BFS Bürogemeinschaft für Fisch- & Gewässerökologische Studien Frankfurt – Marburg

Fische – Makrozoobenthos – Makrophyten – Gewässerökologie - FFH - EG - WRRL

Beratung – Konzeption – Planung

Restocking – Current and future practices

Summary: **Experience in Germany, success and failure**

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Contents

yesterdays environment dictates
tomorrows adaptations (G. de LEANIZ)

The main **criteria** for the selection of a donor-strain are the geographic (and genetic) distance to the donor stream, the spawning time of the donor stock, the length of the donor river, the timing of return of the donor stock, the availability of the source and health status and restrictions.

In 2003/2004 the strategy of introducing mixed stocks in single tributaries was abandoned in favour of using the Swedish **Ätran** strain (Middle Rhine) and French **Allier** (Upper Rhine) only.

Transplanted strains keep their inherited spawning time in the new environment for many generations - spawning time is stock specific. The timing of reproduction ensures optimal timing of hatching and initial feeding for the offspring (HEGGBERGET, 1988) and is of selective importance. In a common garden experiment with various stocks returning to river Gudenau (Denmark) the Ätran strain demonstrated the closest consistency with the ancient Sieg strain (Middle Rhine). This was a major criterion to select Ätran as donor stock for the Middle Rhine and Lower Rhine tributaries.

In the Upper Rhine (Germany, France, Switzerland) the strain Allier was selected.

The **performance** of the donor strains is promising. Survival rates of stocked fish, natural reproduction, smolt-ratios, and returning salmon are assessed in most river systems using the method of electro-fishing. Survival rates, growth and juvenile densities are good, sometimes excellent. Natural reproduction has been successful in various river-systems (e.g. Dhünn, Sieg, Saynbach, Nette, Ahr (Germany), since 13-17 years, followed by Wieslauter, Murg and Kinzig (5-6 years).

Natural reproduction has been recorded in almost all *accessible* tributaries, such as the rivers Sieg(-system), Wupper-Dhünn, Ahr, Nette, Saynbach, Wisper, Wieslauter, Murg, Kinzig. In rivers Sieg (system), Ahr and Saynbach densities where particular high in some years. In the rivers Sieg and Saynbach 10 - 30% of the returners originate from natural reproduction (estimation)

On the other hand, in the Middle Rhine a decline of events of **natural reproduction** is experienced since the year 2008.

The number of recorded adult salmon (**returners**) suffers a considerable decline in the same period. This decline was recorded in the Middle Rhine section as well as in the whole River Rhine catchment (n = 7.715 returners since year 1990).

Genetics and brood-stock (Hesse & Rhineland-Palatinate)

A genetic analysis at the Agri-Food & Biosciences Institute Northern Ireland (AFBINI) in Belfast was conducted, using 79 young-of-the-year (YOY), generation F1, from the brood-stock. The results proofed that the stock consists of fish being almost exclusively of Ätran origin (almost no indication of straying and/or former stocking pratice with Irish, Scottish and French strains). Furthermore a high genetic variability was documented, showing no signs of a bottle-neck.

[Ensing, D. (2014): Genetics study on Atlantic salmon (*Salmo salar*)

from the broodstock in the „Lachszentrum Hasper Talsperre“ hatchery on the River Rhine]

Known and unknown factors responsible for failure

In the Rhine river catchment so far only 22% of the salmon habitat is accessible for returning fish.

The negative human impact in tributaries is often linked with **hydro-energy plants** (*politicians want it, salmons don't).* Mortality occurs due to physical contact with turbines, high predation in stagnating water, and alteration of flow. Barriers confuse and slow down smolts**.** Also, trash racks can cause high risks. A trial with salmon smolts at Kostheim hydroplant (river Main) in April 2011 showed high mortalities at a new site equipped with a „fish-friendly“ trash rack (20 mm bar space). 50% of the smolts were dead or not capable of surviving, due to scale loss, haematoma at the basis of caudal fins and internal bleeding.

The “**cumulative effect**” is important for the downstream migration of smolts as well as for the upstream migration of returners. A graph illustrates the cumulative mortality of migrating salmon smolts in relation to the number of hydro plants for mortality rates of 10% and 20%. The cumulative effect is even doubled in a full life-cycle of Atlantic salmon, as the rate of failing to find even „well-designed“ fishpasses“ in large rivers is most certainly more than 10%.

Rather unknown are the impacts of other factors:

- More very large container **ships** are operating with some thousands horsepower. Their propellers impose a potential threat to all migrating live stages of salmon (under-estimated ?!)
- Salmon are physically able to enter **turbine chutes** from the tailwater at low head hydro-power plants: Max. swimming speed of individuals meassuring 75 – 85 cm is 4,3 – 6,0 m/s (5,8 – 8,4 body length/s) under lab conditions. In the wild up to 10 m/s are suggested!
- **Poaching and „by-catch“** seem to be a substantial problem, not only in The Netherlands
- More **predators**, such as cormorants, asp, catfish, sander inhabiting the migration routes;

sculpin and cormorants are very frequent in the rearing habitats

- **Climate change**, more dry years, like the drought of the century in autumn 2011, hot summers like this year or even 2003 with water temperature of 30°C in the Rhine are of growing concern.
- **Mortality at sea** is very high – the reasons are unknown.

Conclusions and summary

The return rate to the spawning rivers is insufficient and most probably even decreasing.

The documented natural reproduction (some years showed high densities of wild YOY) is a clear indicator, that the reintroduction can be achieved. The Swedish strain Ätran is doing very well (because of spawning time?). Allier salmon so far do not have access to high quality spawning grounds, but successful reproduction has also been documented.

River-specific problems, like dams, weirs, hydroelectric power stations, navigation, habitat quality, temperature, have not improved significantly in the past years – some got worse.

Predator abundance is significantly higher than 15 years ago: cormorant, asp, catfish, sculpin …

Poaching and "by-catch" are seen as a new challenge to authorities and project managers.

Genetic differentiation is based on homing to natal rivers (isolation of populations)

Natal rivers vary in size, gradient, temperature regime, water chemistry, flow, and many other environmental factors. Established populations are adapted to these environmental factors. We have to give our emerging populations time for adaptation and stock differentiation!

In this context, the use of wild fish for brood-stocks may be beneficial.

Finally, reintroduction is a process of adaptation – nobody knows, how many generations it will take.

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