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CANADA

THE TRUE NORTH, STRONG AND FREE-FLOWING

Wild Rivers of the Great Bear

Front cover: A stream flowing through temperate rainforest in northwest British Columbia, Canada.

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WWF is one of the world’s most experienced independent conservation organizations, with over 5 million supporters and a global Network active in more than 100 countries. WWF’s mission is to stop the degradation of the planet’s natural environment and to build a future in which humans live in harmony with nature, by: conserving the world’s biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

INTRODUCTION

A unique group of wild rivers that connect land and sea in northern British Columbia's Great Bear region deserve greater recognition – and protection- as clusters of free-flowing rivers become increasingly rare in the world.

Even in river-rich Canada, there are only a handful of places where wild rivers of this size and in this abundance flow unobstructed by dams from headwaters to the sea. As the other clusters are located in the Arctic, the Great Bear's wild rivers stand out as the only group below the tree line in Canada. BC is fortunate to have southern Canada's last wild free-flowing rivers that provide drinking water and irreplaceable ecological services to the people that depend on them for salmon, other food, livelihoods and spiritual sustenance. Rivers like the Nass, Skeena and Kitimat are an integral part of Canada's history and culture. But today they are at risk. WWF-Canada is working to protect the Wild Rivers of the Great Bear. This report outlines the treasured values of these rivers, lists the major threats they face, and proposes options for better protection.

Twenty years ago, the 74,000 square kilometres Great Bear Rainforest, making up one of the world's last large temperate rainforests, was in danger. Clear cutting had stripped bare much of BC's rainforest, forestry companies raced to stake their claims on what remained, and the future of the Great Bear looked dim. After more than a decade of negotiations, however, First Nations, conservation groups, forest companies, and governments reached a landmark agreement in 2006. About two-thirds of the land is now governed by ecosystem based management standards and almost one-third of the rainforest is off-limits to logging. The agreement ensures eco-friendly logging practices, supports sustainable economies and strengthens First Nations decisions about their traditional lands.

Despite that agreement, the Great Bear remains in danger from a host of threats. The wild rivers that tie the Great Bear Rainforest to the Great Bear Sea are threatened by forestry, dams, and oil and gas development. A major threat comes from a proposed twin pipeline that would cut BC in half to carry bitumen from Alberta's oil sands through the protected rainforest to the town of Kitimat. As this report shows, failing to protect the wild rivers of the Great Bear is a failure to protect the rainforest and the sea, and that failure could come at a high price both ecologically and economically. Solutions must be found and put in place; solutions that are available.

WILD RIVERS OF THE GREAT BEAR: TREASURED

Wild or free-flowing rivers are rivers that flow undisturbed from source to mouth. They are rivers that have not been tamed by dams or dykes, weirs or levees. Rapid development of water management infrastructure means wild rivers are increasingly rare. Of the world's large rivers, two-thirds are impacted at least moderately by dams and reservoirs (Biodiversity Indicators Partnership, 2010). Of

the 177 rivers in the world that are over 1,000 kilometres long, only 21 are connected directly to the sea (WWF, 2006).

Rivers Impacted by Infrastructure

"In order to sustain the wealth of natural processes provided by freshwater ecosystems—such as sediment transport and nutrient delivery, which are vital to farmers in floodplains and deltas; migratory connectivity, vital to inland fisheries; and flood storage, vital to downstream cities— it is imperative to appreciate the importance of free flowing rivers, and developing infrastructure with a basin-wide vision."

WWF, Living Planet Report 2012

In this context, the Great Bear is an ecological treasure. As the world's second-largest intact coastal temperate rainforest, it stands out on a planet that has lost more than 60% of its temperate rainforests (Birch, 2002). The region's concentration of free-flowing rivers that nourish the rainforest is equally significant.

WWF's New Map of Great Bear's Wild Rivers Highlights their Rarity

Our map of the region shows that five of these large free-flowing rivers -- the Nass, Dean, Bella Coola, Wannock, and the Klinaklini form one of only four major concentrations of large, free-flowing rivers remaining in Canada. (As the other three clusters are all in the Arctic or near-Arctic, the wild rivers of the Great Bear show up clearly.) Three other noteworthy free-flowing rivers, the Zymoetz, the Sustut and Kispiox, are upstream tributaries of the Skeena River. The Skeena itself, BC's second longest river, is one of the best known rivers in this corner of northern BC, for the sports and commercial fishing sectors and for its cultural and historical importance. The Skeena runs into the ocean just south of Prince Rupert BC, and supports an abundant estuary. However, due to dams in the Babine, a major tributary to the Skeena, the entirety of the Skeena River is not classified as free-flowing. The Kitimat, a smaller free-flowing, river, completes the picture. It drains into the Pacific at the town of Kitimat and provides clean drinking water for the town.

