

SALMONID FISH PASSAGES IN THE RIVERS HELGE, MÖRRUM AND EMÅN IN THE SOUTH OF SWEDEN

December 2006



Katrin Hammarlund



Coalition Clean Baltic, CCB
Östra Ågatan 53, SE- 753 22 Uppsala, Sweden
Tel: +46 18 71 11 55/+46 18 71 11 70
fax: +46 18 71 11 75
E-mail: secretariat@ccb.se
gunnar.noren@ccb.se
Org. number: 802015-1281, www.ccb.se

INTRODUCTION

One of CCB's priority working areas is protection of the naturally spawning Baltic Salmon. The salmon live in the Baltic Sea but return to its home rivers to spawn. Their migration however, is obstructed in many rivers by hydropower dams. One solution to this problem is to build fish passages in or around the dams. But, it is difficult to construct a well functioning fish passage: of around 500 fish passages in the southern parts of Sweden between one third and one fourth of them do not work at all and half of them are functioning poorly (Hebrand, orally).

The most common passage is the fish ladder, which also is the cheapest option. The disadvantage with the ladder is that no other fish than salmon or Sea trout can pass it. Constructed channels that resemble natural meandering streams with rocky bottoms are another type of passage. One important advantage with this solution is that all kinds of aquatic organisms can use them for migration up/downstream, it is however more expensive than a fish ladder.

Despite what passage is used there are several aspects to consider in making it work properly. In the passage the water usually flows more slowly compared to the outflow from the floodgate. As the fish follows the water with the highest velocity it has difficulties in finding the passage. Another problem is that there has to be enough water in the passages for the fish to pass. Water has to be released from the dam into the passage, this however, means a cut in profit for the hydropower plant owner. In Sweden, Water act permissions for hydropower usually stipulate that 5 % of the annual water flow in the river has to be released to the fish passages. That amount of water is in general not enough for a successful fish migration.

During three days in May 2006, seven salmon experts within the CCB network were invited to participate in a study trip to rivers holding naturally spawning populations of the Baltic Salmon and Sea trout in the south of Sweden. Here follows a presentation of the dam sites visited showing good examples of fish ways that work satisfactory.

EMÅN – FINSJÖ LOWER



River Emån, Finsjö lower.

This fish way in Emån at Finsjö lower was built in 2000. The fish way is a parallel artificially constructed channel that resembles a naturally meandering river stretch. In comparison with a steep fish ladder this fish way's moderate slope (2 %) makes it easier for the fish to migrate both upstream and downstream. Another advantage compared with the fish ladder is that all kinds of occurring fish species (such as perch, pike, roach, etc.) and other freshwater organisms (such as bottom fauna, snails, molluscs, etc.) can use the channel for migration.

Information about the fish way

- **Type:** Artificial channel
- **Construction year:** 2000
- **Components in the system:**
Meandering channel built with clay moraine and nature stone.
- **Length:** 370 m
- **Height of fall:** 9,3 m
- **Cost of installation:**
EUR 170 000
- **Targeted fish species:** Salmon and Sea trout

EMÅN – FINSJÖ UPPER



Information about the fish way

- **Type:** Artificial channel
- **Construction year:** 2000
- **Components in the system:**
Meandering channel built with clay moraine and nature stone.
- **Length:** 370 m
- **Height of fall:** 9,3 m
- **Cost of installation:**
EUR 110 000
- **Targeted fish species:** Salmon and Sea trout
- **Function:** Annual upstream and downstream migration

The fish way in Emån at Finsjö upper is constructed in the same manner as the channel at Finsjö lower. A fish counter is installed in the upper part of the channel. When the fish passes the counters' two sensors, an image (silhouette) of it is created. The image is sent for analysis to a computer to which the counter is connected. From the data it is possible to tell the size, and sometimes the species of the fish as well as its velocity and direction.



Fish counter demonstrated by Peder Johansson. The electronic equipment consists of: A hard disk to show the information; a modem to which you connect and download the information. The counter is run by a battery, which is charged by a solar panel. The cost for the counter including additional construction work was approximately 35 000 EUR.



Automatic fish counter in the river Emån.

RIVER MÖRRUM – FISH LADDER AND FISH COUNTER AT MARIEBERG

The River Mörrum is of great importance for the stock of naturally spawning Baltic Salmon in the Baltic Sea and is a national index river for wild salmon, in accordance with the International Baltic Sea Fishery Commission's Salmon Action Plan.



River Mörrum, fish ladder at Marieberg.

