IP(10)8

Aquaculture, Introductions and Transfers and Transgenics Focus Area Report

EU-Sweden

2009

Focus Area Report on Aquaculture, Introductions and Transfers, and Transgenics

Sweden

Håkan Carlstrand and Erland Lettevall
The Swedish Board of Fisheries

Contents

1. Collaboration between government authorities and other organisations

Wild salmon stocks in the river systems of the west of Sweden are monitored by a combination of national and regional authorities, of whom the most important are the Swedish Board of Fisheries (SBF), the Environmental Protection Agency (EPA) and the County Administrative Boards of Västra Götaland, Halland and Skåne. Key additional players include the National Veterinary Institute and the company Fiskhälsan AB, which has the contract for operating a national programme for the monitoring of the health of fish stocks, known as the Fish Health Control Programme. In addition, several local organisations and NGOs take an active part in the ongoing restoration and management of Swedish river systems. Among the NGOs, the Swedish Aquaculture Association (VRF), the Swedish Angling Association and the "fisheries management areas" (FMAs) play a significant role.

The central authorities involved in issues of salmon management have different functions. The National Veterinary Institute is a national authority which seeks to ensure good health both for animals and for humans in term of disease that can be transmitted between animals and humans. It has its own laboratories for diagnostics, animal protection, work on infectious diseases, health and environmental monitoring, and for providing data for use in decision-making at both national and local levels. The National Veterinary Institute is the national reference laboratory for fish diseases. Due to its role within the national monitoring programme for the parasite *Gyrodactylus salaris*, the institute has a major responsibility for the health of wild salmon. Through a long-standing cooperation agreement, the Swedish authorities are also assisted by the Norwegian Veterinary Institute with the species identification of *Gyrodactylus* as well as in reporting new outbreaks of the parasite.

The Swedish Board of Agriculture (SBA) has overall responsibility for inspection and control measures for fish farms, as well as for most aspects of regulation concerning aquaculture, including the marketing, importation and transportation of fish stocks. The authority is also responsible for all regulations regarding the management of diseases and disease transmission, including for example the procedures to be followed when harvesting fish for the market.

The Swedish Environmental Protection Agency (EPA), as the central government authority for the environment, has the overall responsibility for working towards the national environmental quality objectives. For instance the EPA has produced an extensive manual for the restoration of river habitats together with the SBF.

Fiskhälsan AB operates the Fish Health Control Programme and is therefore responsible for monitoring the health of farmed fish under the Board of Agriculture's regulations. The main objectives are to prevent the occurrence and spread of serious and contagious fish diseases between fish farms and wild

populations. The organisation is also involved in the sampling of the salmonid parasite *G. salaris* within the national monitoring programme.

The government's administrative responsibility for land and water management is primarily handled by the EPA and the SBF. However, aquaculture, fish transfers and stocking (including that of crustaceans and molluscs) are regulated by several different authorities. There is no specific national legislation for this, which make it quite complex regarding who is responsible for issuing the various permits.

The relevant national legislation affecting aquaculture, transfers and stocking is to be found in the Fisheries Act, the Animal Welfare Act and the Epizootics Act (all administered by the Ministry of Agriculture) and the Environmental Act (administered by the Ministry of the Environment). Together these acts cover all relevant areas such as minimising any adverse biological effects of introductions, ensuring basic health and sanitary conditions in fish farms, ensuring minimum environmental standards, regulating animal welfare, controlling notifiable diseases and protecting wild stocks.

The SBF, the SBA and the EPA are responsible for the regulation of aquaculture, including the introduction and transport of fish. However, most authorizations are actually taken at a county level by the County Administrative Boards, which are also partly responsible for monitoring the implementation of the regulations. In addition the County Administrative Boards send a notification about the granting of permits to other state authorities when relevant, as well to the local authorities at the municipal level. In cases that are of international interest, like the introduction or transfer of non-indigenous species or sub species, usually the national authorities carry out the authorizations.

The cross-sectorial collaboration in aquaculture also involves a formal external advisory group which conducts two annual meetings. The SBF has also a specific advisory group concerning the salmonid parasite *G. salaris*. This group meets once a year and has a major function regarding the protection and management of wild salmon and their habitats. For instance it conducts a national monitoring programme in respect of *G. salaris* which also reports on the general health and condition of Atlantic salmon (*Salmon salar*) and suggests related management measures.