Free-Flowing Rivers in the Great Bear Region

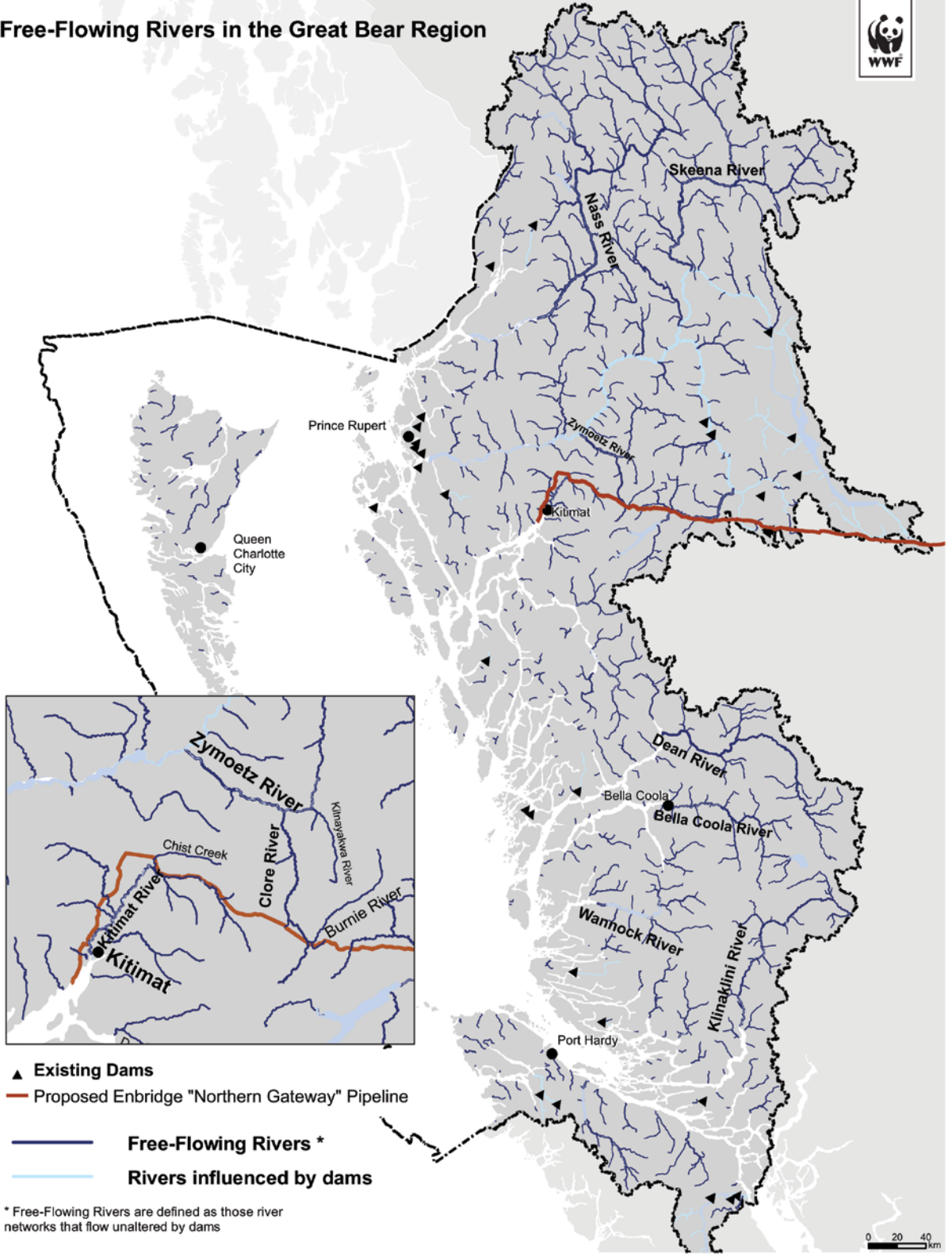
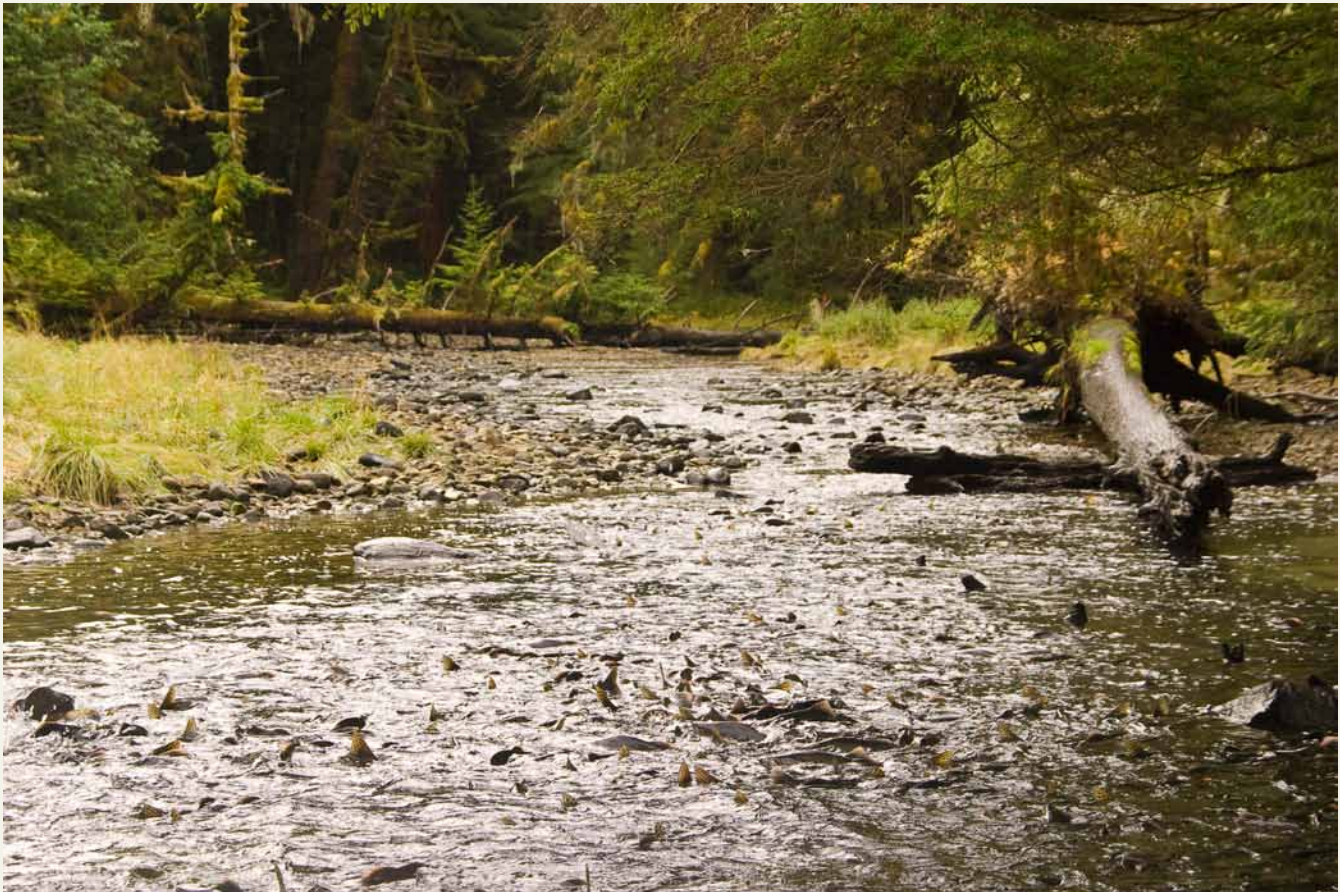


