A Model for Freshwater Habitat Compensation Agreements Based on Relative Salmonid Production Potential of Lakes and Rivers in Insular Newfoundland, Canada

by

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Abstract

Under the Policy for the Management of Fish Habitat and the "no net loss" guiding principle of the Department of Fisheries and Oceans Canada, no harmful alteration, disruption, or destruction (HADD) of fish habitat may proceed without an authorization by the Minister under Subsection 35(2) of the Fisheries Act. Authorizations are not normally to be issued until adequate measures have been developed to compensate for the habitat which is to be harmed, altered, disrupted, or destroyed. In Newfoundland's lakes and rivers occupied by migratory salmonids, substantial variation in habitat use occurs both seasonally and annually and fish numbers or biomass measured over a short term cannot be considered as representative of potential productivity. In this paper, estimated average values of Atlantic salmon (Salmo salar) smolt production in Newfoundland lakes and rivers are used in a calculation of the relative production potential of the two habitat types. The calculated relationship suggests that appropriate compensation for a hectare of lake habitat which is to be harmed, altered, disrupted, or destroyed might be the creation of, or making available for use, 0.023 hectare of river suitable for salmonid habitat. Alternatively, appropriate compensation for a hectare of river habitat which is to be harmed, altered, disrupted, or destroyed might be the creation of, or making available for use, 42.857 hectares of lake suitable for salmonid habitat.

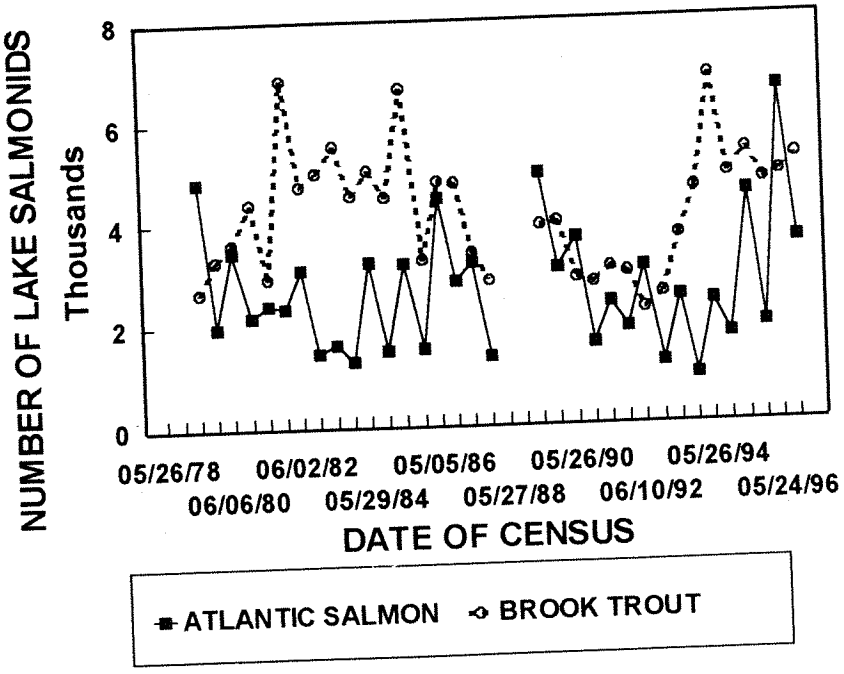
Introduction

As described in the Directive on the Issuance of Subsection 35(2) Authorizations (Anon. 1995), an objective of the Department of Fisheries and Oceans Canada is the maintenance of the productive capacity of fish habitats supporting Canada's fisheries resources. Under the Policy for the Management of Fish Habitat and the "no net loss" guiding principle of the Department, no harmful alteration, disruption, or destruction (HADD) of fish habitat may proceed without an authorization by the Minister under Subsection 35(2) of the Fisheries Act. Authorizations are not normally to be issued until adequate measures have been developed to compensate for the habitat which is to be harmed, altered, disrupted, or destroyed.

In cases where habitat loss will occur in lake (lacustrine, pond, or standing water) or river (fluvial, riverine, or running water) habitats of river systems and compensation measures are being developed, it would be advantageous to have a measure of the relative production potential of these two major habitat types. If a correspondence existed, lost lake habitat (ie. in the case of reservoir creation) might be compensated for by creation of river habitat, provided that the overall productive capacity of the total fish habitat was maintained. A measure of the correspondence between the production potentials of the two habitat types would increase the options available for satisfactory compensation agreements.

In Newfoundland fresh waters occupied by river-spawning salmonids such as Atlantic salmon (Salmo salar) and brook trout (Salvelinus fontinalis), substantial variation in habitat use occurs both seasonally and annually due to the migrations of the species to and from the available habitat types (ie. Knoechel and Ryan 1994, Ryan 1993a, Ryan 1994) (Fig. 1).

Figure 1. Variation in salmonid lake habitat use as exemplified by variation in population sizes of brook trout and Atlantic salmon in two lakes (area = 112.6 ha) of central Newfoundland. For further details on these lakes and the methods employed in the calculation of population sizes see Ryan (1993a, 1993b).



Financial and temporal constraints often apply to environmental assessment processes and fish numbers or biomass measured over a short term cannot be considered as representative of potential productivity. The following method employs estimated average values of Atlantic salmon smolt production in Newfoundland lakes and rivers in the calculation of relative

production potential of the two habitat types. The calculated relationship may be used as an aid in the calculation of habitat of one type required to replace habitat of the other type which is to be harmed, altered, disrupted, or destroyed.

