

Report on Iceland fishery management fact finding trip 25-28th June 2018

Brian Doran, Spey Fishery Board Chairman and Brian Shaw, SFB Biologist visited Iceland, primarily to learn about smolt stocking in Icelandic rivers but also to investigate fishery management in general. This paper reports on the visit.

25th June: arrive in Iceland, travelled to River Hotel on the banks of the West Ranga
The first evening was spent in the hotel socialising with Johannes Hinriksson, West Ranga Fishery Manager, anglers and guides.

Late June is early season in Iceland but 6 or 7 salmon were caught each day, mainly MSW but also grilse. The evening was an excellent introduction to Icelandic food, culture and attitudes.

26th June: visit West Ranga hatchery at Borgannes and meet Throstur Ellidason, Streingir Angling Service

Hatchery visit

The hatchery (station) was located 3 hours drive away on the west side of Iceland. The long distance between river and hatchery was explained by two reasons a) the hatchery was an existing facility that had been built as a commercial aquaculture operation and was available to acquire when the West Ranga company was established, b) the site has a supply of high quality, lava filtered, ambient water and large quantities of geothermal water.

The ambient water runs at a constant 3.8^oC, however by using heat exchangers, complete control of temperatures during the incubation and rearing stages is achieved. The hatchery is gravity fed and so reliable there is no alarm system, even though the hatchery manager lives 30 minutes away.

The facility is housed within a steel frame building of approximately 60m by 20m. Within the building are welfare facilities, hatchery and two rearing compartments. First feeding and initial rearing is in 54 x 2m [squiracle](#) shaped tanks. Once feeding and growth is established grading starts and the fish are gradually moved into the larger, 6m and 9m, circular tanks located in the far end of the building. In addition, there are 2 x 12m circular tanks outside.

The hatchery produces 500,000 smolts for the West Ranga with some fish grown for other rivers.

The fish at the time of the visit the fry were several grams in weight with the first grade underway. The fish are graded using an automatic grader capable of splitting the fish four ways. The fish are graded up to four times over the course of the year, this helps to maintain even growth and ultimately, a higher proportion of smolts.



Figure 1: Vaki fish grader suspended by forklift. Fish handling is by pump and following passage through the grader the fish are piped into tanks according to size.

The target weight for the parr is 10g by the end of September, that being the size threshold required in order for the fish to smolt the following spring. The target average weight of the smolts produced is around 70g.



Figure 2: Some of the squirrel tanks where the first feeding and initial growth occurs.

The large outdoor tanks can hold up to 240,000 presmolt parr. The water temperature in these tanks can also be controlled. Control of lighting is an important aspect of the hatchery operation. All fish are subject to an artificial winter during which period light levels are manipulated to mimic winter conditions.



Figure 3: 6m round tanks inside the hatchery. At the time of the visit each of these tanks contained 150,000 graded fry. The fish are fed automatically at all stages, 24 hours per day. In the larger tanks fan feeders were used to spread the feed.



Figure 4: 12m external tanks, each of which can hold 240,000 presmolts.

The fish were the best quality (physically) that we had ever seen in a hatchery, with not a sign of mortality nor a hint of fin rot in any of the tanks, apart from in tanks where stock from another river were being held back to spread smoltification over a two year period. Internal light levels were low, so much so that it took time for your eyes to acclimatise when coming inside. The fish in the tanks appeared remarkably calm, and the flight response was unusually weak. The fish in all the tanks were stratified and fed to saturation. 35tonnes of fish feed were used each year.