Figure 1. This map illustrates the free-flowing rivers in the Great Bear eco-region, as identified in a geometric network analysis of Canada's rivers using data from NRCan's National Hydro Network. Larger line widths correspond to larger rivers, as quantified by Strahler river order -- a measure of the hierarchy of river tributaries. For more information on methods, see Appendix 1.

The Great Bear region, approximately 8% of the province's area, contains the majority of British Columbia's free-flowing rivers. Canadians and British Columbians are privileged to have them, as other industrialized regions like the United States and Europe contain some of the world's most fragmented rivers (Biodiversity Indicators Partnership, 2010). In the Great Bear, by contrast, one of the world's last intact temperate rainforest meets some of the planet's last large non-Arctic wild rivers and one of the world's most productive coldwater seas. It is a spectacular ecosystem, and a global model of a sustainable economy nested in a connected ecosystem. Salmon reflect the interconnectedness of the sea, wild rivers and land in the Great Bear Sea. Countless streams feed rich estuaries and are lifelines for Pacific salmon. Bears, wolves, birds and trees are all nourished by the salmon.

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Pink salmon (*Oncorhynchus gorbuscha*) spawning in a river on Princess Royal Island, British Columbia, Canada

Great Bear Rivers- Water for Nature

The ecological and economic values of these wild rivers make them worthy of protection. Wild rivers are critical for biodiversity. When they are dammed, disconnected, or otherwise disrupted, migratory fish are blocked from passing. Natural cycles are broken. Nutrients and sediments are unable to flow downstream where they nourish and create dynamic ecosystems (WWF, 2006). Rivers that are not free-flowing are likely to have reduced diversity and the species living in them are less able to adapt (Biodiversity Indicators Partnership, 2010). Wild rivers, on the other hand, face fewer changes in water discharge and less water stress (Palmer et al., 2008).

Freshwater ecosystems in general deliver more biodiversity 'bang for the buck'. As the co-chair of the Committee on the Status of Endangered Wildlife in Canada's Freshwater Fishes Subcommittee recently wrote: "...almost 40% of all fishes (some 33,000 species and counting) occur in freshwaters, yet freshwater habitats make up only 0.8% of the total surface area of the Earth! Per unit area, diversity of freshwater fishes is unmatched." (Taylor, 2012).

Wild rivers also nourish people. Rivers everywhere carry values: spiritual, recreational and tourism, aesthetic, and cultural. They are vital to the health and stability of human communities, providing fisheries, water for domestic use and agriculture, navigation, trade, pollution control, and detoxification (Millennium Ecosystem Assessment, 2005). Scientists have noted the need for strategies to address the potentially significant ecological and societal impacts of disrupted rivers (Palmer et al., 2008).

The waters that flow through the arterial rivers of the Great Bear are intimately tied to the survival and nourishment of hundreds of animal species. Approximately 230 bird species and 68 mammal species live in the region (Bergman, 1999). Among these mammals is the Spirit Bear, also known as the Kermode bear, a subspecies of American Black Bear that has a white or cream coat. At least 17 marine mammals live in the Great Bear Sea, into which the spectacular wild rivers drain. These coastal waters are also home to three out of five of British Columbia's major herring populations and 58% of anadromous salmon on the West Coast (Gunton & Broadbent, 2012), and it is up the undammed rivers of the Great Bear that these salmon swim to spawn.



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River Otters are common users of estuary habitat.

The entire Great Bear ecosystem depends on salmon, and salmon depend on wild rivers. Bears and wolves eat the salmon from the wild rivers and transport nutrient-rich salmon carcasses and drop salmon-rich feces around the rainforest. Biologists have found that over a single spawning season, a lone black or grizzly bear can carry up to 700 half-eaten salmon through the Great Bear Rainforest (Birch, 2002). By tracing the nitrogen isotopes in the fish, those biologists have shown that the nutrients from decaying salmon nourish juvenile fish, diverse insects, and riparian plants (Hocking & Reimchem, 2009). The nutrients can also be traced to tree tissue, and trees fed by salmon carcasses have increased growth rates of two-and-a-half times (Birch, 2002). From the water to the woods, these wild river-dependent, nutrient-rich salmon decay and not only feed the Great Bear but build it.

Great Bear Rivers- Water for People

The Great Bear territory– the North and Central Coast, and Haida Gwaii – is the traditional and unceded territory of a dozen Coastal First Nations. Long before pipelines and oil tankers were a threat, Coastal First Nations depended on the wild rivers of the Great Bear and the biodiversity they support. More than 100 different plants and fungi are used domestically and culturally, or as food and medicine (Coastal First Nations, 2009).

Marine-dependent activities in the region create approximately \$386.5 million in revenue each year and provide for 7,620 jobs (Gunton & Broadbent, 2012). Of that total, \$134.9 million and 1,310 jobs are created by commercial fishing and \$104.3 million and 2,200 jobs by marine tourism (Gunton & Broadbent, 2012). The rivers in the area are world-renowned as premier fishing destinations, home to all five species of Pacific salmon, the elusive steelhead, the culturally-significant eulachon, and several other fish species. The Nass River, the longest completely free-flowing river in the Great Bear at 380 kilometres long, has been relied upon by generations for its annual eulachon run. Its name is Tlingit for “food depot,” referring to its productivity. The Skeena River, fragmented in parts but largely free-flowing and little affected by development across its 580 kilometre length, has a thriving fish industry worth almost \$110 million annually (WWF-Canada, 2009). Healthy rivers spawn healthy fish and healthy economies. In fact, the total economic value of marine-dependent activities of the Coastal First Nations is estimated at between \$28.9 and \$29.9 billion (Gunton & Broadbent, 2012).