2. Management of aquaculture, introductions and transfers

Stocking measures and aquaculture activities are under the strict control of the authorities in order to minimise possible impacts on wild stocks and the risks of spreading diseases. All stocking and aquaculture activities require a permit from the County Administrative Boards and new aquaculture establishments in salmon rivers are prohibited according to regulations issued by the SBF.

The principles regarding stocking are as follows:

- Permission is not granted for the release of fish species or sub-species which are not native to the area in question or which have not already been introduced, nor where the national interests of fishing, the environment or recreation could be damaged.
- It is normally prohibited to transport fish, their eggs or milt in an upstream direction past any artificial barriers in the rivers. Fish eggs may however be transported in this way if they are taken from marine stocks and if they have been quarantined and proved healthy. The same applies to Atlantic eels (*Anguilla anguilla)*.
- Re-stocking of salmon in a river or in the sea near to the mouth of a river is only allowed if the salmon originates from the river in question and if the re-stocking will not have any negative effects on the natural population.
- Permission for stocking with salmon is normally restricted to the ongoing national re-stocking programme, which is designed to compensate for the damage done to natural smolt production by the damming of rivers for hydro-electric power generation.
- Stocking with any species of salmonids is normally prohibited in river systems emptying into the Kattegat or Skagerrak if the parasite *Gyrodactylus salaris* does not already exist in the river system. Stocking may exceptionally be permitted in such rivers, but only upstream of the second barrier from the sea (many Swedish rivers have not just one but several hydro-electric power stations along their course) and provided that the fish is taken from a fish farm which participates in the national monitoring programme for *G. salaris* and which is free from infection.
    - Fish tanks and other equipment used for transporting fish must be disinfected in a way that prevents the spread of fish diseases or parasites. Changing the water while the fish are in transit is only permitted at facilities approved by the county authorities.
    - The principles specifically regarding aquaculture/fish farms are as follows:
    - No new hatcheries or fish farms may be established in freshwater watercourses containing salmon, or whose water is used for supplying existing salmon facilities.
    - Already established hatcheries or fish farms in such areas as above must be under strict control regarding fish disease and parasites. Every transportation of fish, eggs or milt to such facilities must first be authorised by the county authorities.
    - Before artificially reared salmonid fish can be used for stocking, the hatcheries must participate in a fish health monitoring programme designed for stocking purposes for a period of at least three years.
    - Transport of fish, eggs or milt into the hatcheries must be done in such a way that there is no risk of introducing diseases.
    - Health checks must be carried out annually on any egg-producing fish.
    - The introduction of fish or gametes is only allowed from registered hatcheries.

- If eggs originate from wild-caught fish, a risk assessment has to be conducted in relation to the vertical transmission of disease agents. If disease agents are known to occur in the water area from which the eggs are taken, samples must be taken of eggs from all individuals that will be used for breeding purpose. Until these samples have been analysed and cleared, eggs from each breeding individual must be stored separately. If an infectious disease is detected, all eggs from the fish in question must be destroyed.

Regarding stocking and aquaculture in river basins shared with Norway and emptying into the Skagerrak, permits are only granted after consultation with the Norwegian authorities.

The SBF has decided upon a strategy for the introduction and transfer of fish (Sparrevik 2001). The strategy gives guidelines for how to deal with questions concerning the release of hatchery-reared fish in the wild. The strategy stresses that habitat improvement to enhance natural regeneration of stocks should be prioritised over re-stocking from elsewhere. Before any release of hatchery-reared fish in the wild, a risk-benefit analysis should be done. The release of put-and-take fish should only be allowed in water areas where naturally reproducing populations of the species are absent or have no conservation value. Genetically modified fish (GM fish) are permitted for fish farming but not for release into the wild. Fish farm activity has to ensure that there is no escape of the genetically modified organism. However, the strategy has a restrictive attitude since the production of GM fish for consumption may result in ecological and genetic effects that are hard to predict.

3. Salmonid aquaculture on the Swedish west coast and in rivers emptying into the Kattegat and Skagerrak

There are no salmonid farms in the Kattegat or Skagerrak. However, there are some examples in the Baltic Sea, but no farming of Atlantic salmon.

There is only one riverine hatchery facility in the west of Sweden. This facility, known as “Laholms laxodling”, produces Atlantic salmon and sea trout (*Salmo trutta*) smolt in order to fulfil the needs of the continuous re-stocking programme which is designed to compensate for the damage done by hydroelectric power stations to the natural smolt production. This hatchery is situated on the river Lagan 20 km from the sea and downstream of the first hydro-electric power station and produces smolt for the rivers Lagan and Nissan.