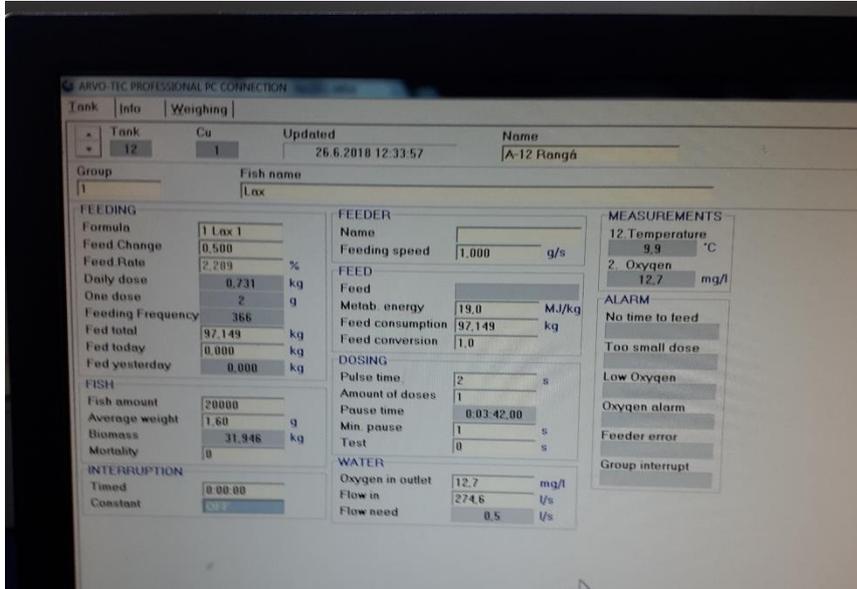


Figure 5: Snap shot of computer programme controlling feeding on one tank

Jon, the hatchery manager was very impressive, clearly committed to his job and always looking for improvements. For example an oxygen injection system was about to be installed. Jon ran the hatchery on his own, with help from his school age son during the holidays. Quality was the aim, and evidently achieved. Jon explained that increased flow speeds in the tanks as the fish grew was very important for producing strong fish, although at the time of our visit flow speeds were low. In that regard, his thinking was very much in the mould of Peter Gray and his “fit athletes”.

During our visit to the Ranga we witnessed rod caught salmon being transferred to the hatchery. Approximately 300 rod caught fish are retained for broodstock with all broodfish killed and health screened after stripping. Presmolts are transferred back to the river release ponds by road, 40,000 per load. This process takes two weeks starting in late April, early May.

The key points about the hatchery are:

- Produces exceptionally high quality fish
- Water quality is consistently high and free geothermal heat is used to control growth rates
- Light levels are manipulated to control growth and smoltification
- 600,000 smolts averaging 70g are produced
- Production costs quoted as 100ISK per smolt (£0.72 at current exchange rates)

Throstur Ellidason, Strengir Angling Service

In the evening we met Throstur, Director of Strengir Angling Services. He initiated smolt stocking on the West Ranga, followed by the East Ranga, but ultimately lost control of both fisheries. He is

currently involved in leasing and managing a variety of other Icelandic rivers, using smolt stocking on all his salmon rivers. He gave a presentation including extensive data on catches, smolt stocking, even densities of wild juveniles. Smolt stocking is deployed in a targeted way, even in productive wild fisheries. Smolt release ponds were considered an essential part of the process and there was agreement from all the fishery managers we spoke to that the smolts returned to the vicinity of the release point. For example in the Hrótafjarðará, Throstur released 10,000 smolts in the middle reaches to try to enhance catches in a part of the river where the fish normally passed through. The catch data he presented showed that catches improved near the release pond; this was considered to be without detriment to the wild stock. Both Throstur, and Jon, the hatchery manager mentioned “DNA” studies in Iceland, which, according to them, demonstrated no impact on wild fish genetics.

Throstur had secured control of the [Jokla River](#), a recently hydro-ed north east river. This had reduced the flow substantially but had removed the previous huge glacial silt load, and for the first time provided an opportunity for the development of a significant salmon fishery in that river.

Throstur explained that he regarded smolt stocking, in part at least, as mitigation. Cold sea temperature conditions of the east of Iceland, as well as low productivity in freshwater were cited as specific issues justifying smolt stocking but it was also clear that this technique was used to enhance the rod catch

27th June: Tour of West Ranga by fishery manager and visit to East Ranga

Prior to the fishery tour we met Gunnar (*surname unknown*), who was the Chairman of the board of farmers who owned the river. During discussion, it became clear that there were similarities between management structures in Iceland and Scotland. Salmon rivers in Iceland were required to establish a board, usually comprising the owners. The rent paid to the farmers was in relation to the catches in the particular stretch of river that they owned. The farmers owned the fishing, the hatchery and had built the hotel; all of which were leased to the West Ranga Company, which was owned by a Norwegian. The lease was for a five-year period. Maintaining good relations with the farmers was an extremely important aspect for the leaseholders.

Johannes Hinriksson is the fishery manager and he was our guide on the tour of the West Ranga, and a quick visit to the East Ranga. Johannes was very welcoming, as were all the Icelanders we met, and very open when answering any questions.

The [West Ranga](#) is a spring fed river, with a large and stable flow, equivalent in volume to spring flows in the Spey (60 m³/sec). It is cold, 7.2°C on the day of the visit and rarely above 13°C. The substrate consists of lava sand and pebbles along with bedrock. Consequently there is very little successful natural spawning. The rivers potential as a salmon fishery was identified in the 1980s with that potential realised and developed by various individuals and organisations using smolt stocking. Smolt release is via riverside smolt release ponds. Most of the ponds we saw were located on side channels of the main river, but the favoured sites included a tributary water supply. Pond location where tributary water can be utilised is considered to enhance homing.

