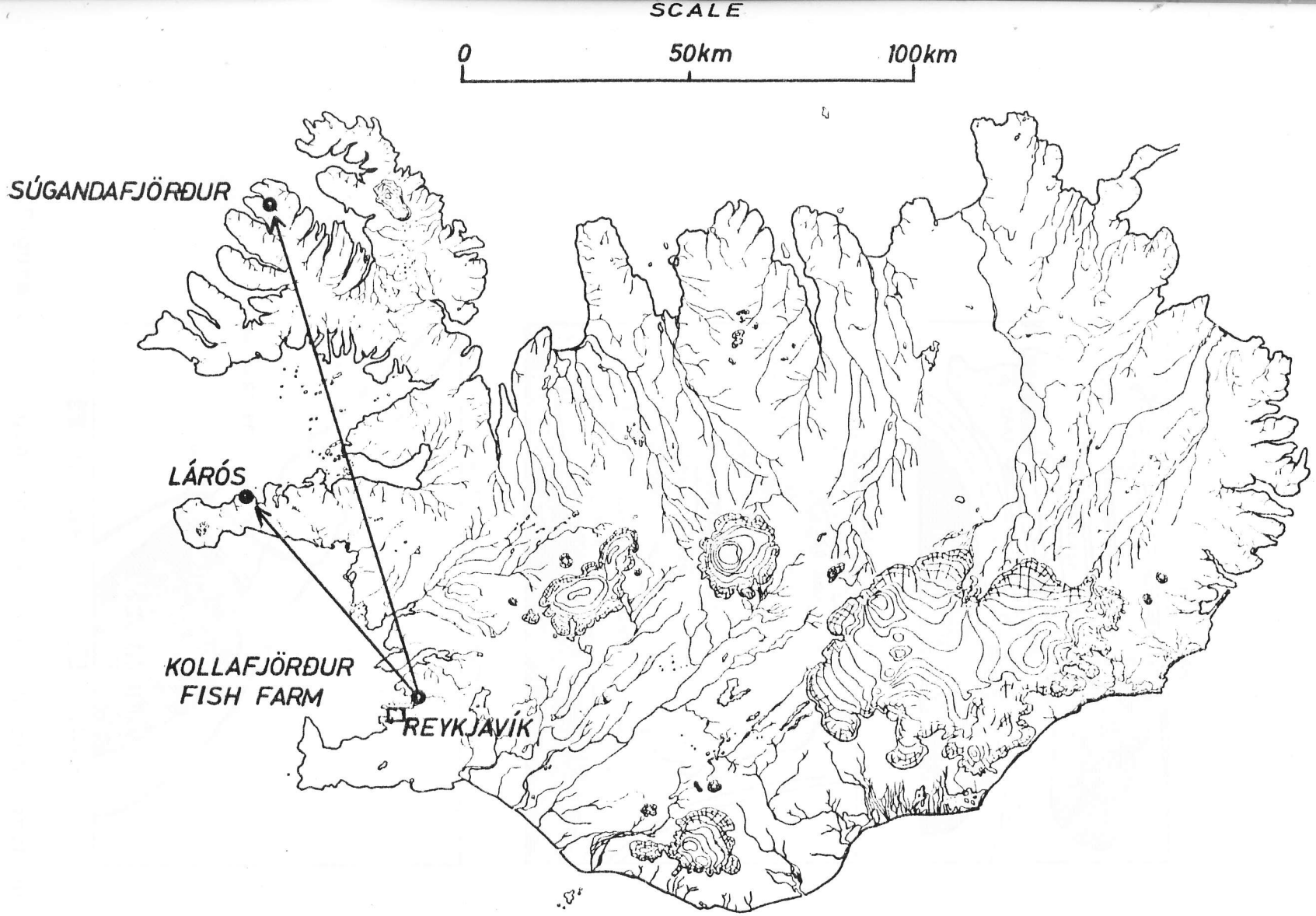

Figure 1. Location of the Kollafjörður Experimental Fish Farm and the salmon ranching sites at Lárós and Súgandafjörður. Arrows indicate the transport of smolts of Kollafjörður stock to the release sites where they were adapted and fed for a month before release.