At the first hydro-electric power station in the River Göta älv, about 50 km from the sea, a fish trap is used to catch returning salmon for restocking in the Göta älv. At the hydro-electric plant is also the salmon eggs held in quarantine before they are allowed to be moved to the hatchery “Långhults Lax AB”. This fish farm is

situated 150 km from the sea and upstream of several hydropower plants on the River Helge å, which empties into the southwestern Baltic Sea.

There are less than ten salmonid fish farms and hatcheries on the rivers of western Sweden:
In the River Göta älv, upstream of a hydro-electric power plant which lacks any fish passage allowing salmon to migrate, is a fish farm in Lake Vänern (within the Göta älv river basin) producing about 50 tonnes of rainbow trout (*Oncorhynchus mykiss*). Further upstream of Lake Vänern there are several fish farms. In total their production are roughly 200–300 tonnes of rainbow trout. In the tributary River Säveån emptying in the Göta älv and upstream of three hydro-electric plants without any fish passages for the salmon, there is another small fish farm (Antens fiskodling). The production is about five tonnes of rainbow trout and brown trout (*Salmo trutta fario*).

On the River Ätran, upstream of several hydro-electric power stations without any salmon passages, there is a small fish farm (Ekeberga kvarn). The production is mainly brown trout.

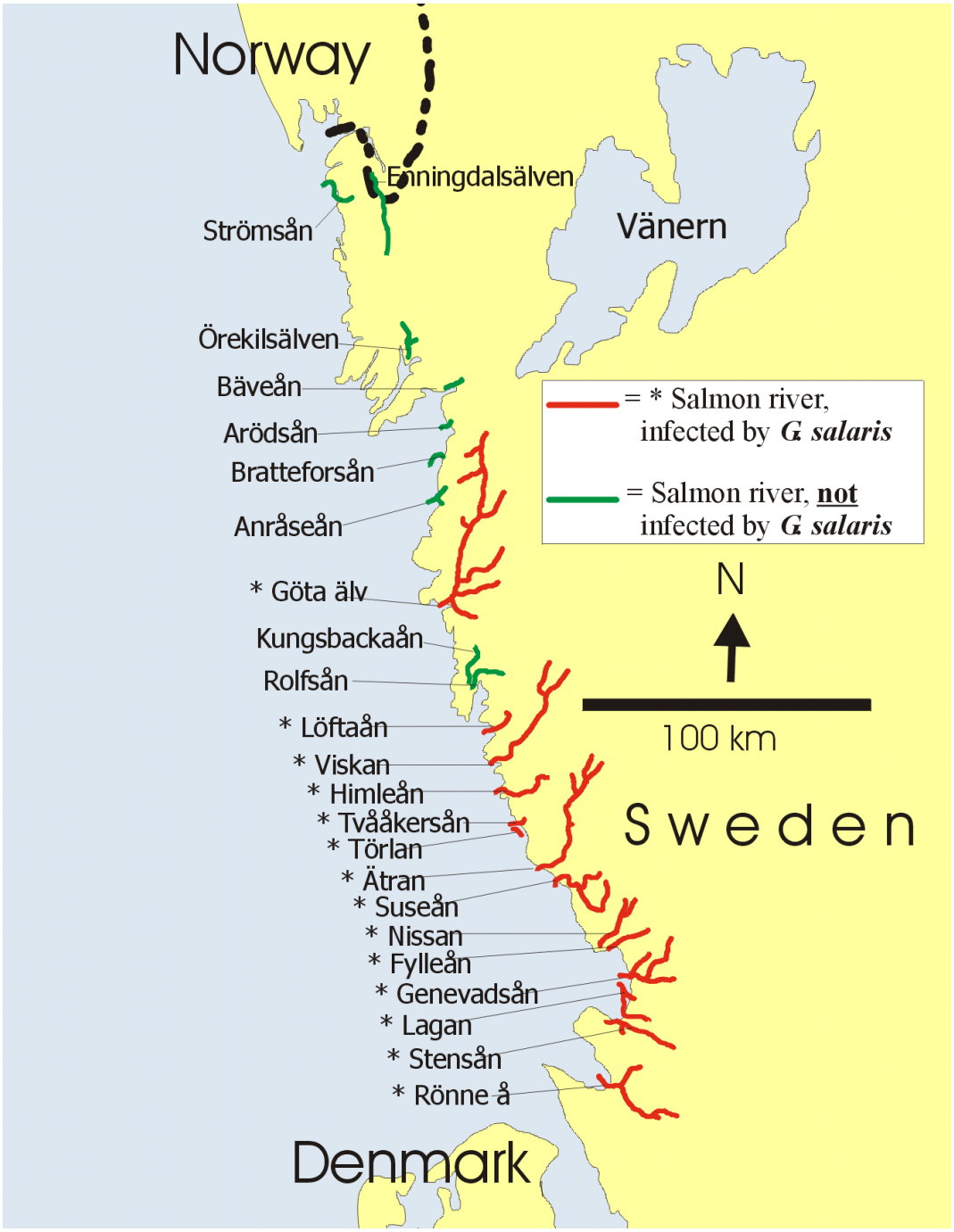
On the River Lagan, as well as "Laholms laxodling" already mentioned, there are two more smaller fish farms (Vänneåns fiskodling and Tiraholms fisk, in Lake Bolmen) upstream of several hydropower plants without fish passages allowing salmon migration. The production in these two fish farms are mainly rainbow trout and the total production is about 20 tonnes.

