Agenda item 6.1
For information

Council

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The policy relating to hatchery and stocking activities in Norway - managing risks and benefits

(Anne Kristin Jøranlid, Norwegian Environment Agency)

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In 2014, the Norwegian Environment Agency developed new guidelines for stock enhancement for anadromous salmonids in Norway. The guidelines seek to implement new scientific knowledge on the risks and benefits of stock enhancement taking into account NASCO's Guidelines for Stocking Atlantic Salmon contained in the 'Williamsburg Resolution', CNL(06)48.

Stocking activity in Norway

Stocking of salmon has a long history in Norway. The first hatchery was established in the 1850s. In the years that followed, local landowners and fishermen established many hatcheries to stock yolk sac fry but since little or no increase in the salmon stock was evident most of this activity ended around 1900.

In the 1940s, salmon stocking commenced again with support from the government. Knowledge on feeding and production of parr and later smolts increased in the 60s and 70s, and eventually led to more and more stocking of one-year old parr and smolts. The stocking activities increased due to an increasing requirement to compensate for environmental impacts including hydropower developments and acidification. However, stocking was also conducted for other reasons including to increase production and, consequently, the harvestable surplus.

Improved understanding of the negative effects associated with stocking and research documenting that the stocking had little or no effect on the number of returning fish contributed to a stricter policy on stocking from the start of the1980s. In 1992, the Salmon Act introduced a general ban on all stocking and any stocking that was approved was under permit from the authorities. The new act required that all stocking must use local stock and provide documentary evidence that the broodfish used were free of infectious diseases (health control).

As a result of the new regulations, stocking activity in Norway has decreased drastically since the 1980s. Today, stocking of anadromous salmonids mainly involves salmon. A review by the Norwegian Scientific Advisory Committee for Atlantic Salmon Management indicated that in the period 2005 – 2009, there were annual releases of approximately eight million stocked salmon, mainly eggs (65%) and juveniles (16%).

Currently, the main reasons for stocking in Norway are to restore populations after rotenone treatment (to eradicate *Gyrodactylus salaris*) or following liming of acidified rivers and these activities account for approximately 4.5 million of the 8 million fish stocked annually. The live gene bank plays an important role in these activities. Mandatory stocking in rivers with hydropower developments involve annual stocking of approximately 2.2 million salmon. This number is decreasing, because restoration of habitat and other biotope enhancing measures are replacing mandatory stocking. Voluntary stocking accounts for approximately

1.3 million salmon annually. The new guidelines seek to shift the focus from stock enhancement towards conservation measures and all stocking permits are in the process of being reviewed to see if there are other biotope enhancing measures that could replace stocking.

Why new guidelines?
In 2010, the Norwegian Scientific Advisory Committee for Atlantic Salmon Management presented a review on the knowledge of fish stocking as a measure to conserve and enhance populations (Anon, 2010). This review stated that:

"The international knowledge on fish stocking clearly shows that such measures rarely meet the intended short term goals and have repeatedly been shown to have negative long term effects on the recipient populations. With a few exceptions, releases of fish from hatcheries are thus not an efficient measure to protect threatened wild populations, or to enhance reduced populations. The Committee recommends that stocking of fish should be terminated and replaced with alternative measures wherever possible, and that the quality of the remaining stocking programs should be evaluated and significantly improved."

Based on this report the Norwegian Environment Agency established a Committee to review stocking activities in Norway for anadromous salmonids and to develop recommendations for new guidelines. The recommendations from this Committee provided the scientific basis for the new guidelines (Report in Norwegian: Innstilling fra utvalg om kultivering av anadrom laksefisk, 2011). The previous guidelines from 1998 also included guidelines for stocking of non-migratory brown trout and charr but the 2014 guidelines relate only to stocking anadromous fish.

Legislations and regulations
Several authorities regulate the stocking activity. The Norwegian Environment Agency is responsible for three acts that regulate stocking activity: the Pollution Control Act, the Nature Diversity Act and the Salmonids and Freshwater Fish Act. The Norwegian Food Safety Authority and the Norwegian Water Resources and Energy Directorate also regulate hatcheries.

Permission from the environmental authorities (the Norwegian Environment Agency or the County governor) is needed both to catch broodstock and to release anadromous and freshwater fish in to rivers, fjords and the sea. Specific conditions are set for the activity, e.g. the number of broodfish permitted, the number of fish stocked and the site of the release. The guidelines are used as a basis for those conditions.

Stock based management
Norway has 465 rivers with salmon stocks. Each river has one or more distinct population. Analysis of molecular genetic markers has revealed significant population genetic structuring. The stocks are managed on an individual river level and in some rivers at the tributary level.

Atlantic salmon stocks in Norway are declining and some stocks are presently not achieving their conservation limits. The reasons for this decline are complex and linked to natural fluctuations and adverse human impacts.