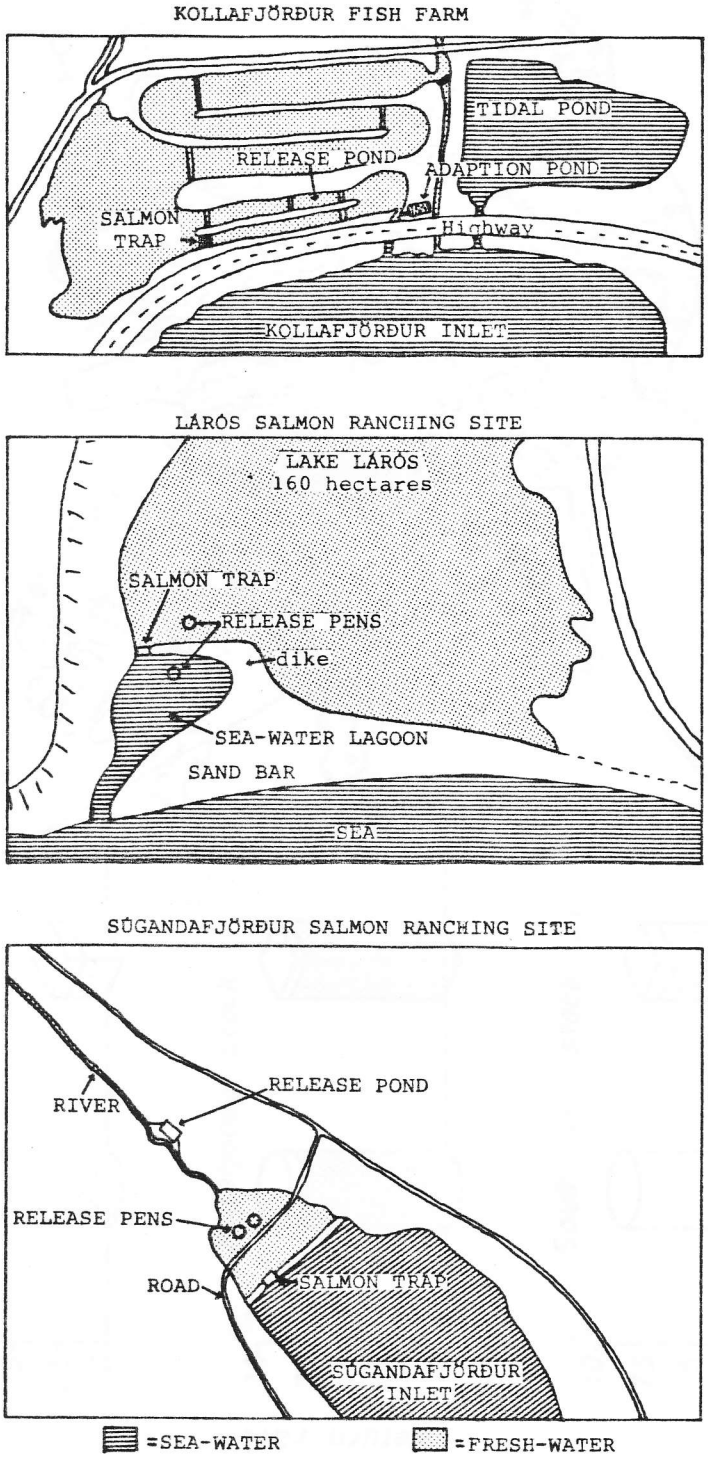

Figure 2. Diagram of the three salmon ranching sites discussed in the paper, showing location of release and recapture facilities.

Figure 3. Percent returns to the Kollafjörður Fish Farm of different stocks reared at the Fish Farm. The wild stocks return primarily after two years in the sea in their native river.