4. Salmon production in western Sweden

The status of Swedish rivers with Atlantic salmon populations has been described in detail by Degerman *et al.* (1999), in the Swedish national implementation plan 2007–2011 (Funegård 2008) and in revised Focus Area Reports (NASCO 2008; NASCO 2009). The rivers in question are shown in Figure 1. Specific measurements for each of the salmon rivers have been recommended; a compensatory national stocking programme has been developed and implementation has begun.

A basic requirement for local organisations to receive government funding for habitat protection and restoration in a river is that the estimated production potential should be at least 1000 wild salmon smolts per year. The biological diversity and production potentials of many smaller rivers are being restored in conjunction with ongoing long term liming programmes (Appelberg et al, 1989; Degerman & Schibli 1998). Voluntary work and funding from various non-governmental bodies are also important in the process of habitat restoration, fish passage construction and the buying out of hydropower plants and dams.

Figure 1. The map presents the distribution of Atlantic salmon in rivers of western Sweden. Red marks show river or river sections where *Gyrodactylus salaris* infections had been observed as of 2009.



A significant part of the rivers of western Sweden are utilized for hydro-electric power. These rivers are also seriously affected by acidification but the pH-level in most of them has been kept at an acceptable level by means of various liming programmes. In addition the water quality is affected by industrial discharges, and

some rivers have been seriously degraded by altering the water regime for favouring agricultural purposes.

The parasite *Gyrodactylus salaris* has been introduced into most of the salmon rivers of western Sweden (Figure 1).

Some problems have been created for juvenile salmon by deforestation and the over-enthusiastic cleaning up of old ditches and watercourses. This has particularly affected the smallest rivers during dry periods.

There are 23 rivers producing wild Atlantic salmon in western Sweden (Table 1). The total production in 1999 was about 200,000 smolt and the maximum potential has been assessed to be about 300,000 smolt annually. The current production (2009) is however less than 200,000 smolt (see below, under Habitat restoration).

Many of the rivers are small and only 12 rivers have a potential annual production of more than 5,000 smolt. Some of these rivers are especially interesting in relation to the increased development of tourism based on various fishing activities.

In three of the rivers, the Lagan, the Nissan and the Göta älv, there is an ongoing compensatory stocking program to compensate for the damage caused by hydro-electric power stations to the previous natural smolt production. An average total of 150,000 salmon smolt are released each year. Of these on average 90,000 smolt are released into the Lagan, 30,000 into the Nissan and 30,000 into the Göta älv. The smolt are supplied by two hatcheries facilities: “Laholms laxodling”, situated downstream of the first hydro-electric power station on the River Lagan, supplies smolt for the Lagan and the Nissan, while “Långhults Lax AB”, situated upstream of several power stations on the River Helge (which empties into the southwestern Baltic), supplies smolt for the Göta älv. (See Table 1.)

Table 1. Present distribution of salmon in rivers draining to the Swedish west coast. Estimated natural smolt production 1999 and the amount of reared and released smolt during 2006–2008.