New guidelines
In general, stocking is considered to be a temporary measure and the goal is to secure natural production in all rivers. Nevertheless, there are some exceptions. Stocking undertaken to mitigate the effects of hydropower developments might lead to more permanent stocking measures if natural production cannot be restored. Even so, stocking by hydropower companies is now under review in order to identify alternative measures, such as habitat restoration, that could replace stocking.

The new guidelines seek to implement new scientific knowledge on the risks and benefits of stock enhancement, taking account of national and international recommendations. The guidelines are founded on conservation biology principles. This implies that the focus should change from stock enhancement towards conservation. To preserve the original population and its genetic variability, measures to remove limits on natural production (like habitat restoration) must be prioritised. Where this is not sufficient to ensure the long-term viability and productivity of the local population, other measures including stock enhancement measures can be considered.

New requirements
The guidelines include specific requirements for stock enhancement activities. Future stocking must be based on an approved plan specific to the river concerned and must contain documentation on the river system, the stock and bottlenecks to natural production. The plan must describe why stock enhancement is necessary and provide a description of the objective for the activity. Importantly, the plan must detail the aims of the activity and a plan for when the stocking will end. All activity undertaken must be documented so the measure can be evaluated.

Another new requirement requires stricter broodfish control to ensure the genetic variability in the population is maintained. In 2016, the guidelines were supported by publication of a guidebook on how to minimise the negative effects from stocking in terms of the loss of genetic variation and genetic integrity of fish populations (report in Norwegian: Veileder for utsetting av fisk for å ivareta genetisk variasjon og integritet - NINA Rapport 1269). The guidebook provides an introduction to the principles concerning preservation of genetic variation and integrity and practical guidance on conducting stocking.

The guidebook describes:
- how to choose the right broodfish;
- why the relationship between number of broodfish, number of stocked fish, and the size of the natural population is important, and how the right balance between these can be found;
- why and how to conduct crosses of broodfish to gain maximum positive effect;
- why the life stage at which fish are being stocked is important; and
- the importance of documenting and evaluating the stocking practice for the development of an optimal strategy in each situation.

Negative effects from stocking can be avoided by following some general rules and guidelines but in order to minimise possible negative effects and to adjust established stocking practices accordingly, it is necessary to build on population-specific knowledge.

The use of local broodfish has been required since 1985. If the local stock is lost, a nearby population with comparable traits or a mix of stocks from local rivers with comparable traits should be used for reestablishing a population in the river.

Primarily, only wild broodfish should be used and not returning hatchery fish. Only where the natural stock would be negatively affected by collecting wild broodfish may first generation returned stocked fish may be considered as broodfish.

Another important new requirement is a genetic test to exclude escaped farmed salmon or the offspring of escaped farmed salmon. It is not easy to tell the difference between a farmed escaped fish and a wild fish and, of course; it is more or less impossible to identify hybrids of wild/escaped fish. The growth pattern on fish scales can distinguish wild and farmed salmon. Scales are analyzed and categorized into wild salmon, escaped farmed salmon, stocked or uncertain. Broodfish that are categorized as (recently) escaped farmed salmon are not approved for use in stocking while broodfish-samples that are categorized as wild, stocked or uncertain are sent for a genetic test. Since farmed salmon differ genetically from wild salmon a set of genetic markers (SNPs) is used to exclude the offspring of farmed salmon as broodfish. This genetic test has been a mandatory requirement for the last three years. The results show that the percentage of broodfish with genes from farmed salmon differs between 0% and 57% between rivers. On average the tests revealed that ~20% of the broodfish are classified as offspring of farmed salmon (report in Norwegian: Stamlakskontroll 2016. - NINA Rapport 1330).

In general, the use of the earliest life-stages as possible is preferable. The river-specific plan is important when deciding the life stage which is appropriate in the river concerned. The individuals that survive in a hatchery environment are probably not the ones that would survive under natural conditions. The earlier the fish is stocked into a natural environment, the higher the chance that the genetic variability of the stocked fish will be characterised by natural selection. Stocking of smolts in rivers that have reached their conservation limit/spawning target in order to enhance fishing represents the greatest deviation from natural production. Research shows that maturing fish derived from stocked smolts have a much higher straying rate and thus can have negative impacts on other populations. Such negative impacts may include genetic influences and spread of diseases. Large scale stocking of smolts in order to enhance a fishery are not consistent with national and international recommendations and contrary national and international legislation and regulations.

Furthermore, all fish stocked in rivers must be identifiable to facilitate evaluation of the stocking activity. When stocking early stages, alizarin marking (colouring the otolith) or genetic marking (SNPs) are the only options.

Finally, effective health control of the broodfish is important and is regulated by the National Food Safety authorities.

In summary, the latest scientific evidence suggests that stocking in most cases is ineffective as a tool to improve stock status, and has many possible hazards. It should therefore be used with caution and in general seen as a last resort, rather than a first choice of measure. Even when few or no other options are left, stocking has to be based on scientifically sound

principles and practices. Implementing the revised guidelines with the new requirements, aiming at minimizing the possible negative effects that stocking might lead to, therefore is an absolute requirement.

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