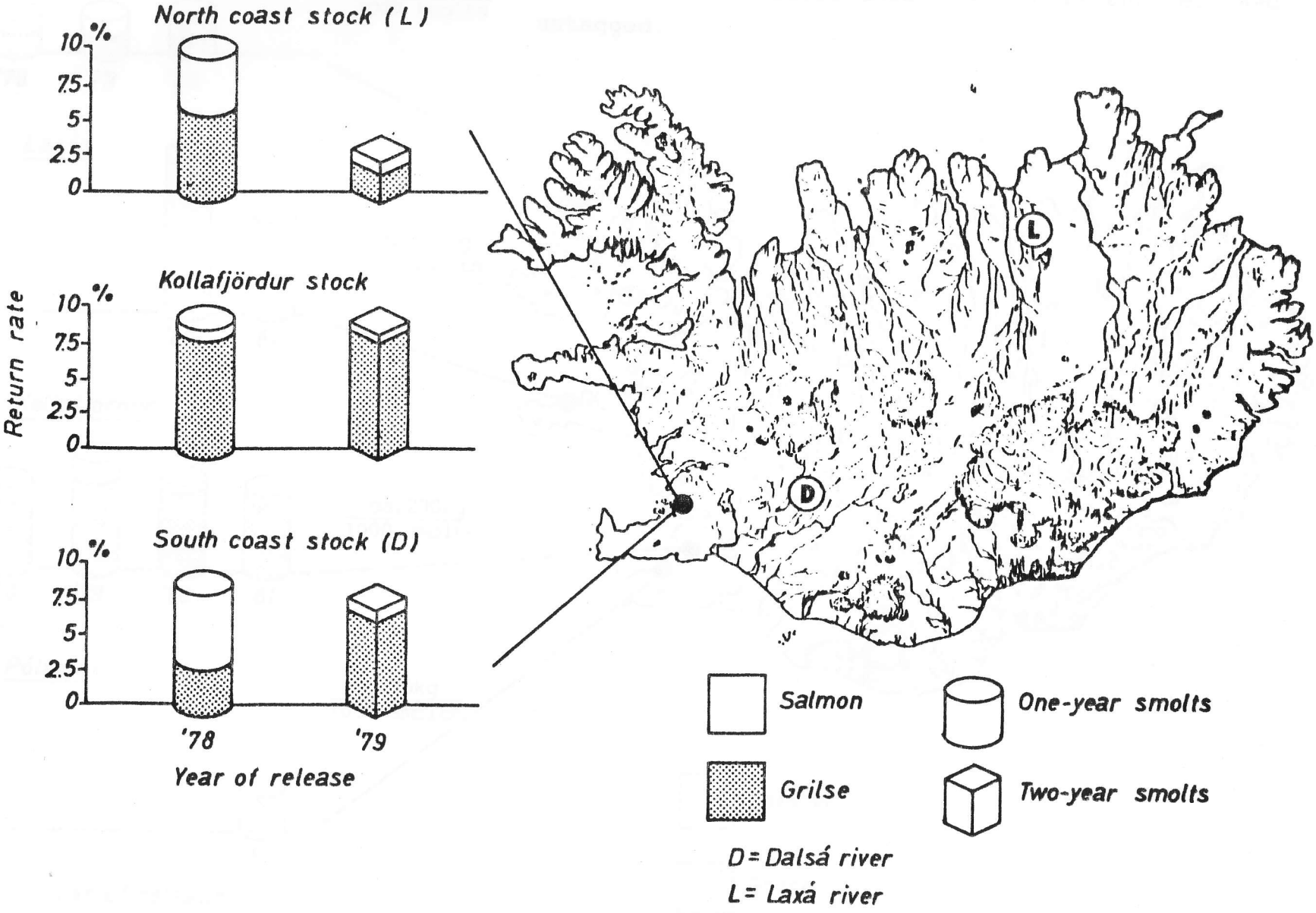

Figure 4. Percent returns of microtagged adults to various salmon ranching sites in western Iceland in 1978-81 release experiments. All smolts released were of Kollafjörður stock and reared at that hatchery with the exception of Pólarlax which reared their own smolts and released them untagged.

