NASCO GUIDELINES FOR THE PROTECTION, RESTORATION AND IMPROVEMENT OF ATLANTIC SALMON HABITAT

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North Atlantic Salmon Conservation Organization

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1. Introduction

Atlantic salmon habitat in freshwater and estuaries has been greatly affected by many human activities, and much historic habitat has been lost or degraded. NASCO's objectives of conserving, restoring and enhancing salmon populations can only be achieved if the species' habitat is protected, and where damaged or deteriorated, restored or improved. NASCO's Ten-Year Strategy and Action Plan, CNL(24)71rev, includes an objective to **maintain and, where possible, increase the current productive capacity of salmon habitat**. In 2001 NASCO adopted its Plan of Action for the Application of the Precautionary Approach to the Protection and Restoration of Atlantic Salmon Habitat, CNL(01)51. This current set of Guidelines is an updated version of CNL(01)51.

It is worth noting that NASCO has 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; and
- Guidelines on the Use of Stock Rebuilding Programmes in the Context of the Precautionary Management of Salmon Stocks, CNL(25)50.

The NASCO Ten-Year Strategy and associated Action Plan, CNL(24)71rev, outline objectives for the appropriate jurisdictions (national, regional and local) that have responsibilities for activities involving salmon habitat. The updated Guidelines for habitat protection and restoration will address these objectives, with recognition of the Precautionary Approach. While these Guidelines are not intended to be prescriptive, their purpose is:

- to assist jurisdictions in making further progress in protecting, restoring and improving salmon habitat, subject to local legislative constraints;
- to provide for an exchange of relevant information; and
- to assist jurisdictions in the preparation of future Conservation Commitment Reports (CCRs) and Performance Indicators on habitat protection, restoration and improvement as well as the process for reviewing the CCRs[1].

These Guidelines offer important recommendations on protection, restoration and improvement. Included is guidance for 'Projects', designed

[1] See 'Combined Performance Indicators / Conservation Commitment Reports Templates for the Fourth Reporting Cycle (2026 to 2032)', CNL(25)55rev.

to restore, and improve salmon habitat, beginning with the early planning steps through final implementation and evaluation.

In this document, the term 'protection' will refer to the actions needed by jurisdictions to maintain the high-quality salmon habitat that exists, without suggesting any physical alterations of the habitat. Protection will reference administrative and legal actions taken to avoid degradation of such habitat by proposed developments, such as dam building, discharge of waste and channelisation of streams. The term 'restoration' will refer to actions that convert a habitat that has lost most of its function back to fully functional habitat. The term 'improvement' will refer to actions applied to degraded salmon habitat that improve it toward a more functional salmon habitat. In practice, many improvement actions are the same as restoration actions but the two may differ in scope and scale.

2. Salmon Habitat Requirements

Understanding salmon's habitat requirements and identifying damage to these habitats are key requirements in meeting the Objectives of NASCO's Ten-Year Strategy for the protection and restoration of habitats ('NASCO's Objectives'). This section provides a brief outline of salmon's habitat requirements and the range of factors that could negatively impact it.

Wild salmon have a complex life-cycle and, consequently, complex habitat requirements. As a geographically widespread anadromous species salmon has adapted to highly variable environmental conditions e.g. length of growing season, water quality, temperature and river morphology. These adaptations are often referred to as 'region or river specific' adaptations. However, anthropogenic changes to physical or habitat conditions may be so severe or rapid that salmon are unable to adapt to them. This may result in severe 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.

These are critical life-history functions that habitats must be able to support:

- spawning, incubation and early development;
- juvenile rearing;
- in-river migrations; and
- estuarine migration.

Each of these elements of the life-cycle requires specific habitat and environmental conditions; they are summarised in Annex 1.

2.1 Factors that Degrade Salmon Habitat

There are many activities and conditions that can negatively impact salmon habitats, including:

a. Damage to spawning substrate and juvenile habitats through gravel abstraction or increased siltation and sedimentation resulting from activities such as changes in flow regime, development construction,

forestry, agricultural and other land management practices, road and urban run-off;

b. Loss of shelter and cover resulting from activities such as substrate alteration and the removal of natural structures such as woody materials and boulders, riparian and in-river vegetation;

c. Reductions in food supply resulting from activities such as removal of riparian and in-river vegetation;

d. Changes in fish species composition and abundance resulting from habitat alteration and the introduction of non-native species, activities such as the introduction of predators or competitors, and reductions in the abundance of species that provide prey and / or a predation buffer for salmon;

e. Physical barriers to migration resulting from the creation or maintenance of structures such as dams / weirs, bridges and culverts;

f. Changes in river morphology and sediment dynamics through the creation and maintenance of structures such as dams / weirs, bridges and culverts, and activities such as channelisation, river-bank armouring, river / channel realignment, dredging, modification of flow regimes. All these activities may also influence water temperature;

g. Changes in water quantity and hydrological regime due to long-term environmental challenges and activities such as hydro power production, irrigation, abstraction, deforestation and other forestry practices, land drainage and over-grazing. All these activities may also influence water temperature; and

h. Deterioration in water quality due to long-term environmental challenges which affects water temperature and through addition of chemicals and nutrients from activities such as industrial and domestic waste discharges, agriculture, forestry and waste from fish farming.

Annex 1 lists some of the above impacts by life-phase. These Guidelines will address how to protect, restore and improve key salmon habitats necessary to support salmon conservation.

3 Considerations Prior to Intervention

Considering the specific habitat requirements across a suitable and relevant spatial scale for salmon at each life stage, and the escalating impacts of existing threats outlined in Section 2 and summarised in Annex 1, there is an urgent need to design and implement measures that mitigate these stressors. These measures should target the protection, improvement and, when possible, restoration of pre-disturbance habitat features to meet NASCO's Objectives.