The approximately 70 kilometre-long Bella Coola River, for example, holds historical significance as a part of the Nuxalk-Carrier Grease Trail used by the explorer Sir Alexander Mackenzie when he completed the first east-to-west crossing of North America above Mexico in 1793. “Grease trails” are so-called because of their use in trade by First Nations, particularly trade of eulachon oil. Because almost 20% of the weight of eulachon is oil, they are caught and rendered to create condiments for food and preservatives for dried berries (Stoffels, 2001). The oil is rich in vitamins A and D, iodine, and other essential vitamins (Stoffels, 2001). Eulachon, like salmon, are anadromous fish and so live in the ocean but swim up rivers to spawn. Following spawning, eulachon soon die and their bodies, like salmon, also feed the ecosystem, likewise connecting the sea to the rivers to the rainforest.

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Eulachon been captured as part of First Nations monitoring efforts on the Skeena River

WILD RIVERS OF THE GREAT BEAR: THREATENED

The wild rivers of the Great Bear are under threat, putting the entire ecosystem at risk. The Kitimat River is a resilient river that has remained largely productive despite past problems with pulp mill pollution. The pulp mill is no longer operational, but the Kitimat now faces the looming threat of the Enbridge Northern Gateway Project (ENGP) and the very real possibility of an oil spill if the pipeline is approved and constructed.

The ENGP would see two pipelines built across the Great Bear, bisecting this sensitive region, pumping 525,000 barrels of oil per day one way and 193,000 barrels of condensate per day the other way. If built, 1177 kilometres of pipeline will snake through the Great Bear and more than 220 supersized oil tankers will pass through the Great Bear Sea each year. This pipeline would cross hundreds of streams and rivers in both Alberta and BC, including directly over the Sutherland River, the Morice River and the Clore River, which feed into the salmon-rich Skeena in BC (DFO, 2011). The pipeline also crosses the Kitimat River which is the main source of drinking water for the community of Kitimat. First Nations food, social and ceremonial (FSC) fisheries are conducted in the upper Fraser, Nechako and Stuart basins near to the proposed pipeline. An oil leak from a pipeline would have far-reaching harmful consequences.

The DFO does not have the resources to conduct a review of all of these proposed pipeline stream crossings at present (DFO, 2012). Of those crossings that have been assessed, DFO assessed at least two important coho streams, tributaries of the Kitimat, as medium or high risk to fish and fish habitat contrary to Enbridge's ranking of the same streams as low-risk (DFO, 2012). To avoid damaging fish habitat, DFO generally requires that construction work should take place in Least Risk Periods that it identifies with the relevant province. However, the Skeena generally lacks these periods, as DFO's evidence to the ENG Joint Review Panel notes.

Impacts of Proposed Pipeline Crossings on Rivers and Fish in the Great Bear

“Within the Skeena watershed 279 [pipeline] crossings are proposed. Due to the varied fish species and abundant distributions, many watersheds lack a least risk period. DFO and others operate numerous fish hatcheries in the Skeena system for all five species of salmon, as well as steelhead. The largest facilities are on the Babine system and include the Pinkut sockeye hatchery, and the Fulton River hatchery, which is the world's largest sockeye spawning channel, where as many as a half million sockeye return to spawn. All proposed crossings are downstream of these two hatcheries, but all salmon returning to these hatcheries pass the proposed pipeline crossings.”

Submission of Fisheries and Oceans Canada to Enbridge Northern Gateway Project (DFO, 2011)

A further problem is that recent regulatory changes could allow untrammelled development in waters in remote areas of the Great Bear, as changes to the federal Fisheries Act will soon drastically weaken the law that protects fish habitat (WWF, 2012). For instance 104 of the 773 crossings (as identified by Enbridge, DFO uses a different figure of 996 crossings) are determined to be non-fishing bearing streams. As a result of changes to the Fisheries Act these streams could in future be ignored by the federal government. It remains an open question how many of the remaining crossings over rivers that support fisheries will be protected by the amended Fisheries Act.

Construction of the pipeline would also require the construction of roads, stream crossings and pipeline right-of-ways which will increase sediments in streams and rivers, potentially lowering biological productivity by affecting stress and reproduction in fish. Aquatic plant growth is also inhibited, which affects fish feeding. High enough concentrations of sediment can kill fish directly (DFO, 2001).

The consequences of construction would be small compared to a spill from pipelines into a river like one of the Great Bear's wild rivers. A pipeline rupture into the Morice River, according to expert evidence to the regulatory review for the project, would be toxic to fish and eggs and would cause longer-term habitat degradation; proposed clean-up methods would be ineffective because the "Morice River is too large, the water velocities are too fast for much of the year, and the channels are too complex to use conventional containment booms, absorbents and skimmers" (Miles & Bustard, 2011). This is just one example of oil spill risk from this massive pipeline project proposal to the Great Bear's wild rivers.