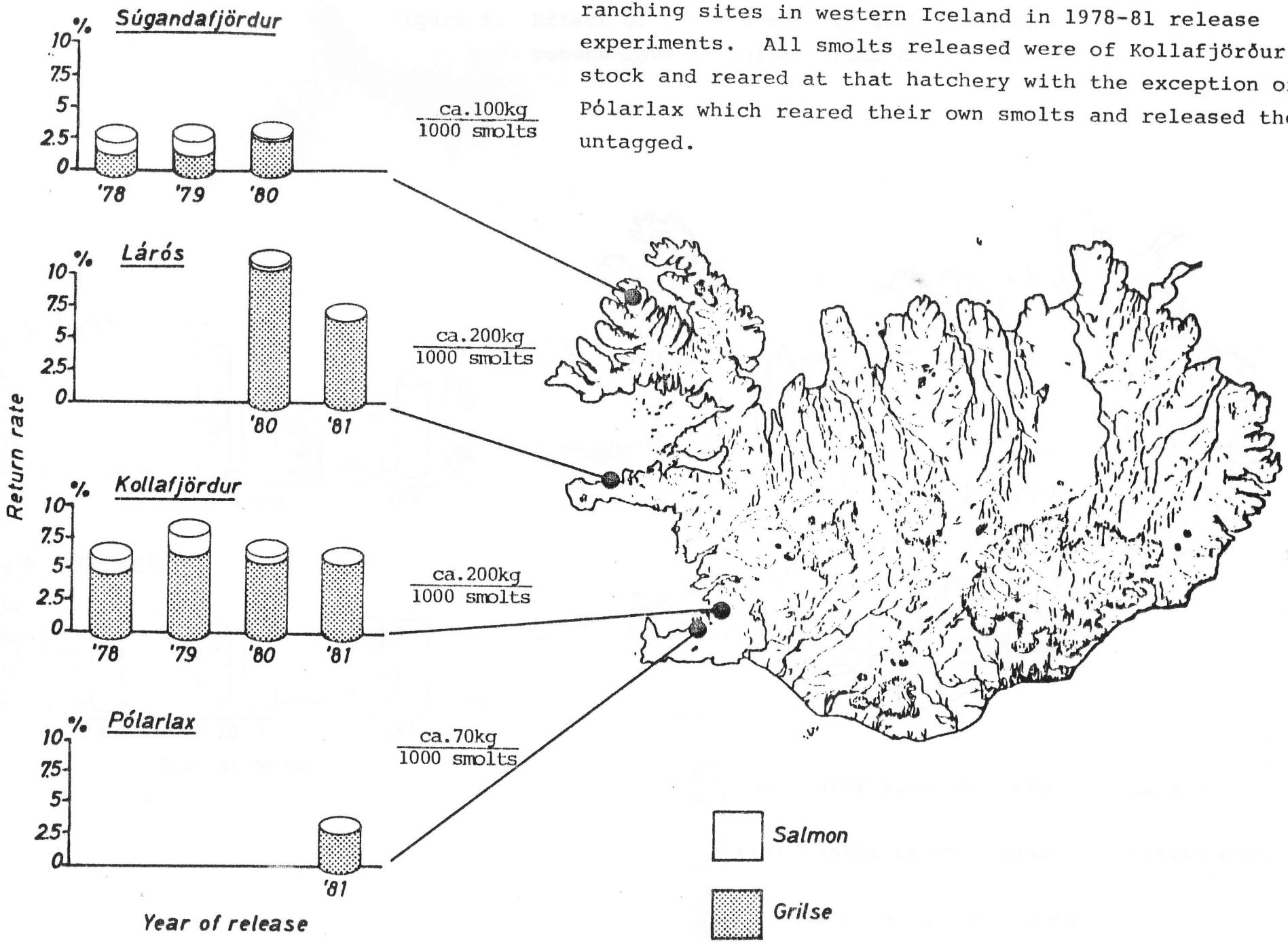

Figure 5. Effect of various release techniques on return-rate at Kollafjörður and Lárós.