However, before any action is implemented, a set of considerations must be carefully assessed, as their proper evaluation is fundamental to success. These may include the collection of baseline information, as well as practical considerations that could influence implementation, such as defining intervention targets and objectives, accounting for cultural and socio-

economic contexts, and ensuring consultation and engagement with groups of stakeholders and Indigenous Peoples.

3.1 Baseline Information

a. Information should be collected prior to implementation of planned interventions, including characterising the status of local salmon populations, and historic trends in abundance, life-history strategies and habitat availability (both quality and quantity).

b. Information should also be obtained, as detailed as possible, about natural and anthropogenic stressors on salmon populations. This should focus not only on the identification and characterisation of existing threats, but also on the assessment of their potential to be eliminated or reduced.

Such information is essential in providing an ecological and environmental baseline against which the objectives, actions and achievements of the planned interventions can be later assessed, after suitable and continuous monitoring (see Section 6). The information should be collected, with as much detail as logistically and financially possible, for individual target rivers and their tributaries, maintained in databases and be regularly updated. If such information is not available, efforts should be made to obtain it.

3.2 Intervention Targets and Objectives

a. A realistic and feasible approach from a catchment-wide perspective should be taken when planning actions. Clearly defined objectives should outline how a habitat can be protected, restored or improved through the elimination or reduction of the existent threats and stressors, and should be informed by the baseline data referred to in 3.1. Such objectives should include consideration of stakeholder and Indigenous Peoples perspectives, cost-benefit analysis, native biodiversity and long-term environmental challenges.

b. These actions often benefit other species, particularly the ones with similar life cycles and habitat requirements. However, prior to their implementation, it should be considered that some of these actions, for example, the enhancement of current habitat or the opening of previously inaccessible habitat, may require careful consideration and consultation, because of the potential to negatively impact other species. These considerations can limit or alter targets and objectives initially foreseen for planned interventions.

3.3 Cultural and Socio-Economic Considerations

a. Prior to any action, an assessment should be conducted to characterise the cultural, social, Indigenous and economic uses of the target area, identify relevant stakeholders (see section 3.4) and anticipate potential conflicts. The magnitude and impact of these uses can vary significantly depending on local or regional cultural and socio-economic factors[2].

[2] See 'Guidelines for incorporating social and economic factors in decisions under the Precautionary Approach', CNL(04)57.

3.4 Consultation and Engagement of Stakeholders and Indigenous Peoples

a. Specific strategies for engagement with groups of stakeholders and Indigenous Peoples should be adequately planned and implemented, avoiding a 'one-size-fits-all' approach. Often, each group of stakeholders and Indigenous Peoples has its own characteristics and the engagement strategy should consider its specific level of involvement, use and exploitation of the target habitat.

b. Meaningful engagement, consultation and information exchange should take place between all relevant agencies, groups of stakeholders and Indigenous Peoples within a jurisdiction. Besides improving awareness of the existing challenges and potential solutions, engaging relevant groups of stakeholders and Indigenous Peoples from the preparatory stage onward is expected to significantly foster acceptance and involvement of local communities, thereby increasing the likelihood of success for these actions.

4. Protection of Salmon Habitat

4.1 Designation of Habitats for Special Protections

a. In combination with efforts to identify and effectively restore or improve salmon habitat that has been destroyed or damaged (outlined below in Section 5), habitats with high conservation status or that serve as relatively natural, pristine examples of salmon habitat should be designated for special protection, to prevent anthropogenic disturbances. Salmon habitats that meet these criteria may already be encoded in policy regulations, which vary by jurisdiction.

b. The criteria used for overall designation and protection of habitats of the highest conservation value to salmon may vary by jurisdiction and legislative framework (Annex 2). For the purposes of developing a Salmon Habitat Protection and Restoration Plan, the protection of these habitats could be identified by each NASCO Party / jurisdiction using the following guiding principles in which the identified habitat:

- should be of either natural or near-natural ecological character (i.e. showcase high fidelity to a defined high-quality condition for that habitat type) and is naturally resilient to external perturbations, such as those associated with long-term environmental challenges;
- needs little to no management intervention ('passive management');
- must provide naturally resilient salmon habitat functions or features that are generally absent in the broader habitat landscape ('habitat refugia'); and / or
- fulfils the specific requirements of salmon at the appropriate life-cycle stage (Annex 1) and is not subject to human activities at an intensity that results in negative habitat impacts such as those listed in Section 2.1.

The size and scale of the identified habitat for designated protection can vary from entire catchments or estuaries to individual tributaries or river reaches.

Habitats not wholly fulfilling the criteria defined above, but that provide critical habitat resources to salmon, should also be considered a habitat category for priority protection. If impacted by damaging human activities, they are important candidates for restoration or improvement (Section 5) to ensure they are retained as long-term critical salmon habitat. Examples include habitats that provide protective refugia for salmon against external environmental stressors, which may occur at fine spatial scales (e.g. tributaries draining high-elevation areas, shaded reaches, river sections with an abundance of deep pools, habitats with thermal or hydrological regimes influenced by springs or groundwater upwellings). Changing environmental conditions (water temperature and flow extremes) and the necessity for anticipating the need for salmon to adapt underline the importance of such habitats as being critical to protect, restore or improve where necessary.

