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Protecting Aquatic Species from Climate Change Impacts

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Issue

The frequency of extreme climate events in Canada has almost doubled over the past 40 years (Groisman and Easterling, 1994; Rodenhuis et al., 2007). As the atmosphere warms, the climate becomes hotter and more variable. Climate models forecast fewer mild winter storms but a greater frequency of very severe storms (IPCC WG I, 2007; Spittlehouse, 2008). Extreme rainfall events and floods will have hydrologic and geomorphic impacts on the composition and structure of fresh water habitat for many aquatic species. More severe storms and flooding will translate into more sediment and debris entering streams affecting the spawning and rearing habitats for fish and other aquatic species. Although recent legislation in British Columbia intends to address broad ecosystem impacts of forestry activities (e.g. Wild Salmon Policy, 2005), major drivers such as climate change are not included in policy design and objectives. This briefing note identifies key recommendations that could address this gap in policy design.

Background

Forests help to regulate critical riparian activities, especially in the face of major disturbances such as climate change. Specific interactions between forests and fish (and other aquatic species) need to be considered in forest policies. For instance, the branches and trunks of large trees that fall into the streams, known as large woody debris (LWD), provide physical structure and habitat in streams, capture sediments eroded by rainfall, trap organic matter, and provide cover from predators. Many aquatic species in the Pacific Northwest, including the commercially significant Pacific salmon, are sensitive to elevated turbidity and suspended sediment concentrations (SSC) in streams, which are directly influenced by the amount of rainfall on the watershed. Elevated SSC impairs water quality and threatens aquatic

organisms. Fine sediment that settles or moves in suspension in streams impairs water flow, which decreases dissolved oxygen concentrations and physically constrains young fish from emerging from the gravel.

In addition, the stream-forest canopy offers shade to streams, regulating stream water temperatures, and it provides habitat for the insects that juvenile fish prey on when they fall into the water. Salmon are particularly sensitive to changes in water temperature, projected to increase due to climate change (Rodenhuis et al. 2007), which can cause direct mortality of juveniles and contribute to behavioral changes in all life stages.

Forest canopies in a watershed intercept snowfall, reducing total snow accumulation (and subsequent melt) on the forest floor, which regulates snowmelt and water flows and helps prevent extreme flow events. Forest clear-cuts, on the other hand, accumulate higher snow packs that melt faster in the spring causing greater flows and velocities and greater risks to habitat (Harr et al., 1975; Jones, 2000). For instance, extreme flows, such as those generated in storms, drag large amounts of sediment and debris into streams.

In Canada, the provinces are responsible for administering water resources' property rights (surface and ground water) while federal government jurisdiction involves navigation, national parks, First Nations reserves, and aquatic resources (e.g., section 35 under the *Fisheries Act*). Current legislation and management policies for the protection of watersheds from sedimentation include the Canada Fisheries Act (1976), the Canada Policy for the Management of Fish Habitat (1986), the BC Fish Protection Act (1997), the Canada Species at Risk Act (2004), the BC Forest and Range Practices Act (2004), and the Canada Wild Salmon Policy (2005). Although policies for the protection of water bodies from forestry and other industrial activities started more than three decades ago, only recently have they begun to integrate ecosystem-based management policies and initiatives (e.g., the *Wild Salmon Policy*, 2005). Although concepts such as watershed-based management are becoming increasingly recognized in policy, their application requires changes in legislation, a stronger science-policy relationship, and updating the current watershed management frameworks.

While recent approaches include a broader view of ecosystem-level impacts some gaps remain. For example, the Forest and Range Practices Act (2004) (FRPA) regulates the activities of forest and range licensees in BC by establishing the requirements for logging operations, planning, road building and deactivation, reforestation, and grazing. The main objective of FRPA is to maintain high levels of protection for eleven forest values (including fish habitat), and to decrease the impact of forestry operations through effective planning processes for both government and industry.

Although FRPA's inclusion of a range of watershed and ecosystem values is a remarkable improvement over older policies, fish habitat still experiences constant degradation due to forestry activities and poor policy compliance (Quigley and Harper, 2006). Specifically FRPA does not require the protection of small fish-bearing streams (class S4) or their tributaries (classes S5 and S6) through the use of mandatory riparian buffers (Moola et al. 2004). Protection of stream classes S4, S5, and S6 as well as fisheries-sensitive zones should be a high priority for new management and policy development, particularly with the development of micro-hydro energy projects. Currently, most policies lack the broader, long-term objectives to address major disturbances in the resource such as the projected impacts of climate

change or the protection of sensitive areas such as headwaters and streams on agricultural land (Spittlehouse 2008).

Recommendations

Current federal and provincial policies designed to protect aquatic habitat and fish still need to go further to protect all habitat and watershed processes effectively. Maintaining the ecological integrity of watersheds will buffer fresh-water aquatic species against projected climate change effects, such as more frequent and severe extreme weather events and increased temperatures. Thus:

1. Watershed-based management should recognize high aquatic resource values while aligning with other commercial and non-commercial uses. Studies such as Knowler and Dust (2007) demonstrate that non-timber products have less impact and provide higher economic returns over the long term when compared to the revenue derived from timber harvesting alone.
2. Watershed-based management approaches that account for entire watershed processes could help minimize projected climate change impacts. Minimizing forestry activities in sensitive areas such as headwaters, will help maximize rainfall capture, thus avoiding scouring impacts that not only destroy stream habitat but also contribute to increased downstream flood risk. Identifying sensitive spawning areas could also minimize impact on habitat by avoiding intensive upstream timber harvesting.
3. Forests play a key role in maintaining ecological integrity and act as buffers to major disturbances for aquatic habitats. Acknowledging this role in maintaining ecosystem resilience against major disturbances such as climate change and in other natural systems is increasingly important.
4. Promoting a more interactive science-policy relationship will ensure sound scientific knowledge is taken into account prior to policy development. Forest-fish interactions are intensively researched in academic circles, and the literature and expert opinion offer great resources for policy makers.
5. Reinforcing monitoring and compliance protocols is necessary to maximize the benefits of watershed and forest-fish interactions. Engaging stakeholders in these activities can be critical for on-the-ground monitoring.

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