Methods

As described by Dempson and O'Connell (1993) and O'Connell and Dempson (1995), smolt production figures considered representative of average values of Atlantic salmon smolt production in lakes and rivers are used in the assessment of target spawning requirements for salmon stocks in Newfoundland river systems. These estimates factor in the potential contribution of both fluvial and lacustrine habitats (Fig. 2).

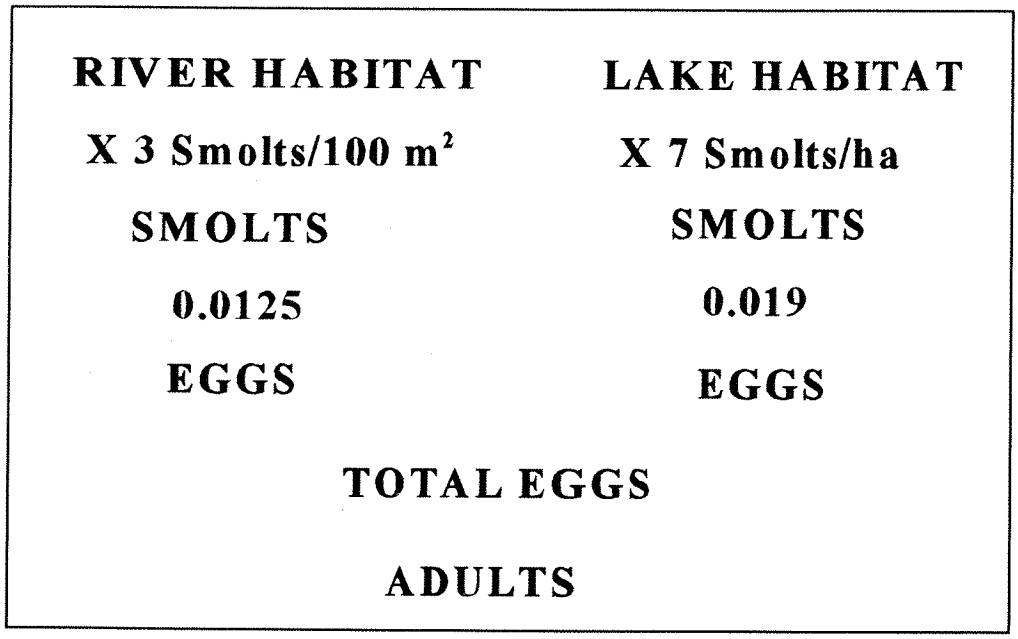


Figure 2. Representation of the model used to calculate target Atlantic salmon egg deposition requirements in Newfoundland river systems. The values 0.0125 and 0.019 are estimated egg-to-smolt survival rates in the two habitat types. Redrawn from Dempson and O'Connell (1993).

Average production values in the two habitat types have been calculated from data such as recommended salmon egg deposition rates for rivers in Atlantic Canada (Elson 1975), relative amounts of lake and river habitat on different rivers systems, and the use of salmon counting fences. Smolt production values from each habitat type are converted to egg deposition using egg-to-smolt survival rates.

Based upon this model used for salmon stock assessment purposes, salmon production potentials in lacustrine (or lake) and riverine (or river) habitats can be related as follows:

Since:

-lake production = 7 smolts/hectare; and

-river production = 3 smolts/100 square metres or 300 smolts/hectare; then

-one hectare of river potential production = 300/7 = 42.857 hectares potential lake production; or

-one hectare of lake potential production = 7/300 = 0.023 hectare potential river production.

This comparison suggests that appropriate compensation for a hectare of lake habitat which is to be harmed, altered, disrupted, or destroyed might be the creation of, or making available for use, 0.023 hectare of river suitable for salmonid habitat.

Alternatively, the comparison suggests that appropriate compensation for a hectare of river habitat which is to be harmed, altered, disrupted, or destroyed might be the creation of, or making available for use, 42.857 hectares of lake suitable for salmonid habitat.

Discussion

Use of the Atlantic salmon stock assessment model does not appear to preclude the application of a correspondence between the habitat types in the case of other salmonids or species mixes. There is strong evidence that similar salmonids occur in patterns of reciprocal abundance in waters of Newfoundland (Ryan 1993b) and elsewhere (Rose 1986). Since the stock assessment model employs figures representative of average values of Atlantic salmon smolt production, it can be expected that varying population sizes of similar salmonids would have occurred in the locations used in the calculation of model parameters.

Application of a correspondence between the habitat types requires consideration of habitats critical to the survival and well-being of the species in question. For example, the lack of availability of suitable river spawning areas near newly available lake habitat would obviously be detrimental to the long-term survival of river-spawning fish. Similarly, the availability of deeper water habitats for greater overwinter survival would provide for a more optimum use of newly available river areas.

Application of the correspondence between habitat types as described above cannot be considered mandatory or optimal in any given situation due to a variety of circumstances such as the possible presence of exceptional stocks (ie. trophy fish stocks) and particular habitats (ie. very popular fishing areas or critical spawning areas). However, the correspondence of potential salmonid

production between the two habitat types described above may serve as a model for use in the preparation of freshwater habitat compensation agreements in many circumstances in insular Newfoundland.

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