4.2 Reactive Responses to Proposals that Could Negatively Impact Salmon Habitat

Developments are constantly being proposed and some of these have the potential to impact salmon habitat negatively. Each jurisdiction has its own way of regulating land use decisions and issuing permits, licences, authorisations and / or permissions (collectively hereinafter referred to as 'Permits'). Given this, certain considerations should be incorporated into the process, regardless of location. Regulatory decisions should be taken to avoid or mitigate significant impacts on salmon habitat, including Permit refusal where appropriate, if significant residual impacts remain. In some cases, agencies that manage salmon have the authority to issue Permits, but in many cases, agencies that do not manage salmon make these decisions. In the latter case, it is important that authorised salmon experts be consulted by the agencies prior to making decisions on the Proposal.

4.2.1 Decision-Making Considerations

a. When assessing risks to the productive capacity of salmon habitat, decision-makers should demonstrate that they are being consistent with the Precautionary Approach[3] by being more cautious when information is uncertain, unreliable or inadequate, and not using the absence of adequate scientific information as a reason for postponing or failing to take appropriate conservation and management measures. Consistent with the Precautionary Approach, there should be clear transparent descriptions available to all groups of stakeholders and Indigenous Peoples of the process by which regulatory decisions will be taken in relation to habitat protection.

b. Proposals should include 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 Proposal.

[3] See 'Guidelines for incorporating social and economic factors in decisions under the Precautionary Approach', CNL(04)57.

c. Conservation of the productive capacity of the salmon habitat should be of prime consideration when evaluating options for Proposals (see Section 2.1 above).

d. If Proposals that could result in the loss of productive capacity of the habitat are approved on the basis of overriding socio-economic / public interest factors, the design should seek to minimise such losses and consideration should be given to the idea of 'No Net Loss'[4].

e. In cases when significant salmon habitat loss is unavoidable, measures to compensate or mitigate for that loss, 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.

f. Where salmon stocks have been designated for special protection, any loss of productive habitat should be avoided, even where measures to compensate or mitigate for the losses are proposed.

g. Monitoring should be conducted to ensure compliance with all conditions specified in authorising / permitting a Proposal. If monitoring identifies a need for corrective measures, these should be implemented without delay and should achieve their purpose promptly. It should be a requirement / condition of a Permit that monitoring be conducted, and the costs associated with any corrective measures should be borne by those conducting the permitted activity.

5. Restoration / Improvement of Salmon Habitat

5.1 Actions to Restore / Improve Salmon Habitat

These actions address the impacts listed in Section 2.1 above. Please note this is not an exhaustive list.

a. Increased Siltation and Sedimentation

Reduce sedimentation by restoring riparian buffers with native vegetation and applying best management practices that respect natural land-water linkages. Restore natural flow regimes and river processes and rehabilitate spawning gravels to support healthy, self-sustaining river systems. Work co-operatively with farmers, foresters and developers to implement salmon-habitat-friendly Projects.

b. Loss of Shelter and Cover

Replant riparian and in-river vegetation and install natural structures such as boulders, cobbles and woody materials to reintroduce shade, cover and habitat complexity. Use natural materials and soft-engineering approaches to stabilise banks, where necessary, while allowing rivers to evolve and function naturally over time.

[4] The idea of 'No Net Loss' is that biodiversity is as a minimum left no worse off after development than before (zu Ermgassen, S.O.S.E., Utamiputri, P., Bennun, L., Edwards, S. and Bull, J.W. 2019. The role of "no net loss" policies in conserving biodiversity threatened by the global infrastructure boom. One Earth, 1, 305-315).

c. Reductions in Food Supply

   Re-establish riparian vegetation and channel diversity to strengthen natural food supply from land to water. Improve invertebrate habitats through varied substrates and woody materials to maintain the ecological balance that supports salmon.

d. Changes in Species Composition and Abundance

   Promote balanced ecosystems by preventing harmful introductions and restoring native biodiversity. Manage non-native species through adaptive, place-based approaches that work with natural processes and local ecological knowledge.

e. Physical Barriers to Migration

   Restore river connectivity by removing barriers and creating and maintaining fish passage facilities where needed.

f. Changes in River Morphology

   In habitats with modified morphology, implement river restoration Projects that follow natural channel design and hydrogeomorphic principles. Use designs that mimic natural processes and preserve flow and sediment dynamics across the catchment.

g. Changes in Water Quantity

   Aim to restore natural flow regimes or implement ecological flow regimes. Improve water-use efficiency. Restore natural land cover, wetlands, forests, and headwaters that store and release water naturally, supporting both aquatic ecosystems and surrounding landscapes.

h. Deterioration in Water Quality

   Advocate for reduced pollution at its source through careful land-use planning and improved effluent control. Increase the resilience of habitats to deterioration in water quality (temperature and dissolved oxygen) by restoring natural river processes and features including rehabilitation of wetlands and flood plains, removing dams and establishing native vegetative buffers, and creating or enhancing thermal refuges. Strengthen water-quality monitoring and shared stewardship to ensure rivers remain capable of supporting all life stages of salmon.

5.2 Approaches to Interventions

Many factors contribute to determining the most appropriate nature of a proposed action; it is not the intention of these Guidelines to be prescriptive in this regard. However, actions should be considered only when damage to salmon habitat is identified and they can benefit the salmon population. It is also recommended that restoration is planned at a catchment level, giving due consideration to all the environmental pressures, long-term environmental challenges, available suitable salmon habitats (see Annex 1) and wider native biodiversity.