Cleanup efforts are costly, both in money and in time, and would not be able to stave off damage, as indicated by DFO in its submission to the Northern Gateway Joint Review Panel. Enbridge proposes to limit pipeline spills to 2000 cubic meters (2 million litres), which, when a spill occurs would likely cause acute mortality of fish and other aquatic species. DFO recommends a lower volume threshold, and warned that the Pine River oil spill in August of 2000, considered one of the worst inland spills in British Columbia to date, released 1000 cubic meters (1 million litres). "The severity of impact was due not only to the acute mortality of fish and other aquatic species, but also to the cleanup effort which resulted in serious and lasting impacts to the habitat and hydrology of the Pine River." DFO, 2011.)

An oil spill into a wild river of the Great Bear would not only poison fish, it could destroy the banks of the rivers, disrupting feeding cycles for bears and birds. The economies and livelihoods of those who live by the rivers would be devastated. Recent revelations about the 2010 Enbridge oil spill in the Kalamazoo River show just how severe the impacts can be.



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Martin in the Great Bear feed off salmon carcasses left by others.

'Keystone Kops' in Charge in Kalamazoo Spill

On July 25, 2010, a ruptured pipeline pumped over 840,000 gallons of crude oil into Michigan's Talmadge Creek and the Kalamazoo River. The Enbridge control center took seventeen hours after the rupture to respond. Thirty to fifty households were asked to evacuate because of the resulting poor air quality, and twice as many households were told not to drink their water (Lambert, 2010). More than 300 people reported symptoms from benzene exposure, a toxic component of crude oil. Cleanup efforts continue and are estimated at \$800 million and counting (National Transportation Safety Board, 2012). Deborah Hersman, the Chairwoman of the National Transportation Safety Board, compared Enbridge's handling of the rupture to the Keystone Kops, and warned that delegating too much authority to Enbridge to assess their own risks "is tantamount to the fox guarding the henhouse" (National Transportation Safety Board, 2012). The inadequacy of this spill response does not bode well for the proposed pipeline in an area that is more remote and further from command centres.

The pipeline and tanker project is the largest threat now facing the wild rivers of the Great Bear, but not the only one.

The Klinaklini River, a popular grizzly watching tourist destination, remains in danger of proposed power developments that would fragment the river and divert much of its stream. The Skeena, Nass and Stikine face the possibility of fracking to enable coal bed methane (CBM) extraction in the Sacred Headwaters, the source of these three rivers. If the proposed CBM project goes through, several thousand wells and more than 3,500 kilometres of roads and pipeline will scar the face of the Sacred Headwaters (Davis, 2011).

Then there is the looming threat of climate change. The eastern North Pacific has been in a warming phase since 1978 minus some brief periods, and this warming is correlated with lower ocean survival of young salmon (Gottesfeld & Rabnett, 2008). Average air temperature in the Skeena watershed is expected to rise by between 2.4 °C and 4.4 °C by the 2080s (WWF-Canada, 2009). Such a rise in temperature likely means lower summer flows causing more difficulty for spawning for salmon and other anadromous fish. Changes in flow associated with climate change will likely alter the movement of rich nutrients that feed the Great Bear.

WILD RIVERS OF THE GREAT BEAR: PROTECTED?

The threats are numerous and the stakes are high. However, solutions do exist. The Great Bear itself provides an example. The landmark forest and land management agreement is lauded the world over and was celebrated by WWF in 2007 with its' prestigious Gift to the Earth award.

Saying No to the Northern Gateway Pipeline

The single greatest threat for the Great Bear's wild rivers is the proposed Northern Gateway pipeline and tanker project. WWF is among many who oppose this project. The risks of this project are too great. The Great Bear is not the place for a pipeline or oil tankers. Refusing to approve this project is the first step towards achieving lasting protection for the Great Bear's wild rivers.

There are other examples of legal and policy tools to protect rivers.

BC Legal Tools to Protect Wild Rivers

Existing Tools

BC's visionary Fish Protection Act contains a critical section that prohibits the construction of new dams on the main stems of fifteen listed rivers, including the Nass, Skeena and Babine. The Act also contains the power to extend this prohibition on dams to other rivers and streams, a power that should be kept in mind for potential future threats from dams. According to WWF's definition of free flowing when a river converges with a dammed tributary of equal or greater size, the downstream section of that river is not considered to be free flowing. BC's Fish Protection Act expressly excludes tributaries, unless they are also listed in the Act. WWF believes it is vital to also protect tributaries. Rivers are connected systems and dams in the tributaries influence the flow of water in the main stem.

