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FISH HABITAT CONSIDERATIONS ASSOCIATED WITH HYDRO-ELECTRIC DEVELOPMENTS IN QUEBEC REGION

Figure 1: Map of the Department of Fisheries and Oceans' (DFO) six administrative regions.

Context

Hydro Quebec is considering two new, large hydro-electric power generation facilities. The approach commonly used for evaluating impacts of undertakings on productive fish habitat under the no-net-loss habitat policy will not apply readily to projects on the proposed scale. Hydro Quebec has been exploring alternative approaches for evaluating the effects of large hydroelectric on fish habitat, and asked DFO to provide feedback on their progress. A report prepared by Hydro Quebec was presented to a meeting organized by DFO-CSAS, and provided the basis for discussion and the conclusions below.

SUMMARY

- The arguments presented for needing to use different methods for quantifying productivity and/or abundance - upstream and downstream; before and after - are sound. No single method would produce scientifically sound estimates under all the four situations, let alone produce the best estimates under every set of conditions.

- For each of the four specific situations – upstream before the dam, upstream after the dam, downstream before, and downstream after – the proposed methods for habitat and fish abundance quantification were considered reasonable and practical to use under the circumstances. Concerns were expressed, however, over methods relying on the morpho-edaphic index of a lake in predicting fish abundance. Arguments tabled indicate that the

methods seem to have reasonable robustness to major sources of uncertainty, and provide estimates which, considering the latitude, climate, general habitat of the areas and past experience, correspond to expectations. In most cases, however, further technical refinements are possible.

- Habitat Management in DFO, la Société de la faune et des parcs du Québec, le Ministère de l'Environnement du Québec and the proponent are prepared to work together on the outstanding methodological issues. It was proposed that a technical working group of all the parties be established to continue the necessary work, and hold technical workshops where issues could be explored in more depth. There would be benefits from having scientists in other regions connected to this technical working group in some way, both to entrain more expertise in the process, and because the implications of some of the questions being explored will extend beyond just the Quebec Region.

- The methods planned for use to estimate species composition in the upstream-after condition have precedents in the scientific literature, but are particularly in need of further examination, monitoring during and after the project (should it proceed), and validation under local conditions. There is also particular concern with the 0.7:1 scaling of river to reservoir productivity and some participants supported use of a 1:1 ratio as more precautionary. The scaling value requires further careful investigation, and testing the catch efficiency of gill nets in rivers and lakes should be part of that investigation.

- To this point, implementation of the no-net-loss guiding principle of DFO's Policy for the Management of Fish Habitat has not condoned the use of a habitat budget for "fish". For example it has not been considered consistent with the policy to balance sturgeon losses downstream and whitefish gains upstream of a dam. For the proposed methods for quantifying or estimating project impacts on fish communities to be acceptable, there will have to be a shift in DFO policy relative to applying the no-net-loss policy rigidly on the scale of individual species. Science can contribute factual information to the dialogue and likely consultation on such a policy change, and explore as far as the scientific information will allow the consequences of various options. However, it is stressed that it is a policy choice, not a science issue to accept approaches which may maintain productivity of fish biomass but do not maintain the same species composition.

DESCRIPTION OF THE ISSUE

The guiding principle of no-net-loss is expressed in terms of productive capacity. Tested methods can provide reliable estimates of productivity and biomass for small streams, but productive capacity is difficult to measure for large water bodies. There are robust methods for estimating the productivity of lake or reservoir, but partitioning the production among species is more problematic and often impossible. Productive capacity of large rivers is especially hard to measure. These complications pose practical impediments to narrow interpretation and application of the policy for large hydro-electric projects, which involve small and large rivers as well as lakes and reservoirs.

Both projects, and particularly the Eastmain 1A-Rupert River diversion, will convert long stretches of river into reservoir, and reduce the flow in the rivers below the impoundments, at least at some times of year. By creating reservoirs from small rivers and reducing the flow

seasonally in large rivers all the problems with measuring productive capacity by species for large water bodies and large rivers will have to be addressed for these projects.

The nature of the changes “upstream” and “downstream” from the dams are fundamentally different. Upstream the change will be from a river to a reservoir; downstream from a moderate to large river to a smaller river with regulated flow. These changes are different enough that in practice it will be impossible within the nature of the project to identify the potential losses of productive capacity of the habitats on a species by species basis. Is no-net-loss to be accounted for on this scale, or are other methods of accounting consistent with the overall objectives of DFO’s Policy for the Management of Fish Habitat Management?

ASSESSMENT

The Proposed Methods

For streams and small rivers, estimates of biomass and productivity will be obtained from established methods of electrofishing, combined with accurate maps of the river and stream characteristics. It has been argued that widely used analytical methods, such as Habitat Suitability Indices, were difficult to apply throughout large study areas and that suitability as a surrogate to productivity could not be applied in these cases. It has been explained and discussed that habitat productivity indices methods could be more appropriate, although further work is needed to establish their robustness and uncertainty for these specific conditions.