When deciding the nature of the action at a specific location, consideration should be given to the following approaches:

a. Passive Restoration

   Passive Restoration involves removing the source anthropogenic stressor, which is damaging the habitat, and allowing the natural riverine processes to return the habitat to a pre-disturbance state. Passive Restoration could involve an active element, for example removing barriers or bank protection, thereby enabling natural river processes to occur and restore the ecosystem. Passive Restoration should not be considered a 'do nothing' option. Passive Restoration, when compared to active intervention in channel morphology, may take longer to establish habitat improvements; however, the results can often deliver the most appropriate self-sustaining habitat for salmon and wider biodiversity.

b. Active Restoration

   Active Restoration of a river channel is a systemic approach to restoration, which aims to eliminate stressors and where the damage to the river habitat is significant and of a scale that will not recover unaided and as such would require instream intervention. Such Projects may include instream works to re-establish salmon habitat suitable for all life stages (see Annex 1) or the re-meandering of straightened sections of rivers.

c. Active Improvement

   Depending on the nature of the damaged river habitat and the limiting factors constraining restoration, it may not be possible to fully eliminate the major stressors on the catchment. This should not preclude efforts to improve the existing habitat or connectivity between habitats. For example, in catchments which have been channelised, nature-like restoration may not be possible but localised interventions may improve salmon habitat. In addition, where a barrier impairs the natural river flow or the migration of salmon, and the optimal solution of removing the barrier is not possible, improving fish passage or flow compensation / mitigation measures should be considered.

While these Guidelines define three approaches to habitat restoration, restoration / improvement Projects, particularly those of a large scale, will often combine these approaches.

5.3 Decision-Making Process

5.3.1 Selection of Locations for Action

a. Where salmon habitat has been degraded or lost, options for its restoration or improvement should be identified and prioritised. Priority should be given to actions that will yield the greatest direct (increase in productive capacity) and indirect (overall value of ecosystem services, socio-economic / public-interest aspects) benefits relative to the costs of the actions.

b. Consultations are needed in the early stages when various options are being considered. These should include diverse groups of stakeholders,

such as landowners, regulators and authorities concerned with biodiversity issues, and Indigenous Peoples.

c. Restoration of salmon habitat requires attention to the four life-history stage habitats that support:

   - spawning, incubation and early development;
   - juvenile rearing;
   - in-river migrations; and
   - estuarine migration.

   See Section 2 and Annex 1.

d. Early consideration should be given to how restoration activities should be evaluated and monitored to assess achievement of the objectives and to inform future activities (see Section 6).

5.3.2. Develop Options for Intervention

It is common for proponents of habitat Projects to consider several options for action. They could be quite different in nature (dam removal vs. fish ladder) or variations of the same approach (tree planting along the left bank vs. tree planting along the right bank). Often, they are conceptual in nature, allowing the Project team and community to agree on the basic approach. These conceptual options typically include details such as location, basic design, pros and cons, impact on biodiversity, identification of future roles and responsibilities, the general nature of approach(es) to be taken (see Section 5.2) and a general cost estimate.

a. Consultations

   It is important to get input on the conceptual plans from groups of stakeholders and Indigenous Peoples as mentioned in 5.3.1.b. Their input at this stage is critical to determine if the design can proceed as proposed or if significant changes are required.

b. Issues to be Addressed in the Options

   Options should be developed that include a catchment-wide perspective. Also, it is important to understand other planned Projects within the catchment to ensure that different Projects do not work at cross purposes. Consideration of long-term environmental challenges is essential not only to allow salmon to better adapt to them but also to ensure that any Project's design accounts for forecasted changes, such as altered hydrology, thus ensuring the restored / improved habitat remains resilient and functional long into the future. All options should be assessed for compliance with all existing plans, such as catchment plans. Consultation with biodiversity experts is needed to determine if any options may result in a significant negative impact on sensitive species.

5.3.3. Select Preferred Option

After all assessments, studies, and consultations are completed, the Project team must identify the preferred option for further development. The

preferred option is transferred to the appropriate persons, as dictated by the specifics of the Project, who are responsible for additional design, including technical and environmental specialists, in-house experts, and consultants such as engineers and fluvial geomorphologists.

5.4. Design

The final design of the preferred option for salmon habitat restoration / improvement includes a set of tasks that must be undertaken to ensure success. Tasks such as those described below foster timely intervention and the sustainability of the Project.

5.4.1. Consultation with Local Stakeholders and Indigenous Peoples

Depending on the nature of the Project, there may be a need for ongoing consultation, including during option selection and final design, with the previously identified groups of stakeholders and Indigenous Peoples. Refinement of the preferred option details may include changes for better adaptation to local geomorphology, climate and riverine characteristics, but also to incorporate plans for future operation and maintenance and to consider the local social and cultural context.

5.4.2. Additional Environmental Assessments

Depending on the scale and specifications of the Project, there may be a need for additional impact assessments, including sensitive species, flood-risk, historical resources and other environmental resources. These will complement and update previously collected baseline information but also help the Project team to identify and possibly reduce potential impacts and risks.

5.4.3. Technical Specifications

There is a need to develop full technical details for a design plan for each Project, which will be used for Permits, assistance with procurement / bidding and guiding implementation. Such information might include inputs from an array of specialities such as hydrogeomorphologists, ecologists, engineers, fisheries biologists, among others. Development of technical specifications leads to more precise Project costing. It is also required for more technical Projects, such as obstacle removal, fish passage construction or retrofitting and riverbank renaturalisation, among others.

5.4.4. Permits and Agreements

Prior to implementing the Project, the Project team must obtain the necessary Permits and agreements. This includes Permits from local, regional or national administration, depending on the jurisdiction's legal framework and on the spatial coverage of the Project. If the Project will take place on private property, the Project team may also need to obtain agreements from owners or managers of the targeted site. The Project team should anticipate the amount of time required to obtain necessary Permits and agreements.