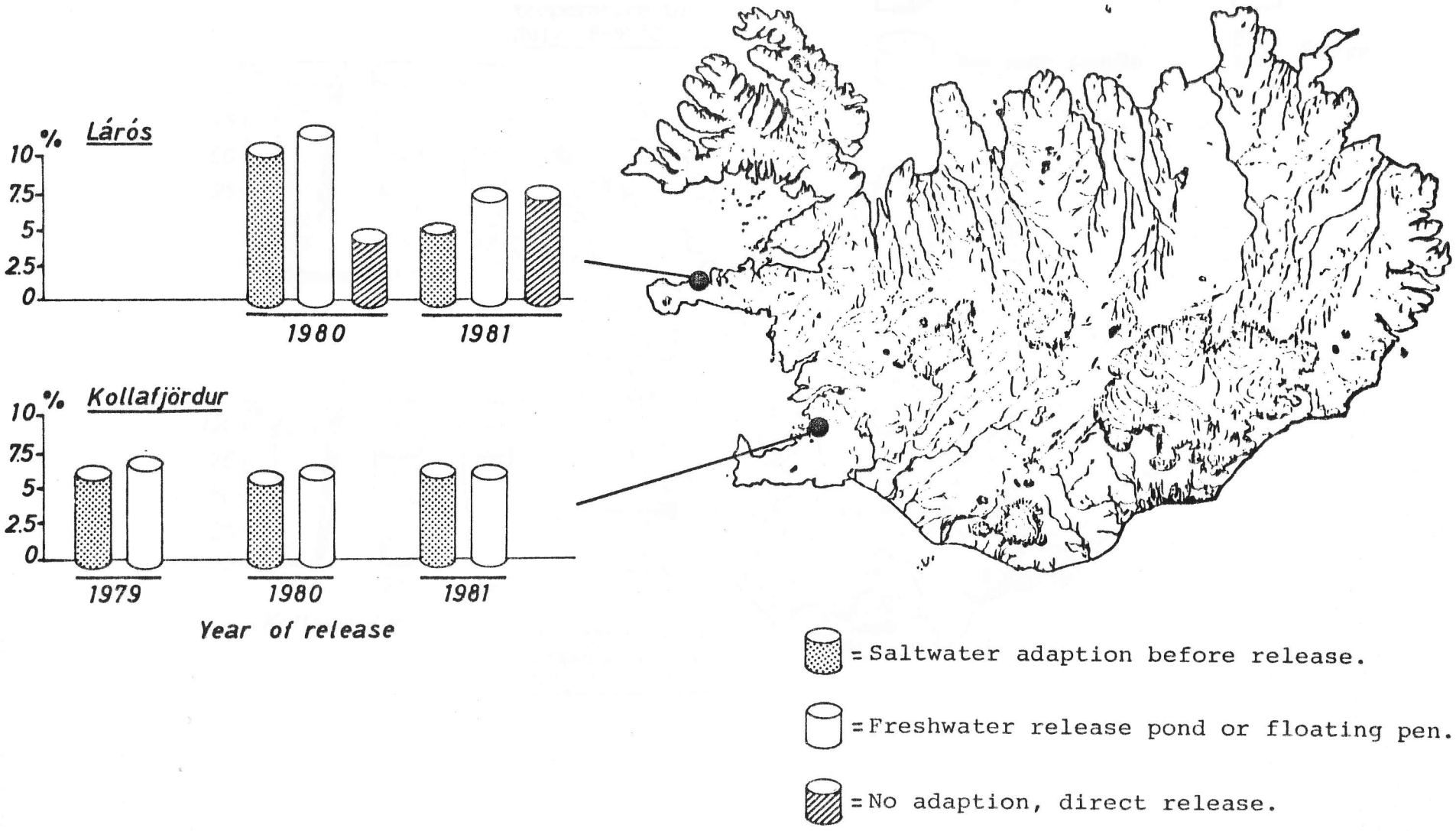

Figure 6. Grilse-salmon ratio of microtagged groups of salmon returning to Kollafjörður and Súgandafjörður salmon ranching facilities from comparable smolts released in 1978 and 1979.