The smolt release ponds were approximately 20 to 40m in length, about 8m wide and up to 2m deep. They were simple structures; an excavated hole in the ground with a substantial intake and screened outlet. Netting was used to avoid predation losses. Fish are stocked into the ponds at presmolt stage with the smoltification occurring within the pond. The ponds on the main river were

co-located with “heating pools” upstream. The heating pools were shallows, exposed to the elements, where water temperatures would rise on warm days to promote smoltification. The fish were fed in the ponds, by hand. After a settling in period, when pond outlets were screened, a volitional release policy was implemented with the outlet screen opened and the smolts free to migrate when they were ready.

We observed that some of the ponds contained substantial numbers of smolts, even though they had been open to downstream migration for an extended period. This was in contrast to our prior understanding that when the smolts were ready there was a mass migration. Rather, it appears that the smolts self-release, potentially over an extended period, although perhaps the cold spring and early summer weather of 2018 was a factor. There were 11 smolt release ponds on the river, at least one of which was located within sight of the sea. Stocking levels were 40-80,000 presmolts per pond.



Figure 6: Smolt release pond in the lower river (Holsa) with the sea in the background. A feed bin is located on the right bank.

The West Ranga is the most productive fishery in Iceland with the rod catch averaging 7,095 over the last 12 years. Over that period the catch has varied from just over 3,000 to over 14,000 in 2008. The river itself is not particularly attractive, with the exception of the lower falls, but even the extremely featureless lower beat has produced up to 1,200 fish.

The main fishery supports 12 rods with an additional four rods in the lower beat, which is located on the west bank of the Holsa. The season runs from 20th June to mid October, one of the longest seasons in Iceland due to the artificial nature of the run. It is clearly popular, even in early season the hotel was virtually full. Most of the fishers were European.

At the time of our visit the fishing was concentrated in one or two productive stretches. Fishing hours, in the early season, are in two sessions; from 7am to 1pm, then 4pm to 10pm. Through selective use of multi sea winter broodfish they are endeavouring to increase the average weight of the run. There seems to be some evidence this is working although the bulk of the catch consists of grilse.



Figure 7: A German angler playing a 6kg fish in the Holsa River below the junction of the East & West Ranga.



Figure 8: A photo for the album before the fish is placed in a hatchery holding box. Fish can be stored in these boxes for up to a week.



Figure 9: Inspecting the fish destined for the hatchery. The tank contained 11 fish at the time. Johannes Hinriksson is on the left.



Figure 10: The classic Ranga view showing the lower river falls

Clearly, this style of fishery management works in the West Ranga, and in the East Ranga. The East Ranga is a different type of river. It is partially glacier fed, and levels fluctuate in response to rain. Consequently, it can be coloured and unfishable at times. It is a more classic salmon river type with

typical run/ riffle/pool sequences. The East Ranga is also reliant on smolt stocking, although from another hatchery.



Figure 11: Smolt release pond on the East Ranga. The screens on this pond were still closed and the smolts were being fed from the automatic feeder suspended above the netting,

It was clear soon after arrival that there was a large population of piscivorous birds on the West Ranga, and in many of the other rivers we passed. Mergansers, goosanders and divers were in constant passage up or down the river. It turns out that these birds are protected in Iceland at that time of year although some unofficial control does occur. The guides explained the apparent anomaly between the high density of sawbills and the absence of natural juvenile fish in the West Ranga. The birds preyed on the stocked smolts, some of which were thought to remain in the river until the following year. No parr, nor smolts, were observed rising in the river, even during calm conditions.

The river also supports a large population of big brown trout; one captured that week was 8kg. These have always been present in the West Ranga but their size has increased since the smolt stocking commenced. These fish are highly valued and preserved for their sporting potential.

Seal management appeared to be less strictly controlled, one of the guides shot two in the estuary that day. They consider that the presence of seals, in what is a wide and shallow river mouth, deters adult fish from running the river. This aspect considered to be of greater importance than direct predation.



Figure 12: A predation hotspot? An early morning flock of 20 mergansers upstream of the cabin. A visit to the river later revealed that there was a smolt release pond just upstream of the side channel photographed.

The guides on the river were self-employed and earned high salaries. The fishery provides board and lodgings in a dedicated hostel whilst they are employed there. In high season one guide looked after two rods. The guides expressed surprise that we were not stocking with smolts, as far as they were concerned this was the answer.

