CNL(10)51

NASCO Guidelines for the Protection, Restoration and Enhancement of Atlantic salmon Habitat

1. Introduction

Salmon habitat in freshwater has been greatly affected by various activities, both small- and large-scale in nature, and it is clear that much habitat has been lost over the last 150 years, although in recent years there have also been some notable gains. NASCO's objectives of conserving, restoring and enhancing Atlantic salmon can only be achieved if their habitat is protected, restored and, where appropriate enhanced. NASCO and its Parties have, therefore, agreed to adopt and apply a Precautionary Approach to the conservation, management and exploitation of salmon in order to protect the resource and preserve the environments in which it lives. Accordingly, their objective for the protection and restoration of salmon habitat is to **maintain and, where possible, increase the current productive capacity of Atlantic salmon habitat,** hereinafter referred to as the 'international objective'. In support of the international objective, NASCO has developed the following agreement:

- NASCO Plan of Action for the Application of the Precautionary Approach to the Protection and Restoration of Atlantic Salmon Habitat, CNL(01)51.

NASCO has also developed the following guidelines which are relevant to the protection and restoration of salmon habitat:

- Guidelines for Incorporating Social and Economic Factors in Decisions Under the Precautionary Approach, CNL(04)57;
- Guidelines on the Use of Stock Rebuilding Programmes in the Context of the Precautionary Management of Salmon Stocks, CNL(04)55.

The NASCO Plan of Action provides a framework for use by the appropriate jurisdictions, national, regional and local, that have responsibilities for activities involving salmon habitat. It lays down the guiding principles to support application of the Precautionary Approach to habitat protection and restoration. It calls for the development of comprehensive habitat protection and restoration plans and inventories by each jurisdiction in support of the international objective. The intention in developing these guidelines is:

- to assist the jurisdictions in making further progress in implementing NASCO's agreements and guidelines for the protection and restoration of salmon habitat, subject to their national legislation;
- to provide for an exchange of information on approaches to the protection, restoration and enhancement of salmon habitat around the North Atlantic;
- to assist jurisdictions in the preparation of future Focus Area Reports (FARs) on habitat protection, restoration and enhancement as well as the process for reviewing the FARs; and
- to assist in the identification of what additional actions may be required.

2. Salmon habitat requirements

Understanding the Atlantic salmon's habitat requirements and identifying impacts to this habitat are key requirements in meeting the international objective for the protection and restoration of habitats. This section provides a brief outline of the Atlantic salmon's habitat requirements and the range of factors that could adversely impact it, so as to provide a structure around which the development of the habitat inventories called for under the NASCO Plan of Action may be developed.

Wild Atlantic salmon have a complex life-cycle and, consequently, complex habitat requirements. As a geographically widespread, anadromous species, the Atlantic salmon has adapted to highly variable habitats and environmental conditions e.g. with regard to length of growing season, water acidity and temperature etc. These adaptations are often referred to as 'river specific' adaptations. However, anthropogenic changes to habitat may be so severe or rapid that the salmon is unable to adapt to them resulting in declines in abundance or even local extinctions. Protecting the environmental conditions that allow the maintenance of variable life-history strategies should be a guiding principle in salmon habitat management.

There are many threats of a physical, chemical and biological nature to habitat which Atlantic salmon require for:

- spawning, incubation and early development;
- juvenile rearing;
- juvenile and adult migrations; and
- pre-spawning adults.

Each of these elements of the life-cycle require specific habitat and environmental conditions; they are summarised in general terms below, together with the factors that may impact each habitat. Examples of activities that may cause these impacts are described in paragraph 3.5 below. Given the range of tolerance to environmental variables among salmon populations (i.e. local adaptations) it is not possible to specifically describe optimal habitat conditions applicable to all salmon populations across the North Atlantic. However, the general requirements are described below.

(a) Habitat for spawning, incubation and early development

Salmon spawn in nests or redds excavated in areas of non-compacted, stable, permeable gravel, often in riffles or at the head or tail of a pool. After hatching from the egg, the young fish, known as alevins, remain in the gravel for several weeks before emerging. A number of factors influence the choice of spawning site, including intra-gravel flow, gravel size, water quantity and quality, and cover. Egg and alevin survival in the nest depend on many factors but oxygen supply and temperature are particularly important.

Requirements: permeable gravel substrate with an adequate flow of cool, well oxygenated water.

Impact factors: Increased siltation/sedimentation, changes in substrate (e.g. gravel removal), changes in river morphology (e.g. channelization), changes in water quantity (e.g. reduced base flows) and quality (e.g. domestic and industrial effluents and nutrient enrichment).