River in water area	Natural production 1999			Compensatory hatchery released smolt									Producer of reared smolt
				Year 2006			Year 2007			Year 2008			
	No. of smolt	Area ha	Smolt per 100 m^2	Total number	Adipose clip[3]	External tag	Total number	Adipose clip[3]	External tag	Total number	Adipose clip[3]	External tag	Fishfarm/river system
Enningdalsälven	300	1,70	1,80	0			0			0			
Strömsån	300	1,10	2,90	0			0			0			
Örekilsälven	21 200	23,00	9,20	0			0			0			
Bäveån	200	0,50	4,00	0			0			0			
Arödsån	500	1,00	5,30	0			0			0			
Bratteforsån	600	2,10	2,90	0			0			0			
Anråse å	300	2,20	1,40	0			0			0			
Göta älv	14 900	17,20	8,60	30 000	30 000	0	29 898	29 898	0	11 250	11 250	0	Långhults lax AB/Helge å
Kungsbackaån	5 100	4,40	11,60	0			0			0			
Rolfsån	3 000	3,10	9,70	0			0			0			
Löftaån	2 500	1,00	25,00	0			0			0			
Viskan	23 000	16,10	14,30	0			0			0			
Himleån	4 300	3,60	11,90	0			0			0			
Tvååkersån	1 400	1,20	11,70	0			0			0			
Törlan	100	0,90	1,10	0			0			0			
Ätran	37 600	54,90	6,90	0			0			0			
Suseån	9 600	9,50	10,10	0			0			0			
Nissan	8 100	10,90	7,40	34 055	34 055	1 000	37 051	37 051	1 000	30 239	30 239	1 000	Laholms laxodling/Lagan
Fylleån	9 500	17,80	5,30	0			0			0			
Genevadsån	17 600	13,90	12,70	0			0			0			
Lagan	5 000	8,80	5,70	109 300	109 300	2 000	128 312	128 312	2 000	111 427	111 427	2 000	Laholms laxodling/Lagan
Stensån	21 300	12,40	17,10	0			0			0			
Rönneå	20 000	27,00	7,40	0			0			0			
Total	206 400	234,00		173 355	173 355	3 000	195 261	195 261	3 000	150 000	152 916	3 000	

5. Catch proportion, natural and reared smolt

Hatchery-reared fish , released as smolt for the hydro-electric scheme compensation programmes, made up as much as 78% of total catches in 2008, which is a higher proportion than in previous years (Karlsson 2009; NASCO 2008).

The very high proportion (78%, Table 2) of hatchery-reared salmon in anglers' catches compared to the estimated proportion of smolt natural produced smolt (more than 60% natural smolt, Table 1) indicates crucial problems with the natural smolt production in the rivers.

Table 2. Catch of salmon in tonnes by category of origin during 2002–08.

Year	Wild tonnes	Hatchery-reared tonnes	Total tonnes
2002	11	17	28
2003	6	19	25
2004	7	13	19
2005	7	8	15
2006	6	8	14
2007	5	11	16
2008	4	14	18

6. *Gyrodactylus salaris* in salmon rivers emptying into the Kattegat and Skagerrak

Infestation of the ectoparasite (class Monogena) *Gyrodactylus salaris* was documented for the first time in 1989 on salmon in the west of Sweden at the hatchery “Laholms laxodling” on the River Lagan, as well as on wild-caught salmon in the River Säveån, a tributary to the Göta älv.

A monitoring programme was started in early 1990. An increase in infected rivers was noticed especially on the southern part of the Swedish west coast probably partly as a result of the expanding monitoring programme and also partly due to infection in new rivers.

In order to prevent the parasite spreading to new rivers, restrictions on fish farming, fish transports and stocking were introduced in two stages, in 1999 and 2003.

The last river to be newly infected was the Himleån in 2005. This infection and the impact on the salmon stock concerned has been followed up in a special project which started very soon after the parasite was first noticed in the river.

Currently all rivers emptying north of the Göta älv are free from the parasite whereas only two (the rivers Kungsbackaån and Rolfsån) south of the Göta älv are considered free.

The monitoring of the occurrence and levels of infestation of *G. salaris* continues. Field experiments comparing the growth and survival of infected and non-infected salmon parr have been carried out. The results demonstrate a significant negative effect on the growth rates and condition of the parr.

Sweden is cooperating with Norway in this area and is taking advantage of the existing knowledge base in Norway. The Norwegian Veterinary Institute is identifying species of *Gyrodactylus* in the Swedish monitoring programme and is also responsible for genetic studies of *G. salaris* using samples from the rivers in the monitoring programme.