5.5 Implementation

When implementing the Projects, the recommended practices below should be followed to conduct the work in a timely and successful manner. Details will vary between jurisdictions, but in general, Projects should be developed and pursued to:

a. Guarantee that all involved groups of stakeholders and Indigenous Peoples are continuously engaged with the Project and are consulted in respect to proposed changes to the original technical specifications;

b. Ensure that Project budgets are actively managed and adjusted as necessary, especially when facing increases in material or labour costs;

c. Ensure compliance with all Permit conditions, including any time-of-year restrictions;

d. Incorporate Project timeline contingencies to anticipate operational risks to the project schedule related to local and seasonal conditions, such as weather or changes in river hydrology, and logistics, including machinery;

e. Hire specialised and experienced contractors to conduct, monitor and provide oversight to the Project, guaranteeing an evaluation of the ongoing work; and

f. Ensure compliance with all appropriate legal, health and safety and administrative frameworks / regulations of each jurisdiction.

6. Monitoring and Evaluation

A monitoring plan should be developed in advance of Project implementation, identifying the critical metrics to be established and monitored. All relevant baseline data against which success can be measured should be assembled, including metrics on the productivity of the catchment at as fine a scale as possible (see Section 3.1).

Monitoring the critical metrics should continue after Project completion at a temporal and spatial scale and scope that will allow evaluation of the longer-term benefits, the sustainability of benefits and the 'lessons learned'.

Habitat restoration Projects can be iterative in that when monitoring demonstrates all objectives have not been fully met, the original actions may be revisited or altered, and on occasion, new actions may be introduced to meet the original Project objectives. This adaptive management approach described above is a continuous cycle of action, monitoring, learning and responding to improve outcomes and adapt to changing conditions.

7. Other Considerations

The following are some additional areas for consideration when developing and implementing Projects.

7.1 Integration with Research and Development

Consideration should be given to how habitat plans can be developed to integrate with research and development opportunities. This could involve

utilising new and novel technologies and techniques to identify, target and monitor habitat protection, restoration and improvement measures.

7.2 Cultural and Socio-Economic Factors

Cultural and socio-economic factors often influence land and water use in ways that can challenge the protection and restoration of salmon habitats. However, the protection of salmon habitats also has cultural and socio-economic benefits. Projects should include expertise that reflects these realities, combining economic analysis with cultural and Indigenous perspectives to understand trade-offs and build shared priorities.

Habitat initiatives should apply socio-economic tools and natural-capital approaches to demonstrate the broad value of healthy salmon ecosystems, including their contributions to food security, cultural identity, community well-being and local economies. Embedding these benefits within national and international biodiversity, restoration and / or climate commitments, as applicable and relevant, can strengthen justification for conservation action. The concept of natural capital, and the ecosystem services it generates, should be researched and utilised in decision-making processes (see Section 5.3).

Policies and decisions must be transparent and inclusive, ensuring Indigenous Peoples are engaged as rights-holders and partners, not just stakeholders. The 2023 NASCO Special Session on Indigenous Perspectives and Roles in Salmon Conservation highlighted that Indigenous Knowledge systems, guided by ideas such as 'two-eyed seeing', provide essential insight for sustaining salmon habitats. Recognising Indigenous cultural and spiritual relationships with salmon, and supporting Indigenous-led monitoring and restoration, will lead to more resilient, place-based outcomes across jurisdictions.

This approach may include placing those requirements in the context of national and / or international commitments and targets on biodiversity and nature restoration, as applicable and relevant.

7.3 Reference Materials

To further inform the development of Projects, NASCO has prepared a reference list of relevant technical literature, agreements and best-practice literature relevant to the field of protection, restoration and improvement of salmon habitat, which can be accessed via the NASCO website. Development of future Projects should also be informed by the latest advances in the field of habitat protection, restoration and improvement science.

7.4 Cross-cutting Opportunities

Many of the benefits of these Projects can be cross-cutting in nature, benefiting other habitats and species. Opportunities should be recognised on how Projects could complement national and international plans. Efficiencies and synergies should be developed when possible.

7.5 Partnerships

The development of partnerships can significantly improve the impact and success of habitat Projects. Roles and responsibilities should be clearly

identified and monitored to ensure the effective and efficient use of resources. Many funding bodies will expect partners with specific expertise to develop successful Projects. Co-operation and formal Project management will aid in maximising benefits. Salmon habitat Projects would benefit from environmental networks with complementary expertise.

7.6 Communication and Outreach

To maximise Project impact, effective communication should be developed to deliver information on key benefits to a wide audience, including groups of stakeholders and Indigenous Peoples. The development of suitable communication materials and styles should be agreed and co-ordinated by partners to ensure key messages can be communicated in a range of formats.

Overview of Essential Atlantic Salmon Habitats

As noted in Section 2, Atlantic salmon has a complex life cycle and complex habitat requirements. 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.

Life History Stage	***Habitat Description***	***Requirements***	***Impact Factors***
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. Several 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.	• Permeable substrate of gravel and cobble size with an adequate flow of cool, well oxygenated water; and • in proximity to juvenile rearing habitat.	• Changes in land use / management; • increased siltation / sedimentation; • changes in substrate (e.g. gravel removal); • changes in river morphology (e.g. channelisation); and • changes in water temperature, water quantity (e.g. reduced base flows) and quality (e.g. domestic and industrial effluents and nutrient enrichment).