The Flathead River in southeastern British Columbia which flows into Montana was spared from a proposed open-pit coal mine, assuring a greater margin of safety for one of the highest density populations of inland grizzly bears in North America (McLellan & Hovey, 1995). The government of British Columbia passed the Flathead Watershed Area Conservation Act banning oil, gas, and mineral development in the Flathead watershed in 2011. The Sacred Headwaters of Skeena, Nass and Stikine would be greatly aided by similar protection as that offered the Flathead.

Fisheries Sensitive Watershed and Temperature Sensitive Watershed designations under the Forest Practices and Range Act regulations could also be used to increase protection for the wild rivers of the Great Bear. This designation enables regulators to require better operational practices such as riparian management and road building practices to maintain healthy streams. For these designated watersheds, forest tenure holders must undertake management actions to protect significant fisheries values and watershed sensitivity (BC MOE, undated). Extension of Fisheries Sensitive Watershed and Temperature Sensitive Watershed designations to apply to other industrial activities, such as mining and oil and gas, would allow for greater protection for water and fish values in a watershed.

New Tools

An immediate policy action that can be taken is to require all future approvals for Crown resources to be accompanied by climate smart plans. For instance, all new Forest Stewardship Plans could be made climate smart. A priority should be placed on forestry activities that increase the capacity of waterways to respond and rebound from change. In light of the critical importance of freshwater resources all climate smart plans need to include activities that maintain water temperature and environmental flow.

*A **Climate-Smart** Forest Stewardship Plan incorporates the latest knowledge of future conditions that will be caused by climate change into the planned activities of the forestry company.*

The proposed BC Water Sustainability Act will be another important tool for protecting watershed resilience. The provincial government pledged that by 2012, the chief provincial water law would be reformed to improve the protection of ecological values, provide for more community involvement, provide incentives to be water efficient, and recognize water flow requirements for ecosystems and species. Though the legislative timetable has been delayed, the government is still committed to pass these critically needed changes, which can substantially improve wild river protection. WWF is working to ensure that the new Act contains strong protection for environmental flow regimes. In wild rivers such as those found in the Great Bear, the primary priority for water allocation should be to maintain the health of these rivers. A good threshold is to keep cumulative changes to less than 10 percent of the natural flow regime.

Enacting these policy and legal changes are significant steps that the province of BC can take to keep the rivers of the Great Bear wild.

National Canadian Legal Tools to Protect Wild Rivers

One way that all governments of Canada can ensure that wild rivers are protected not only in the Great Bear but across the country – Quebec, for example, has a large share of wild rivers – is to cooperate in designing a consistent system of legal protection. This system could start with a vision statement such as: “Canadians have access to clean, safe and sufficient water to meet their needs in ways that also maintain the integrity of ecosystems” (Canadian Council of Ministers of the Environment, 2010). A strong legal framework would ensure that the ecological and economic values of wild rivers are truly protected.

Canada currently recognizes rivers through the voluntary Canadian Heritage River System (CHRS) created in 1984. The CHRS is administered by federal, provincial and territorial governments to conserve and recognize rivers with outstanding natural, cultural, or recreational heritage, and to encourage public appreciation. The system has its limits. When a river is designated as a Heritage River, no new restrictions apply to activities that could harm the river, such as dams, pipelines, mining, or oil and gas development. Heritage rivers are supposed to be monitored and protected by a management plan that is a condition of designation. But these plans can be very general in nature, and usually impose no substantive obligations.

The CHRS is also entirely voluntary as demonstrated by Quebec’s withdrawal from the program in 2006. To date thirty-seven rivers have been designated totaling 9032 kilometres. Four more rivers are currently nominated totaling 1927 kilometres. While recognition of significant rivers is a step in the right direction, when unaccompanied by changes in legal status wild rivers are still potentially at risk.

Legal Tools from Other Countries to Protect Wild Rivers

Other countries provide examples of how Canada could improve protection of wild rivers through law.

In the United States, Congress enacted the National Wild and Scenic Rivers system in 1968 under the Wild and Scenic Rivers Act to counter the spread of large dams.

“It is hereby declared to be the policy of the United States that certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing conditions, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations.”

Wild and Scenic Rivers Act, 16 U.S.C. § 1271 (1968).