This fish ladder is situated near the floodgates of the hydropower dam therefore the fish finds it easily. Salmon and Sea trout can migrate via the ladder, but no other organisms. By the fish ladder a fish counter has been installed in order to be able to control upstream and downstream migration of fish. Data from the fish counter shows that very few fish migrate downstream. To ease the downstream migration the flood gates are kept open six weeks during the peak migration period. The power company is compensated for the loss of revenue from the Swedish Environmental Protection Agency. A more long-term solution would be to construct a functioning fish passage for downstream migration.

Information about the fish counter

- **Type:** Fish counter
- **Installation year:** 2001
- **Components in the system:**
Fish counter installed at a fish ladder
- **Cost of installation:**
EUR 26 000

RIVER MÖRRUM – HEMSJÖ UPPER AND HEMSJÖ LOWER



River Mörrum, Hemsjö upper.

Information about the fish way

- **Type:** Artificial channel
- **Construction year:** 2003
- **Components in the system:** Meandering channel built with moraine and nature stone behind a steel tongue
- **Length:** 90 m + 1 950 m dry furrow
- **Height of fall:** 1,8 m + 13 m in dry furrow
- **Cost of installation:** EUR 320 000
- **Targeted fish species:** Salmon and Sea trout
- **Function:** Annual upstream and downstream migration

Fish that has been migrating upstream in Mörrum to spawn has for almost a century been stopped by the power stations at Hemsjö. Two fish ways were built to solve this problem: one at Hemsjö lower and one at Hemsjö upper. The fish ways are constructed as natural river stretches with moderate slopes and the river floor is covered with gravel, rocks and boulders. The cost for each fish way was 320 000 EUR. The difference between these fish ways and the fish ways at Finsjö lower and upper is that they are constructed by recreating new river beds into the existing dam.



River Emån, Hemsjö lower.

Information about the fish way

- **Type:** Artificial channel
- **Construction year:** 2003
- **Components in the system:** Meandering channel built with moraine and nature stone behind a steel tongue
- **Length:** 120 m + 1 200 m dry furrow
- **Height of fall:** 2,3 m + 9 m in dry furrow
- **Cost of installation:** EUR 320 000
- **Targeted fish species:** Salmon and Sea trout
- **Function:** Annual upstream and downstream migration

THE RIVER ALMA – SPÅNGA DAMSITE



River Alma, Spånga damsite. The opening of the constructed fish way is in the centre of the photo.

The fish usually have problems finding the fish passage if the water in it flows more slowly compared to the water that comes through the floodgates (see photo above). Too little water in the passage also poses a problem. In the River Alma a great solution has been found to these two problems. First, the channel is built near the outflow from the floodgates so it is easy for the fish to find. Second, the 5 % water released from the main stream is being used as efficiently as possible. At the top of the channel there is a pump that is regulating the gates to the channel and the water flow. During the time of migration for the salmon the water flow is increased from 200 litres per second to 500 litres per second. Every 14 days the flow is increased further to 1 500 litres per second. During the most intense migration the flow of 1 500 litres per second occurs every five days. The fish thus has to queue up in front of the dam site for some time before it is permitted upstream. The raised water flow in the fish way attracts them to migrate upstream.

The cost for this kind of solution is higher than the ordinary passages, approx EUR 210 000, and it requires a better control. What solution is the best then – both from an ecological and economic perspective? Mats Hebrand, leading expert in the field says: there are no fixed solutions, adjustments must be made for every water course and every season.

Information about the fish way

- **Type:** Artificial channel
- **Construction year:**
 - Channel: 1997
 - Fish counter: 1998
 - Regulating pump: 1998
- **Components in the system:**
 - Meandering channel built with gravel and nature stone; fish counter; a pump that is regulating the water flow in the channel
- **Length:** 160 m + 770 m natural furrow
- **Height of fall:** 2,2 m + 7 m in natural furrow
- **Cost of installation:**
 - Channel: EUR 75 000
 - Fish counter: EUR 23 000
 - Regulating pump: EUR 210 000
- **Targeted fish species:** Salmon and Sea trout
- **Function:** Annual upstream and downstream migration

THE RIVER ALMA – BRITTEDAL



River Alma, Brittedal fish way.