Life History Stage	*Habitat Description*	*Requirements*	*Impact Factors*
Juvenile rearing	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 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.	• Well-connected freshwater areas comprising repeated sequences of diverse stream elements, for example pools, riffles and glides (with cool, clean, well-oxygenated water); • adequate food supply; • cover for shade and protection from predation and severe environmental events; and • open coarse substrate of heterogeneous size.	• Increased siltation / sedimentation; • changes to shelter / cover (e.g. removal of instream boulders and large woody materials, stream fragmentation due to barriers to migration, removal of bankside vegetation); • changes in substrate; • changes in river morphology; • changes in water temperature, quantity and quality; • changes to the food supply (e.g. reduction in invertebrate production); and • changes in species composition and abundance (e.g. introduction of non-native species, increase in predators).

Life History Stage	*Habitat Description*	*Requirements*	*Impact Factors*
In-river migration (parr, smolts, pre-spawning adults and kelts)	Parr migrate to different habitats seasonally. Smolts migrate to sea in spring. Pre-spawn adults migrate upstream to the spawning grounds. After spawning, kelts move downstream and eventually to sea. When migrating, adult salmon often will pause for days, weeks or months.	Migration corridors free from physical, chemical or biological barriers that prevent or impede: • in-river movements of parr (e.g. to over-wintering habitat or thermal refugia); • downstream movements of smolts and kelts to the estuary / sea; and • upstream migration of adults to spawning grounds. Salmon that pause during their migration require: • deep pools with cool, clean, well oxygenated water; and • cover for shade and protection from predation and severe environmental events. Water flow and temperature are important factors.	• Physical, chemical and biological barriers to migration; • changes in river morphology; • changes in water temperature, quantity and quality; • predator interactions; • increased siltation / sedimentation; • changes to shelter / cover; and • changes in substrate.

Life History Stage	*Habitat Description*	*Requirements*	*Impact Factors*
Estuarine migration (smolts, pre-spawn adults and kelts)	During outward migration, smolts undergo drastic physiological changes to adapt to salt water. In most cases, smolts migrate quickly through estuaries and near shore areas, but local geography can influence migration time and possible stressors. The same applies to kelts. Pre-spawn adults returning to freshwater may need to wait in estuaries for favourable conditions for upstream migration. All life-phases are subject to increased predation pressures in estuaries.	• Uninterrupted migration routes in estuaries with clean waters; • intact native estuarine vegetation; and • naturalised freshwater and tidal flow regimes.	• Obstructions to migration; • changes in estuarine morphology possibly leading to increased predation; • changes in water temperature, quantity and quality; • changes in species composition and abundance of predator; • modification of freshwater and tidal flow regimes; and • loss of native estuarine vegetation.

Annex 2

Examples of Legislation for the Protection of Atlantic Salmon Habitats

Canada

In Canada there exists a variety of federal and provincial policies and legislation, as well as assertions of Indigenous authority that support the protection and conservation of Atlantic salmon habitat.

Examples of Canadian legislation and federal policy that provide protection for Atlantic salmon habitat:

- ***Fisheries Act*** – Canada's primary legal instrument for fish and fish habitat protection, including prohibitions on the harmful alteration or destruction of fish habitat and the deposit of harmful substances in waters frequented by fish. https://laws-lois.justice.gc.ca/eng/acts/f-14/;
- ***Species at Risk Act*** – Provides for the recovery of extirpated, threatened, and endangered wildlife as a result of human activity and to manage species of special concern to prevent them from becoming endangered or threatened, https://laws-lois.justice.gc.ca/eng/acts/S-15.3/;
- ***Oceans Act*** – Enables the creation of Marine Protected Areas for the conservation of fishery resources and critical habitat. https://laws-lois.justice.gc.ca/eng/acts/O-2.4/;
- ***Impact Assessment Act*** – Requires designated projects to assess and mitigate effects on fish and fish habitat, including freshwater and marine environments used by Atlantic salmon. https://laws-lois.justice.gc.ca/eng/acts/I-2.75/;

Canada's approach to Atlantic salmon conservation is guided by:

- ***Canada's Wild Atlantic Salmon Conservation Policy (2018)*** – https://www.dfo-mpo.gc.ca/reports-rapports/regs/wildsalmon-atl-saumonsauvage-eng.htm; and
- ***Canada's National Strategy to Ensure the Future of Atlantic Salmon (2024-2036)*** – https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41286686.pdf.

Canada's adoption of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), which came into Canadian law through the UNDRIP Act (2021), https://www.justice.gc.ca/eng/declaration/about-apropos.html, has enabled increased recognition of self-determination for habitat stewardship and monitoring, as well as First Nations, Inuit and Co-Management bodies. Examples include Aboriginal Aquatic Resource Oceans Management bodies, https://aarom.ca/, and a variety of Indigenous community-based conservation departments.

EU

- ***EU Water Framework Directive (2000/60/EC)*** – The main purpose is for member states to manage water resources and to protect or restore the quality

of all waterbodies (inland, transitional and coastal waters) in order to reach 'good' status (meaning both good chemical and ecological status), and to prevent deterioration. https://environment.ec.europa.eu/topics/water/water-framework-directive_en;