Norway, Sweden and Finland are also cooperating in the north of Scandinavia, since *G. salaris* is also present in Baltic rivers. The project in question concerns an information campaign to prevent the accidental introduction, for example with fishing gear, from Baltic rivers to rivers draining into the North Atlantic region.

7. Sealice on salmon in the Kattegat and Skagerrak

There have not been any reports of unnatural infestations of sea lice (crustacean ectoparasite of the *Caligus* and *Lepeophtherius* species) on returning wild adult salmon, salmon smolt or sea trout in the Kattegat or Skagerrak. Nor are there any salmonid farms in the sea or river mouths of this area.

8. Adult migrating salmon of unknown origin

8.1. Straying salmon from delayed release of smolt in the Baltic Sea

Atlantic salmon, reared from two different Baltic strains, were released around the islands of Bornholm and Møn in the southern Baltic Sea between 1995 and 1999 (Pedersen 2007). A total 600,000 reared salmon were released from net pens using

the delayed release technique, keeping the salmon in net pens for about three months after they turned into smolt, and 208,000 were released directly from the hatchery located on the island Bornholm. Of these, 15,958 were tagged with Carlin tags. Additionally, 65,300 coded wire tagged salmon were released as delayed release salmon close to Bornholm in 2000.

Recaptures from the five years of Carlin tagged releases varied between 2.8% and 21.2% (average 13.1%). Nearly all recaptures were from within the Baltic Sea (average 98%), but a few were recaptured elsewhere, either in the North Sea (1%) or in fresh water systems (1%). Recaptures outside the Baltic Sea and in fresh water were higher for releases at Møn in the western part of the Baltic, than for releases at Bornholm. Straying rates from the releases into six rivers on the Swedish west coast were estimated using information from capture in traps, by anglers and in hatcheries. The proportion of straying salmon in rivers on the Swedish west coast was about 3.8% of the total salmon run, but with large variations between rivers. Releases from the Baltic were discontinued because of possible deleterious effect on local wild salmon populations. The delayed release of salmon at Bornholm and Møn ceased after 2000.

8.2. Straying salmon of unknown origin in western Sweden

Since 2005 all artificially reared Swedish salmon and sea trout have been required to have their adipose fin removed before they are released. The same regulation has been implemented in the Baltic and in the west of Sweden. The purpose is to make it possible to visually distinguish wild salmon from farmed salmon. A problem with this is that adipose fin clipping is only carried out in a few other countries. There is therefore a risk that straying farmed salmon migrating into Swedish rivers are wrongly classified as wild salmon. Every year salmon are caught in Swedish rivers which are indeed suspected of having escaped from salmon farms in other countries

During the autumn of 2008 an unusual number of such suspected escapees was reported from rivers draining into the Kattegat and Skagerrak. These salmon differed from the native stock in the river by morphological appearance and/or marks on their bodies normally associated with salmon farming. A genetic investigation was therefore carried out in order to compare suspected farmed salmon migrating into the rivers Lagan and Göta älv with adipose fin-clipped salmon of known hatchery origin from the same rivers (Dannewitz & Prestegaard 2009).

The study showed that a significant proportion of salmon with the adipose fin not removed did indeed differ genetically from the original stock in the rivers Lagan and Göta älv and that these salmon did not originate from known salmon stocks in the Baltic sea either. Both salmon with marks on the bodies normally incurred in salmon farming and salmon without such marks seemed to form a genetically homogeneous group which was nevertheless distinct from the native salmon and

indicated that they had an identical and extraneous origin. The migration of salmon of unknown origin into Swedish rivers brings new management problems both in relation to the wild stocks and to the ongoing compensatory stocking programme.

9. Overview of ongoing activities

9.1. Adoption of fish health legislation and development of a new strategy

For 2010 the SBF plans to develop a new strategy for the transfer and introduction of fish. Due to the new directive 2006/88/EC (on animal health requirements for aquaculture animals and products thereof) the current legislation FIFS 2001:3 (on farming, release, and transfer of fish), which was last amended in 2007, needs minor changes in order to be better integrated with the directive. However, in order to maintain existing levels of fish health in Sweden, the SBF would like to complement the legislation with a new strategy designed to encourage preventative health care measures by means of appropriate voluntarily agreed codes of practice. The goal is to develop a new strategy in collaboration with several authorities and organisations in the hope that it would be well received.