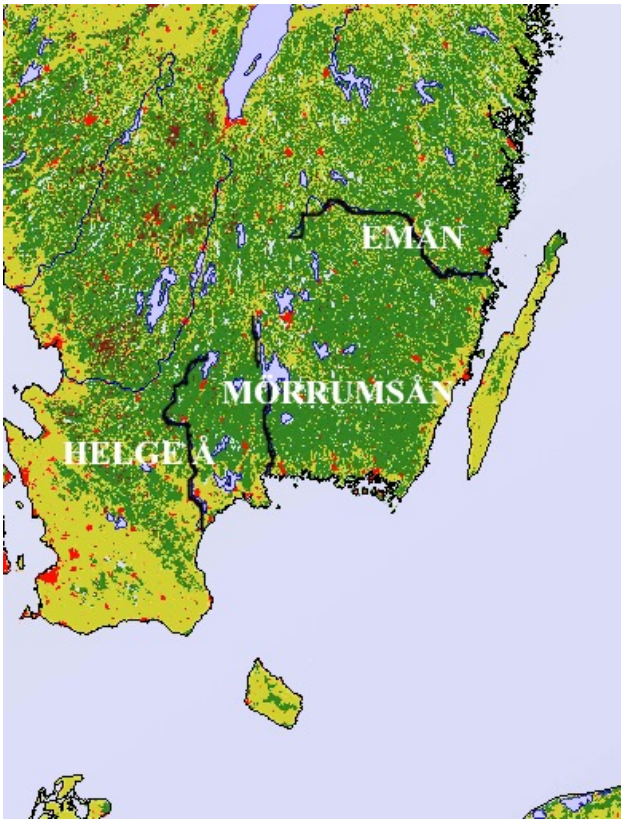
Information about the fish way

- **Type:** Artificial channel
- **Construction year:**
Channel: 1998
Fish counter: 1998
Regulating pump: 1998
- **Components in the system:**
Meandering channel built with gravel and nature stone; fish counter; a pump that is regulating the water flow in the channel
- **Length:** 220 m + 250 m natural furrow
- **Height of fall:** 4,7 m + 2 m in natural furrow
- **Cost of installation:**
Channel: EUR 37 000
Fish counter: EUR 23 000
Regulating pump: EUR 210 000
- **Targeted fish species:** Salmon and Sea trout
- **Function:** Annual upstream and downstream migration

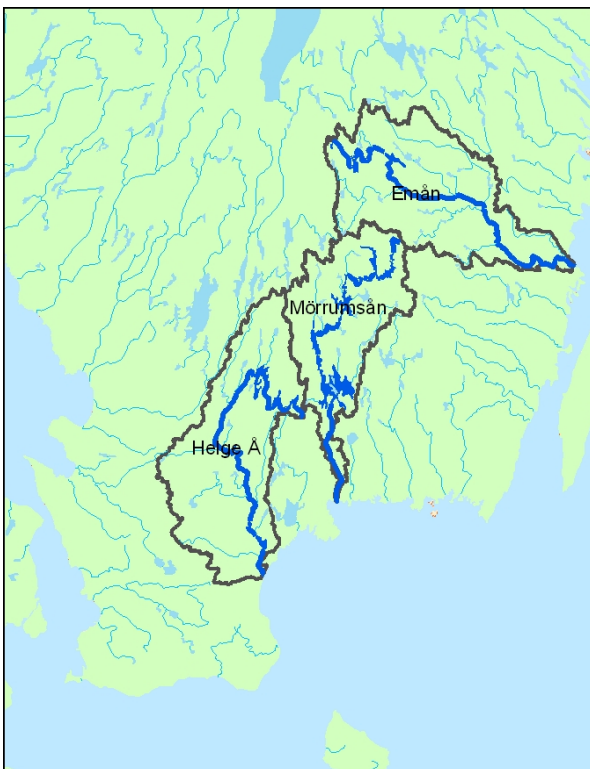
The fish way is constructed as the fish way at Spånga; see description above. It is a natural riverbed with a moderate slope and the river floor is covered with gravel, rocks and boulders.

Annex 1

Maps over the rivers Emån, Mörrumsån and Helge å



Physical map.



Map showing the drainage basins of the three rivers.
(Map: Niklas Holmgren)

Annex 2

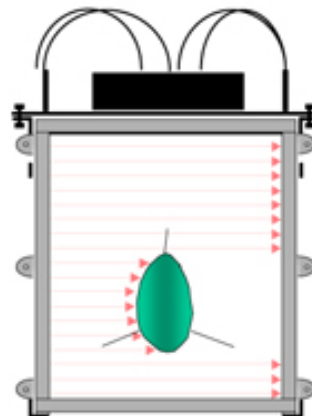
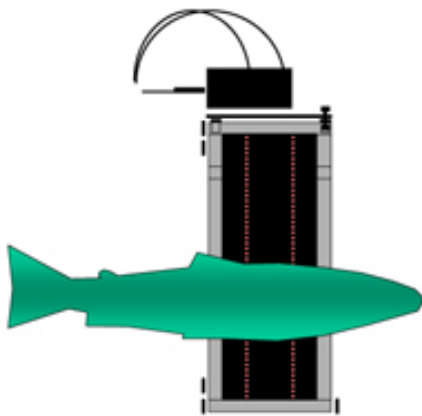
Fish counter



Automatic fish counter installed at Finsjö, Emån.