- ***EU Habitats Directive (92/42/EEC)*** – Annex II lists animal and plant species whose conservation requires the designation of Special Areas of Conservation (SAC) as part of the Natura 2000 network. Atlantic salmon are included as an Annex II species, and therefore in SACs including Atlantic salmon as a qualifying interest, protection of salmon and their habitats is legislated for as part of the site-specific active conservation measures. https://environment.ec.europa.eu/topics/nature-and-biodiversity/habitats-directive_en;
- ***Inland Fisheries Act 2010*** – This Act established Inland Fisheries Ireland (IFI) as the national state agency responsible for managing and protecting Ireland's inland fisheries and sea-angling resources. Through IFI, the state can take action to protect and rehabilitate habitats utilised by salmon (e.g. spawning grounds, migratory routes). https://www.irishstatutebook.ie/eli/2010/act/10/enacted/en/print#sec7;
- ***The Fisheries (Consolidation) Act 1959*** – This Act plus subsequent amendments make it a statutory offence in Ireland to willfully obstruct passage of salmon, disturb spawning grounds or discharge deleterious matter into waters. https://www.irishstatutebook.ie/eli/1959/act/14/enacted/en/html;
- ***EU Environmental Impact Assessment (EIA) Directive (2011/92/EU as amended by 2014/52/EU)*** – This Directive requires member states of the EU to carry out assessments of the environmental impact of major building or development projects before they are allowed to proceed. If significant impacts on salmon habitat are identified, the competent authority can only consent to the project if avoidance or mitigation measures are applied. https://environment.ec.europa.eu/law-and-governance/environmental-assessments/environmental-impact-assessment_en; and
- ***EU Strategic Environmental Assessment (SEA) Directive (2001/42/EC)*** – This Directive requires EU member states to carry out assessments of the environmental effects of proposed plans and programmes specific before they can be adopted. https://environment.ec.europa.eu/law-and-governance/environmental-assessments/strategic-environmental-assessment_en.

Iceland

- ***Act on Salmon and Trout Fishing (Lög um lax- og silungsveiði)*** – https://www.althingi.is/lagas/nuna/2006061.html. Sections not related to habitat but migration are:
  - Section 14.gr. states that it is illegal to fish salmon at sea;
  - Section 21.gr. restricts fishing in estuaries;
  - Section 22.gr. states that when laying nets in rivers you cannot lay the nets across the river's centreline;

- Section 33.gr. is the most important for passive protection. It states that you need permission for any structure or action within 100m from a river or lake bank; and
- Section 35.gr. is on mitigation measures (fishways) if you get permission for structures;

- ***Nature Conservation Act 2013 No. 60 10 April (Lög um náttúruvernd)*** – https://www.althingi.is/lagas/nuna/2013060.html. Mostly a general law on nature conservation but Section 62.gr. is on protection of bank vegetation; and
- ***Water Management Act (Lög um stjórn vatnamála)*** – https://www.althingi.is/lagas/nuna/2011036.html. Iceland has implemented the water framework directive from the EU.

Norway

- ***National Salmon Rivers*** – St.prp. nr. 32 (2006-2007) - regjeringen.no. These are designated watercourses given special protection to preserve wild Atlantic salmon habitats. A special protection regime applies to the National Salmon Rivers to ensure that new interventions do not significantly affect the wild salmon. The salmon stocks included will also be prioritized for other measures aimed at strengthening the populations. Norway has 52 National Salmon Rivers;
- ***Protection Plan for River Systems*** – St.prp. nr. 53 (2008-2009) - regjeringen.no. This is a scheme where entire or parts of watercourses are protected primarily against hydropower development, but other values that formed the basis for the protection must also be taken into account. A total of 118 salmon rivers, or part of such, are protected against further hydropower development - thus, this Protection Plan plays a role in the effort to protect Atlantic Salmon habitats in Norway;
- ***Act Relating to Salmonids and Fresh-water Fish*** – Lov om laksefisk og innlandsfisk mv. (lakse- og innlandsfiskloven) - Lovdata The purpose of this Act is to ensure that natural stocks of anadromous salmonids, freshwater fish and their habitats, as well as other freshwater organisms, are managed so that the diversity and productivity are preserved. The Act includes a **Regulation on Physical Measures in Watercourses** (Forskrift om fysiske tiltak i vassdrag - Lovdata, that intends to safeguard fish habitats and other biodiversity when new interventions in watercourses are planned/carried out; and
- **The Water Resources Act** – Lov om vassdrag og grunnvann (vannressursloven) - Lovdata The purpose of this law is to ensure a socially responsible use and management of watercourses and groundwater. The law does not directly address salmon, but it will indirectly have a positive effect on salmon habitat as it imposes requirements such as minimum water flow (E-flow), riparian vegetation etc.

In addition, Norway also has legislation such as the **EU Water Framework Directive** (through a separate Norwegian regulation 'Vannforskriften'), **The Norwegian Nature Diversity Act**, the **Pollution Control Act**, etc.

UK

- ***Salmon and Freshwater Fisheries Act 1975*** –
  - Part II Obstructions to Passage of Fish https://www.legislation.gov.uk/ukpga/1975/51/part/II/enacted; and
  - Part I Section 2 Roe, spawning and unclean fish, etc. https://www.legislation.gov.uk/ukpga/1975/51/section/2/enacted;
- ***Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003*** –
  - Section 23 Young salmon and spawning beds https://www.legislation.gov.uk/asp/2003/15/section/23; and
  - Section 10 Offences in relation to passage of salmon https://www.legislation.gov.uk/asp/2003/15/section/10;
- ***Fisheries Act (Northern Ireland) 1966*** –
  - PART IV PROTECTION OF FISHERIES Protection of young and breeding fish https://www.legislation.gov.uk/apni/1966/17/part/IV; and
  - PART IV PROTECTION OF FISHERIES Obstructions to passage of fish - https://www.legislation.gov.uk/apni/1966/17/part/IV/chapter/n2;
- ***Foyle Fisheries Act (Northern Ireland) 1952*** –
  - PART VI PROTECTION OF FISHERIES Protection of young and breeding fish - https://www.legislation.gov.uk/apni/1952/5/part/VI/chapter/n3;
- ***The Conservation of Habitats and Species Regulations 2017*** – Part 2 Conservation of Natural Habitats and Habitats of Species https://www.legislation.gov.uk/uksi/2017/1012/part/2;
- ***The Conservation (Natural Habitats, &c.) Amendment (Scotland) Regulations 2004*** – https://www.legislation.gov.uk/ssi/2004/475/contents/made;
- ***The Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017*** - https://www.legislation.gov.uk/nisr/2017/81/contents/made;
- ***The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017*** - https://www.legislation.gov.uk/uksi/2017/407/contents;
- ***Water Environment and Water Services (Scotland) Act 2003*** - https://www.legislation.gov.uk/asp/2003/3/contents;
- ***The Town and Country Planning (Environmental Impact Assessment) Regulations 2017*** - https://www.legislation.gov.uk/uksi/2017/571/contents;
- ***The Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017*** - https://www.legislation.gov.uk/wsi/2017/567/contents;
- ***The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017*** - https://www.legislation.gov.uk/ssi/2017/102/contents; and