9.2. Aquaculture enquiry

In 2009 a commission of enquiry was tasked with producing a national strategy for aquaculture. The main issue was how to ensure the development of an ecologically and economically sustainable form of aquaculture in Sweden. The commission reported amongst other things on the species with the best potential for farming. The salmonid fish mentioned in the report were rainbow trout for farming in lakes with poor nutrient levels and Arctic char for cultivation in cold inland lakes with regulated water levels in northern Sweden. Atlantic salmon was not judged to be an important species in future Swedish aquaculture industry, due to the lack of suitable available sites for salmon farming.

9.3. Fish Health Health Monitoring Programme

The main objective of the Fish Health Monitoring Programme is to prevent the occurrence and the spread of serious and contagious fish diseases to fish farms and to wild fish populations.

Important parts of the voluntary fish health monitoring programme are:

- Breeding programme for good fish health.
- Participation in monitoring programme for virus infections and renibacteriosis or Bacterial Kidney Disease (BKD).

- Vaccination programme to prevent the diseases furunculosis and vibriosis.
- Extensive information, advice and training for our associated fish farming companies.
- Animal husbandry programme for improving animal welfare of fish during farming.
- Training for safe and restrictive use of medications, antibiotics and chemicals.
- Preventive efforts, advice and investigations for certain production diseases.

Since 1990, Fiskhälsan has overseen a voluntary monitoring programme aimed at the national control and eradication of BKD. The programme has resulted in a decrease in the number of new BKD cases and the disease is now unusual in Swedish fish farms. Originally this programme was voluntary but it has now become part of the mandatory fish health monitoring programme. This has allowed Sweden to require that imported farmed fish be BKD-free and has made it possible to protect both the Swedish aquaculture industry and wild populations from infection from other countries.

9.4. Gyrodactylus monitoring

The monitoring of occurrence and infestation of *Gyrodactylus salaris* continues. Field experiments comparing the growth and survival of infected and uninfected salmon parr have been carried out. The results indicate that *Gyrodactylus* has a significant effect on the growth and condition factor of salmon parr.

9.5. Fish passages

During 2008 a fish passage was established on the River Genevadsån (at Vessingeån) and in 2009 two passages were built on the River Rolfsån (at Apelnäs and Bosgården).

During the period 2006–2011 several more fish passages are planned for the Rivers Rolfsån and Göta älv (in its tributary the Säveån at Hedefors) and an old fish passage is being restored on the River Örekilsälven (at Torp).

During 2007 the last migration obstacle was eliminated from the River Himleån. The whole river, with its tributaries, is now accessible for salmon and sea-run brown trout.

During 2010 it is planned to dismantle a hydropower plant at Herting (in the town of Falkenberg) on the River Ätran. Salmon can already pass the plant using a fish ladder (Denil-type) built in 1945, but removal of the plant will further enhance the spawning run and also the smolt migration in this water system. The estimated cost is about €1.8 million.

Habitat restoration

During 2007, habitat restoration was carried out in the Göta älv river system, in the Säveån at Jonsered. This area should now produce about 300 additional salmon smolt annually.

Restoration work was undertaken in the River Himle during 2007–2008. Also in 2009 a previously straightened stretch of the River Himle had its natural meanders restored

In the River Enningdalsälven, habitat restoration of the strech Långevallsälven is planned for 2010.

Several other habitat restoration operations will be carried out, e.g. in tributaries to the River Viskan and the River Lagan.

Increased water flow from hydropower

Following a court ruling in 2008, the hydro-electric power plant at Lake Aspen (fed by the River Säveån) was required to increase the water flow downstream from 0.5 m^3 per second to 2.4 m^3 per second. It is estimated that this will allow the production of about 560 additional salmon smolt annually.

Elimination of private trap fishing

In the River Fylleån a private salmon trap had been operating. In 2008 the Halland County Administrative Board bought the fishing rights and the fishing has ceased. Private trap fisheries remain today only in the River Rolf.

Liming

Liming operations will be continued in all rivers.

Monitoring of parr

Monitoring of parr populations is undertaken annually in 22 of the rivers. Generally this is carried out by the County Boards. Data are compiled annually and evaluated at a national level.

Index river

In the index river the River Ätran, with its tributary the Högvadsån, work has continued to establish the catch efficiency of the smolt trap. The efficiency varies with water flow. Another year with a high spring flow is required for a final evaluation.