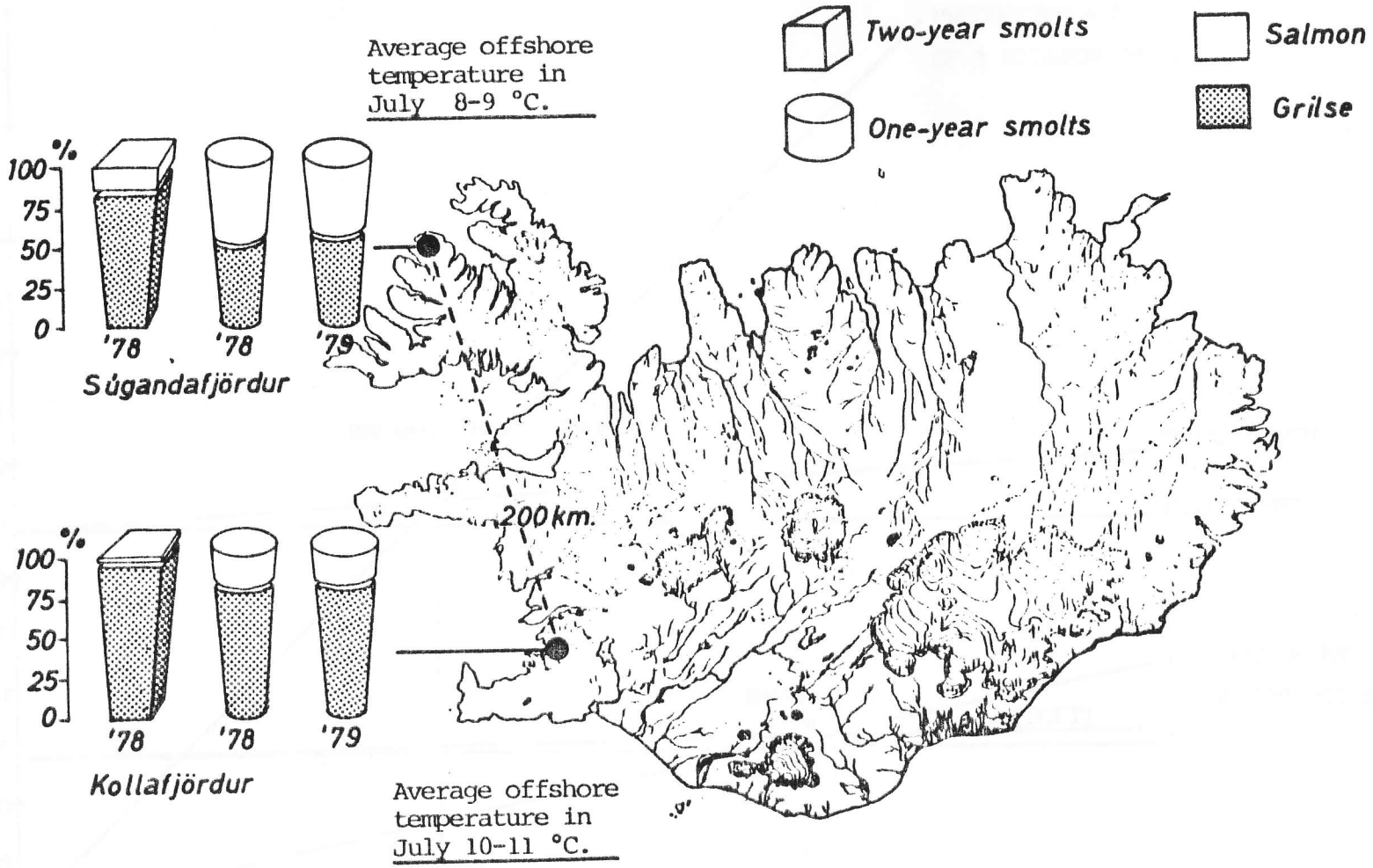

Figure 7. Economic viability of two fish farms engaged in salmon ranching, one producing and releasing 200.000 smolts, the other approximately 1 million smolts.