For lakes and reservoirs, biomass and production will be estimated from models starting with the morpho-edaphic index and measures of lake/reservoir area. The productivity will be partitioned among species according to BPUE in surveys of existing lakes and reservoirs. Major uncertainties include the relative catchabilities of different species in the survey gears, whether the CPUE and MSY estimates from lakes will apply accurately to reservoirs, and the reliability of biomass and production predictions using the morphoedaphic index .

With the approach a major challenge to applying the no-net-loss policy on a species-by-species basis is that population estimates upstream of the impoundments will be MSY based whereas downstream will be BPUE based. A conversion factor is needed, and a ratio of 0.7:1 is being proposed for rivers to reservoirs. The basis for the 0.7:1 scaling factor was questioned, and some participants favoured a 1:1 scaling option as more precautionary.

The proponent of the methodology acknowledges that in large-scale projects not all habitats can be replaced on a one-for-one basis. It is proposed that mitigation and/or compensation should be considered on a case-by-case basis and related to:

- Importance of impact on fish production
- Geographic range of the impacts
- Regional fisheries management objectives, including objectives for commercial, recreational, and subsistence fisheries, and for biodiversity conservation.
- Special attention to SARA-listed species, particularly Atlantic salmon and lake sturgeon.

Outstanding Science Issues from the Review

Agreement that the allocation of production / productivity among species will be problematic. Historic sampling data from past monitoring and impact assessments of previous hydroelectric developments are proposed for use. These are the best data available, but concerns about ability to relate relative species abundances in the samples to relative abundance in the lakes are legitimate. Assumptions about differential catchability of species in pelagic and littoral zones are tenuous and catchability may even differ between near-shore areas and comparable depths in the water column of deeper areas.

Some additional field sampling is likely needed in the areas that would be impacted by the developments. This sampling should focus on the status and life histories of potentially threatened or endangered species, and species important to commercial, recreational, and subsistence fisheries.

There are concerns about the technical methods used to carry the uncertainties which are presented in the sampling and monitoring data into the forecasts about future abundances in different parts of the two systems. More work on the risk quantification taking account of these uncertainties is warranted.

Also related to uncertainty, the proposal attempts to use habitat classification methods to reduce uncertainty about abundance measures and forecasts. By measuring or predicting the areas of each habitat type, and having the expected abundance in each habitat type, the summed estimates should have much less uncertainty than overall abundance. This is reasonable but has the potential to underestimate uncertainty if the assignment to habitat classes is considered to be without error. Some further work could be done to optimise how many habitat categories and what boundary locations are best, relative to the variance of abundance within each class.

It is acknowledged that there are no “unimportant” habitats nor “unimportant” species. Nonetheless federal and provincial objectives for managing freshwater habitats and fish populations do not necessarily give equal weights to all species and habitats. For example, there are special legal obligations associated with species protected under the federal Species-at-Risk Act. Currently federal and provincial fisheries management and biodiversity conservation objectives are not sufficiently clear and explicit for this region. More focused dialogue at the policy level is needed to make the management objectives of both levels of government clear and explicit in these areas. This dialogue can be informed by science information, but it must be led by the governance system, not by science.

Predictive models of fish population characteristics presented in the background papers use temperature as a covariate in the predictions. These models have been well tested, but need to be parameterized for exactly the range of temperatures that will be associated with these projects, and validated to the extent possible for the local area.

It was unclear how fully the models could be validated however, in part because of the nature of the changes that would be associated with these projects – creating completely new lake-like habitat from streams and rivers. Promising lines of investigation were identified, however. There may be data available from past monitoring of the LaGrande system which would allow model predictions using HPI before and after construction to be tested for that system. It could also be tested for selected bays in larger reservoirs, rather than for the entire reservoir, as more

informative about performance under conditions likely to be encountered in downstream applications.

Habitat suitability index methods take no account of the ecological flexibility that a species may show to small or to moderate changes in habitat availability. Further investigation is warranted of the potential for fish populations to adapt to at least some degree of habitat change under these conditions. Parts of this work could be done efficiently within the additional field sampling called for above. Policy discussions regarding necessary mitigation and acceptability of the proposed projects would also have to decide how to take account of any demonstrated capacity of fish to adapt.

CONCLUSIONS AND ADVICE

This meeting represented a review of progress to date, and was not intended to produce final conclusions or advice on the issues. Participants agreed the discussion was valuable to both the industry and the regulators. All participants agreed to continue to work together on a number of technical issues, but also agreed that not all issues had technical solutions and some policy discussions would also be needed.

FOR MORE INFORMATION

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