Also in this river, a programme of tagging of migrating wild salmon smolt has been carried out, as well as an extensive electrofishing programme. Previously,

ascending spawners were checked at two sites (at Herting and in the Högvadsån), but since the dam at Herting is scheduled for removal, monitoring of spawners will continue only in the Högvadsån.

The river habitat has not yet been classified according to Swedish habitat classification standards.

Activities to share and exchange information

Information exchange is predominately accomplished using open databases, guideline documents on the internet, seminars and workshops. In cooperation with the Swedish Angling Association, seminars are held on the status of the Atlantic salmon, open to the public and normally with invited speakers from other countries.

As stated previously much of the relevant data can be accessed by the public on the internet. Data can be downloaded for free and are frequently used by the County Boards, fisheries consultants and NGOs.

The fishing rights of the salmon rivers are generally privately owned. On most river stretches, the owners of the fishing rights have constituted fisheries management areas with elected boards of management. These are always contacted before any initiatives are undertaken in the rivers in question.

As a part of the EU Water Framework Directive citizens are encouraged to participate in Catchment Management Advice Groups. Such groups exist for all major river basins.

The restoration of the salmon rivers of the west of Sweden is demonstrated and encouraged by means of a range of seminars organised by the SBF. Habitat restoration seminars are offered twice each year. In 2007 a seminar with excursion took place to relate to the ongoing restoration in the river Rolfsån. In 2008 a similar meeting took places and was related to the ongoing restoration of the upper parts of the river Nissan. These seminars are attended by consultants, university staff and regional and local authority staff. In 2009 a seminar was arranged in the town of Falkenberg and the River Ätran was in focus.

References

Appelberg, M., Degerman, E., Johlander, A. & Karlsson, L. 1989. Liming increases the catches of Atlantic salmon on the west coast of Sweden. Nordic. J. Freshw. Res. 65:44–53.

Dannewitz, J., & Prestegaard, T. 2009.Genetisk analys av fenklipt och oklippt lax från Göta älv. (Genetically analyses of salmon with adipose fin removed and not removed in river Göta älv). PM Fiskeriverkets Söltvattenslaboratorium, Drottningholm. In Swedish.

Degerman, E., Almer, B., Höglind, K. 1999. Västkustens laxåar. (English summary). Fiskeriverket informerar, 1999:9.

Degerman, E. & Schibli, H. 1998. Restaurering av västkustens laxälvar genom kalkning och biologisk återställning (Restoration of salmon rivers through liming and habitat restoration.). Atlantlaxsymposium II, 15 maj 1998. Svenska kommittén för Atlantlaxens bevarande, 23 s. (In Swedish).

Fiskeriverket and Naturvårdsverket 2008. Ekologisk restaurering av vattendrag. (Ecological restoration of rivers). Naturvårdsverket & Fiskeriverket, Internet, 300 p. http://www.fiskeriverket.se/service/varorochtjanster/ekologiskrestaureringavvattendrag.4.6c4377b411c8913db65800035.html. (In Swedish).

Funegård, P. 2008 Swedish national implementation plan 2007–2001. Swedish Board of fisheries. 2008.

Karlsson, L. 2009. Salmon fisheries and status of salmon stocks in Sweden: National report for 2008. Working Group on North Atlantic Salmon 2009/33.

NASO 2008. Fisheries Management. Focus Area Report, European Union – Sweden. IP(08)25. North Atlantic Salmon Conservations Organization.

NASO 2009. Protection, Restoration, and Enhancement of Salmon Habitat. Focus Area Report, European Union – Sweden. IP(09)19. North Atlantic Salmon Conservations Organization.

Pedersen, S., Rasmussen, G., Nielsen, E.E., Karlsson, L. & Nyberg, P. 2007. Straying of Atlantic salmon, *Salmo salar*, from delayed and coastal releases in the Baltic Sea, with special focus on the Swedish west coast. Fisheries Management and Ecology 14:21–32.

Sers, B., Magnusson, K. & Degerman, E. 2006. Referensvärden från Svenskt Elfiskeregister. Information från Svenskt ElfiskeRegiSter, nr 2, 46 s. (Reference values from the Swedish Electrofishing RegiSter). In Swedish.

Sparrevik, E. 2001. Utsättning och spridning av fisk – Strategi och bakgrund (English summary). Fiskeriverket Informerar, 2001:8.