(b) Juvenile rearing habitat

After emergence through spaces in the gravel, juvenile salmon establish and defend territories, the size of which determines the carrying capacity of a stream. The size of a territory is influenced by both biotic and abiotic factors including channel morphology, substrate, gradient, water quantity and quality, cover, food abundance, and predator and competitor abundance. Salmon fry and parr generally prefer riffle habitat but may move into deeper water as they grow in size and during the winter and periods of drought. Juvenile salmon may also occupy lakes, ponds and slackwater areas. Thus, a diverse array of well connected habitat types is required.

Requirements: well connected freshwater areas with cool, clean, well-oxygenated water, adequate food supply and cover for shade and protection from predation and severe environmental events.

Impact factors: Increased siltation/sedimentation, changes to shelter/cover (e.g. removal of in-stream boulders and large woody debris, removal of bankside vegetation), changes in substrate, changes in river morphology, changes in water quantity and quality, changes to the food supply (e.g. reduction in invertebrate production), changes in species composition and abundance (e.g. introduction of invasive species, increase in predators, reductions in the diadromous fish community).

(c) Juvenile and adult migration

At the end of the freshwater phase, juvenile salmon migrate to sea as smolts. Adult salmon require free access to the spawning grounds. Barriers to migration in fresh water and estuaries, whether natural or man-made, can either block or delay access and may lead to increased mortality through, for example, diseases and predation. Delays in smolt migration may also result in increased disease incidence and predation and may affect the smolt's ability to adapt to sea water. Water flow and temperature are important factors.

Requirements: Migration corridors free from physical, chemical or biological barriers that prevent or impede: in-river movements of parr (e.g. to over-wintering habitat); downstream movements of parr and smolts to the estuary/sea; and upstream migration of adults to spawning grounds.

Impact factors: Physical obstructions to migration (e.g. dams), changes in river morphology, changes in water quantity and quality, changes in species composition and abundance.

(d) Habitat for pre-spawning adults

Adult salmon require holding and resting areas both during their upstream migration and in the vicinity of the spawning grounds, since they may arrive well in advance of spawning. These holding areas provide shade and protection from predation and severe environmental events.

Requirements: deep pools with cool, clean, well oxygenated water and cover for shade and protection from predation and severe environmental events.

Impact factors: Increased siltation/sedimentation, changes to shelter/cover, changes in substrate, changes in river morphology, changes in water quantity and quality.

3 Key elements of management

It is recognised that the size of salmon stocks, the management responsibilities and approaches, the pressures on the habitat, and the resources available for habitat protection, restoration and enhancement vary considerably among countries. Nevertheless, to achieve the international goal of maintaining, and where possible increasing, the productive capacity of Atlantic salmon habitat, the following elements of NASCO's agreements and guidelines should be applied in all jurisdictions through the establishment of comprehensive plans for the protection, restoration and enhancement of salmon habitat and inventories to allow an assessment of progress towards achieving the international objective.

3.1 Description of current and historic habitat

- A range of information should be collected on a routine basis through reporting and monitoring programmes relating to the productive capacity of salmon stocks and any factors that may be adversely affecting it. Section 2 above provides a structure around which inventories of information might be developed. In particular, the quantity and quality of salmon habitat currently available should be determined. This information is essential in providing a baseline against which achievement of the international goal can be assessed. The information should be collected for individual rivers and their tributaries and maintained in inventories and be regularly updated.
- Where available, information on the quantity of habitat historically available to salmon should be used to inform restoration initiatives. Where such information is not available, efforts should be made to obtain it.

3.2 Identifying risks to productive capacity

- Wherever feasible, a holistic approach should be taken to habitat protection and restoration, through catchment management planning so as to identify risks to the productive capacity of the resource and prioritise measures to address them. In this regard, it should be noted that the cumulative effect of several impact factors may exceed the sum of the individual factors. Furthermore, while losses during the early stages of the salmon's life-cycle may be compensated for through natural processes, this does not occur for losses of parr and smolts. Actions to enhance salmon habitat, both artificial enhancement of current habitat and opening previously inaccessible habitat, require careful consideration and consultation (see section 3.7 below) because of the potential adverse effects on other species.
- Management measures to protect habitat should be reviewed and updated, in a timely fashion, in response to any new or emerging threats to the productive capacity of the resource. For example, climate change poses significant challenges for the management of salmon habitat in the future e.g. in relation to managing water abstraction and riparian vegetation.

3.3 Information Exchange

- One of the complexities of salmon habitat management is that there are many factors and activities (both natural and man-made) that can affect the productive capacity of the resource, and many stakeholders involved. Procedures should, therefore, be in place for consultation and information exchange among all relevant agencies and stakeholders within a jurisdiction and internationally to improve awareness of salmon habitat issues and approaches to addressing them.