Close-up of an automatic fish counter.



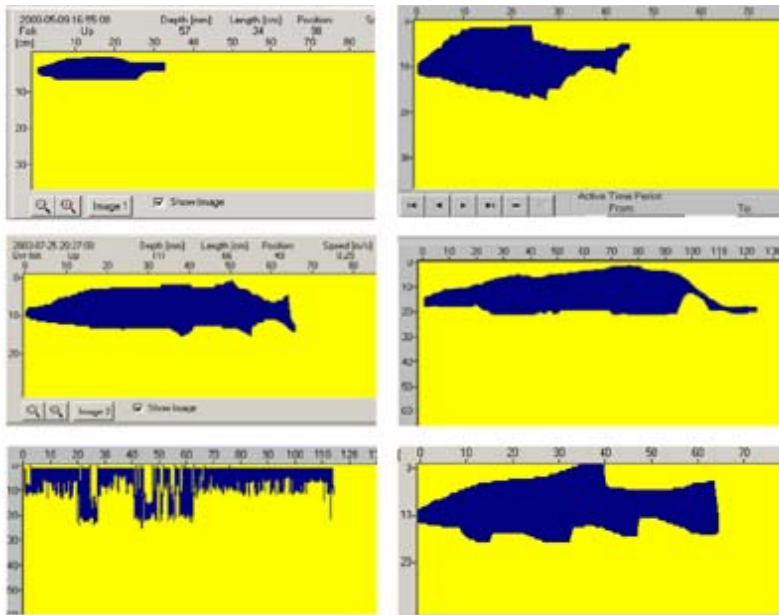
How the fish counter works

When the fish passes the two sensors an image of the fish is created. The high resolution of the picture makes it possible to tell different species apart.

What data can you extract from the fish counter?

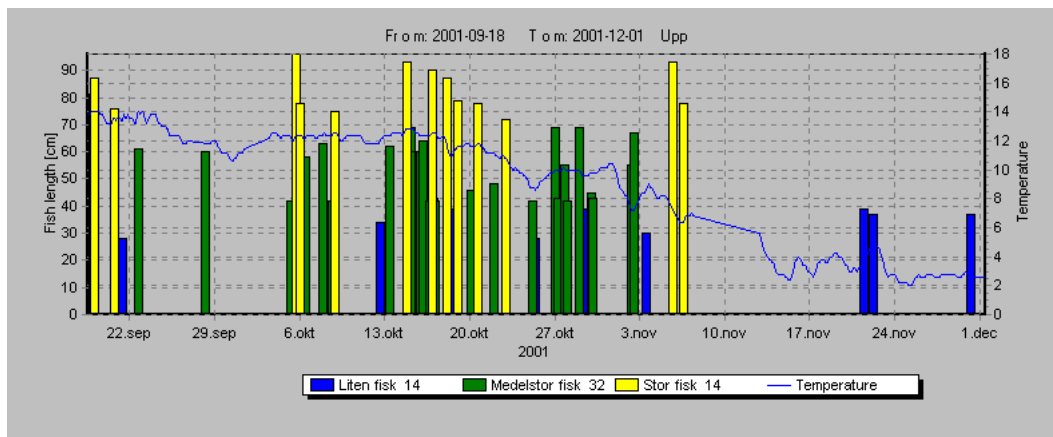
- image of the fish (tell species)
- size
- date, time and water temperature of individual fish passing
- direction of the fish (up/down)
- number of fish passing
- diagrams showing the information by day, week, month or year

Examples of information given by the fish counter



The picture to the left shows the images of different species as portrayed by the fish counter.

Upper row: Färna and Bream
 Middle row: Pike and Beaver
 Bottom row: Bubbles and Sutare



The picture above shows the number and size of fish over time as well as the water temperature, all in the same graph. The data is based on information from Holjeån, Gonarp, southern Sweden.

Annex 3

Information about the excursion

One of CCB's prioritised working areas is protection of the naturally spawning Baltic Salmon. During three days in May 2006, seven salmon experts within the CCB network were invited to participate in a study trip to rivers holding naturally spawning populations of the Baltic Salmon and Sea trout in the South of Sweden. The purpose of the trip was to see solutions that actually work.

Participants:

1. Nina Polutskaya, Belarus
2. Sergey Titov, Russia
3. Taavi Nuum, Estonia
4. Alvis Birkovs, Latvia
5. Elita Kalnina, Latvia
6. Maris Olte, Latvia
7. Antanas Kontautas, Lithuania
8. Gunnar Norén, CCB Secretariat
9. Katrin Hammarlund, CCB Secretariat