The differing attitudes to management between Scottish and Icelandic authorities was highlighted by the attitude to fish passage at waterfalls. The lower waterfall in the West Ranga is effectively impassable to salmon but a fish pass has been built to allow fish passage. This is common practice in Iceland, subject to the agreement of all owners. Waterfalls are frequent in Iceland, a consequence of the lava flows which often form horizontal rock profiles.



Figure 13: Slotted step/pool fish pass in the lower West Ranga falls. A Vaki fish counter is located between the two uprights and the top pool exit but is ineffective due to turbulence.

June 28th: visit to Fiskistofa to meet Gudni Magnus Eiriksson.

It was a commonly held view by fishery managers, guides and the hatchery manager, that stocking with smolts was not detrimental to the wild stock in any way. Indeed, two persons mentioned that Icelandic genetic studies had proven this point. In order to investigate this further a visit was made to Fiskistofa, the government agency responsible for fisheries management in Iceland. There we met the Director of Salmonid Fisheries Management, Gudni Magnus Eiriksson. Gudni was a fish geneticist, although his PhD was on charr rather than salmon. When questioned he stated that he was aware of concerns about the impact of stocking on wild stocks but this was not considered to be a threat in Iceland.

Gudni reported that Iceland had withdrawn from NASCO after the 2008 crash, leaving him, by his own admission, a little isolated from current thinking on salmon management. He had however, just returned from a conference in Norway where stocking had been in the programme. There he heard Kyle Young talk about the risks from hatchery fish. Gudni also quoted recent Norwegian research that had investigated the genetics of stocking. However, he was not aware of the Icelandic studies quoted by others. He promised to investigate with his research colleagues and to forward his findings.

During discussion, it became clear that fishery managers in Iceland are required to submit an application prior to activities such as hatchery operation or stocking. The application needed the support of a plan, which was then scrutinised by government fishery biologists before approval.

There were limited resources for auditing of such programmes. It appeared that the key points, as far as the regulators were concerned, were that the broodstock were native to the river (a legal requirement since 1997) and that multiple males were crossed with each female.

Subsequent to returning home communication with Gudni Gudbergusson (via Throstur Ellidison) was established. Gudni is Head of Freshwater Division in the Marine and Freshwater Research Institute. He forwarded a report on a genetic study of salmon in Iceland. This study showed that the salmon population of Iceland was relatively immature, as would be expected in a recently deglaciated landmass but with two distinct geographical groupings. There was no suggestion in the genetic studies to support the claims, made by others during the trip, of evidence that smolt ranching had no impact on the genetics of wild fish. Gudni also stated that the smolt releases in rivers other than the Rangas, and one or two others, were “not in accordance with our advice”.

A translation of the Icelandic Fishery Act can be found by clicking this link [Icelandic Act 2006](#).

Summary

The trip to Iceland was very worthwhile & informative. The Icelandic people and our hosts in particular, were very open and more than willing to share their experiences. All the objectives of the trip were achieved and more. In addition, contact was established with Icelandic fishery regulators and scientists.

The West Ranga very different to the Spey in terms of character but there were a few other examples of rivers, more akin to the Spey, where smolt stocking was used for enhancement purposes. This technique is regarded as cost effective and without detriment to the native stocks, by anglers, fishery managers and the guides we met. Icelandic salmon catches are stable, perhaps increasing although there are good years and bad. The proportion of one sea winter fish is increasing in Iceland, decreasing in the UK (ICES, 2017). Marine survival is also higher in Iceland. Marine survival of hatchery smolts is lower than for wild smolts (1.43% c/w 7.88%) but in ranches rivers such as the Rangas this is sufficient to generate a viable salmon fishery where no commercial rod fishery existed before.

The West Ranga fishery is undoubtedly the ultimate expression of Atlantic salmon smolt ranching to the rod. No other Icelandic smolt ranching river operates on such a scale, nor, it would seem to such high standards. Smolt ranching has a long history in Iceland with government promoted commercial smolt stocking initiated in the 1970s. All these operations ultimately failed economically but ranching to the rod has proven to be more economically resilient. Angling on the West Ranga is expensive, around £1800 per day in high season although this includes accommodation and all services. Despite the success of smolt ranching to the rod in the West Ranga, the overwhelming majority of salmon rivers in Iceland rely on natural spawning. It would appear that there are less than ten rivers in Iceland using smolt stocking as a fishery management tool. Rod catches have increased across Iceland, even in natural fisheries, where C&R appears to have had beneficial impacts, although some considered that recaptures were inflating catches.

The trip dispelled some myths e.g. that predatory birds are cleared prior to smolt release and that the smolts migrate en masse when the ponds are opened. It is clear however, that attitudes to fishery management are different, in some respects, in Iceland compared to Scotland. How much of what we observed is applicable to the Spey needs further consideration.