- ***The Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 2017*** - https://www.legislation.gov.uk/nisr/2017/83/made.

US

Endangered Species Act Section 4. Determination of Endangered Species and Threatened Species | U.S. Fish & Wildlife Service

GLOSSARY

Active Improvement – interventions to repair or partially recover ecological functioning that benefits biodiversity, in scenarios where the potential for full ecosystem recovery is not feasible due to the scale of damage or competing human needs.

Active Restoration – the deliberate, hands-on process of intervening in a heavily damaged or degraded habitat that has lost natural processes and its capacity to recover unaided, in order to reestablish its functional capacity and biodiversity and accelerate its recovery.

Adaptive Management – a systematic process for continually improving management policies and practises by learning from the outcomes of operational programmes.

Catchment – area from which a given body of flowing or standing water is fed through catching and collection of water over a natural drainage area[5].

Channelisation – river and stream channel engineering activities that include straightening, widening, deepening, or relocating existing stream channels[6].

Compensation / mitigation – restoration, establishment, improvement or preservation of natural resources to offset unavoidable adverse impacts to those resources caused by a development project or activity.

Ecological flow – the water quantity and flow regime needed to maintain a healthy and functional aquatic (i.e. stream, river and estuarine) ecosystem.

Heterogeneous size – a mixture of sizes, i.e. a mix of sand, gravel and pebbles.

Hydrogeomorphic – the study of the dynamic interactions between hydrological processes (like water flow and movement) and geomorphic processes (like erosion and landform creation).

Juvenile – young stages of animals, usually between the post larval stages up to the time they become sexually mature[5].

Kelt – a post-spawning mature salmon that has survived reproduction and has not yet recovered its weight or re-entered saltwater[5].

Native Biodiversity – the biological diversity of plant and animal species that occur naturally in each area or region.

Naturalised freshwater – freshwater bodies, i.e. rivers, that have been returned to a more natural state through the restoration of original, self-sustaining natural processes.

[5]FAO. 1978. Glossary of inland fishery terms, EIFAC Occasional Paper No. 12, https://www.fao.org/3/ae987b/ae987b.pdf.

[6]United States Environmental Protection Agency. 2007. National Management Measures to Control Nonpoint Source Pollution from Hydromodification. EPA 841-B-07-002. 287p.

GLOSSARY

Parr – the juvenile stage of development in the life of a salmon before the fish develops into a smolt. Usually fish more than one year old, which have developed parr marks (distinctive vertical bars on the sides) and are actively feeding in fresh water. This stage comes after the alevin stage, which develops from the egg and still has a yolk sac, and the fry stage, at which the yolk sac is absorbed and the fish is usually less than one year old[7].

Passive Restoration – habitat recovery that occurs once the source(s) of degradation are removed. This is suitable for less severely damaged systems where there is a sufficient timeframe to allow for longer-term natural recovery rates, where natural habitat processes are still intact and nearby populations exist to allow recolonization.

Pre-spawn adult – mature fish that has migrated from the ocean back into freshwater rivers and is in the final stage of preparing to reproduce (spawn) but has not yet deposited or fertilized eggs[7].

Re-meandering – reconnecting a cut-off meander, i.e. a U-form taken by a river, or creating a new meandering course, where rivers have been straightened by cutting off meanders[8].

Smolt – a juvenile salmon which has undergone metamorphosis and is ready to migrate, usually found on its way downstream toward the sea[5]. Metamorphosis is a process by which the salmon undergo physiological changes like losing their parr marks and slowly changing to be more silver in colouring, as well as changing internally to prepare for the saltwater environment.

Stressor – threat that both directly impacts Atlantic salmon productivity and indirectly intensifies the impacts of other pressures across the species' life cycle[9].

Tidal flow regime – the patterns of tides (i.e. the regular rise and fall of the sea surface) in a specific geographic location.

Two-eyed seeing – (Etuaptmumk in Mi'kmaw) learning to see from one eye with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of mainstream knowledges and ways of knowing, and to use both these eyes together, for the benefit of all[10].

Uncompacted substrate – riverbed surface material i.e. gravel, rocks and boulders, that has a relatively low density and a high volume of pore space (gaps for air and water).

[7]Fish-uk. 2007. Fishing Dictionary - A to Z of fishing words and terms with their meanings. (Accessed 27 November 2025).
[8]NWRM project (Service contract 07.0330/2013/659147/SER/ENV.C1). N4: Re-meandering, 10pp. n4_-_re-meandering.pdf (Accessed 27 November 2025).
[9]Damon-Randall, K. and Hatfield, E. 2024. Drafting NASCO's Draft Strategy and Action Plan, CNL(24)69.
[10]Reid, A.J. *et al.* 2021. "Two-Eyed Seeing": An Indigenous framework to transform fisheries research and management. Fish and Fisheries, 22, 243-261. https://doi.org/10.1111/faf.12516



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