A river under the National Wild and Scenic Rivers System can be designated as wild, scenic, or recreational. Wild rivers are unpolluted, free-flowing, and have no access; scenic rivers are free-flowing with some development and access; and recreational rivers are accessible, with some development and are not free-flowing. When a river or a segment of a river is designated under this law, the American federal government is prohibited from supporting the construction of dams or any other power project, and the essential characteristics of the river cannot be changed by development or usage. To date, 20,275 kilometres of 203 rivers are protected. This, however, is less than 0.25% of American rivers.

Australia is another leader. In the Australian state of Queensland, the Wild Rivers Act was enacted in 2005 to protect wild rivers. When a river is designated, the designation includes prohibitions against or conditions for development within the entire river system, on activities like building new dams and weirs, developing large irrigation projects, introducing non-native fish or invasive species into the waters, developing new aquaculture farms, and mining or mineral extraction. Day-to-day activities and low impact developments are generally permitted, as are essential community infrastructure like houses, fishing and camping, and traditional Indigenous activities.

Formal designations to protect the Great Bear’s wild rivers would match the protection accorded to the rainforest and would complement ecosystem based management plans now in process for the Great Bear Sea. Laws like those in place in the United States or Australia would protect the wild rivers of the Great Bear from energy projects that put the ecology and economy of the region at unacceptable risk.

Recommendation: WWF –Canada recommends that the federal and provincial government take action to increase the protection for free-flowing rivers to preserve this unique part of Canada’s natural legacy. This report, and the forthcoming report from WWF-Canada on free-flowing rivers across the country, can serve as starting points in this dialogue.

CONCLUSION

The Great Bear Rainforest is under ecosystem-based management because First Nations, conservation groups, forest companies and governments joined forces.

Today, many people are advocating for change to protect the wild rivers of the Great Bear and the livelihoods they sustain.

Canada has a global duty to protect unique areas of biodiversity. Failing to protect the spectacular concentration of wild rivers that crisscross the Great Bear would shirk that responsibility. The wild rivers of the Great Bear are home to fish that connect the Great Bear Rainforest to the Great Bear Sea. These connections allow rich, dense ecosystems to flourish where trees can grow for a millennium and black bears can be born white. If the rainforest is the lungs of the Great Bear, the watersheds are its heart and the rivers its veins, pumping life-giving waters to the furthest limbs of the Great Bear. Through careful planning and strong protections, the heart of the Great Bear can keep pumping as it has done since the last ice age.

Join us in our efforts to protect the Wild Rivers of the Great Bear.

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TECHNICAL NOTE - APPENDIX 1

METHODS

The free-flowing rivers of the Great Bear were identified as part of a forthcoming Canada-wide analysis of free-flowing rivers, completed by WWF-Canada. This analysis uses spatial data on Canada's rivers provided by National Resources Canada, known as the National Hydro Network (NHN). This dataset provides the best available description of Canada's inland surface waters, including lakes and rivers, as well as man-made obstacles, including dams, as compiled from federal and provincial agencies.

The NHN river network and dam datasets were used to complete an analysis of river connectivity for each of Canada's eleven Water Survey of Canada major drainage basins. Using the Geometric Network tools in ArcInfo for ArcGIS Desktop 10 (ESRI, 2011), this analysis built upon attribute information on the direction of river flow within the NHN data to build an interconnected network of river flow at the basin scale. The relative location of dams within the river networks were used to identify river sections where upstream and downstream river flows could be influenced by in-stream infrastructure. Conversely, this analysis identified river networks where no dams were located and hence were considered "free-flowing". This classification is consistent with the definition of free-flowing rivers proposed by WWF (2006) as "any river that flows undisturbed from its source to its mouth, either at the coast, an inland sea or at the confluence with a larger river, without encountering any dams, weirs or barrages and without being hemmed in by dykes or levees". Hence, due to the structure of this analysis, it is possible for upstream sections of a river system to receive "free-flowing" status but, due to a convergence with a dammed tributary of equal or greater size, the downstream section of that river network is not considered to meet this standard.

In order to characterize the relative size of both free-flowing and fragmented rivers, the analysis included measures of river length and Strahler stream order, which provides a metric of the relative hierarchical structure of river tributaries.

RESULTS OF FREE-FLOWING RIVERS ANALYSIS

The Great Bear ecoregion includes 5 large free-flowing rivers that flow directly to the Great Bear Sea -- the Nass, Dean, Bella Coola, Wannock and Klinaklini -- which form one of four major concentrations of large, free-flowing rivers in Canada. Of the free-flowing rivers identified in the Great Bear region, the Nass is the largest, both in terms of length and Strahler order. Although the most northerly of the free-flowing rivers in the Great Bear, the Nass River is the most southerly of the largest remaining free-flowing rivers in Canada -- specifically those with Strahler river order greater than nine.



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