3.4 Decision making process

- Consistent with the Precautionary Approach, there should be clear and transparent descriptions available to all stakeholders of the process by which management decisions will be taken in relation to habitat protection, restoration and enhancement; these could take the form of a flow diagram or decision structure.
- Proponents of any activity that could adversely impact salmon habitat should be required to provide all the information needed to allow the risks to the productive capacity of the resource to be assessed, including a range of options for achieving the objectives of the proposed activity.
- In evaluating options for activities that could adversely impact salmon habitat, conservation of the productive capacity of the resource should take precedence (see section 3.5 below).
- Where activities are approved that could result in the loss of productive capacity of the resource, on the basis of overriding socio-economic factors, the losses should be minimised and compensation or mitigation measures should be agreed prior to approval of the activity so that there will be no net loss of productive capacity. The costs of these compensation or mitigation measures should be borne by the proponent.
- Where salmon stocks have been designated for special protection, there should be a strong presumption against any loss of productive capacity, even where measures to compensate or mitigate for the losses are proposed.
- In assessing risks to productive capacity of the resource, consistent with the Precautionary Approach, managers should demonstrate that they are being more cautious when information is uncertain, unreliable or inadequate, and the absence of adequate scientific information should not be used as a reason for postponing or failing to take appropriate conservation and management measures.
- Monitoring should be conducted to ensure compliance with all conditions specified in authorising an activity. In the event that monitoring identifies a need for corrective measures, these should be implemented without delay and should achieve their purpose promptly. It should be a requirement of an authorisation that the costs associated with any corrective measures should be borne by those conducting the activity.

3.5 Protection of salmon habitat

Measures should be taken to protect salmon habitat for all freshwater life-stages of Atlantic salmon and to prevent the loss of productive capacity of the resource, *inter alia*, as a result of any of the impact factors listed in section 2 above (or other factors known to adversely affect salmon populations) resulting from the following activities:

- increased siltation and sedimentation resulting from activities such as development construction, forestry. agricultural and other land management practices, road and urban run-off etc; damage to spawning substrate resulting from activities such as gravel abstraction, and changes in flow regime;
- loss of shelter and cover resulting from activities such as removal of riparian and in-river vegetation, and substrate alteration;
- reductions in food supply resulting from activities such as removal of riparian and in-river vegetation;
- changes in species composition and abundance resulting from activities such as stocking predators or competitors, and reductions in the abundance of species that provide prey and/or a predation buffer for salmon;
- creating physical barriers to migration resulting from activities such as dam, bridge and weir construction. and hydropower facilities;
- changes in river morphology through activities such as dam, bridge, culvert and weir construction, and in-river engineering;
- changes in water quantity through activities such as irrigation, abstraction, deforestation, land drainage, and livestock over-grazing;
- deterioration in water quality through addition of chemicals and nutrients from activities such as industrial and domestic waste discharges, agriculture and forestry, and freshwater fish farming.

3.6 Identifying and designating key habitats for improvement

- Where salmon habitat has been degraded or lost, options for its restoration should be identified and prioritised. Priority should be given to management options that will have the greatest direct (increase in productive capacity) and indirect (overall value of ecosystem services, public relations aspects) benefits relative to the costs of the improvement work. Restoration activities should be evaluated to assess achievement of the objectives and to inform future activities.
- Wherever possible, restoration initiatives should include community participation. There is a need for consultations on the various options with stakeholders, including the authorities concerned with biodiversity issues.
- Restoration of habitat should generally take precedence over habitat enhancement.
- Restoration of salmon habitat requires restoration of the four key habitat components listed in section 2 above.

3.7 Maintaining Biodiversity

- Measures to protect existing salmon habitat should generally benefit other flora and fauna in the area concerned. However, where measures are taken to restore and, in particular, enhance salmon habitat, any potential risks to other species will need to be balanced with the benefits to the salmon. There will be a need for consultation and cooperation with the authorities responsible for biodiversity issues and with stakeholders.

3.8 Other biological factors influencing the stock(s)

- Factors other than habitat degradation may adversely affect productive capacity, and actions should be taken to identify and address these problems as part of an integrated approach to habitat management (see NASCO Guidelines on the Use of Stock Rebuilding Programmes in the Context of the Precautionary Management of Salmon Stocks, CNL(04)55). These factors could include parasites and diseases, predation, composition and abundance of fish communities, exploitation and aquaculture.

3.9 Socio-economic factors

- Transparent policies and processes should be in place to take account of socio-economic factors in making habitat management decisions and for consulting stakeholders (see paragraph 3.4 above).

3.10 Effectiveness of management measures

- Managers should assess the expected effects of management actions and the timescale in which they will occur prior to their implementation.
- Managers should also monitor the outcomes of the management actions to determine whether they have achieved the desired aims.

Further information on the measures being taken to protect, restore and enhance salmon habitat is available at www.nasco.int/habitat.html. The Focus Area Reports by each jurisdiction include references to more detailed guidance relating to particular aspects of habitat protection, restoration and enhancement.