Columbia River
INTEGRATED ENVIRONMENTAL
MONITORING PROGRAM

2005 Environmental Status Report

PUBLIC UPDATE ON THE ENVIRONMENTAL HEALTH OF THE COLUMBIA RIVER FROM HUGH KEENLEYSIDE DAM TO THE BORDER

WHAT'S INSIDE?

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INTRODUCTION

Why report on the Columbia River?

The Columbia River provides a myriad of benefits to the communities that rely on its extensive watershed. It supplies water for power, industry, recreation, irrigation and drinking, and at the same time supports diverse communities of fish, wildlife, and other aquatic species. The challenge is to balance the many social and economic benefits the river provides with protection of the river ecosystem and human health. Ongoing monitoring of and reporting on the river environment is necessary to meet these challenges, and to the long-term health of the river, our economies, our communities, and ourselves.

The **Columbia River Integrated Environmental Monitoring Program (CRIEMP)** has completed this Environmental Status Report to provide an overview of the changes and improvements in the Columbia River between Hugh Keenleyside Dam and the Canada-US border since the early 1990s, and to update the public on the health of the river since CRIEMP's last report in 1994. This latest update relies on the selected environmental indicators of water flow, water quality, sediment quality, productivity, and fish to reflect the current status of the Columbia River. Indicators are compared to accepted environmental guidelines and scientific criteria.

QUICK Q & A

Is the water safe to drink?
Yes, although all surface water used for drinking should have general surface treatment.

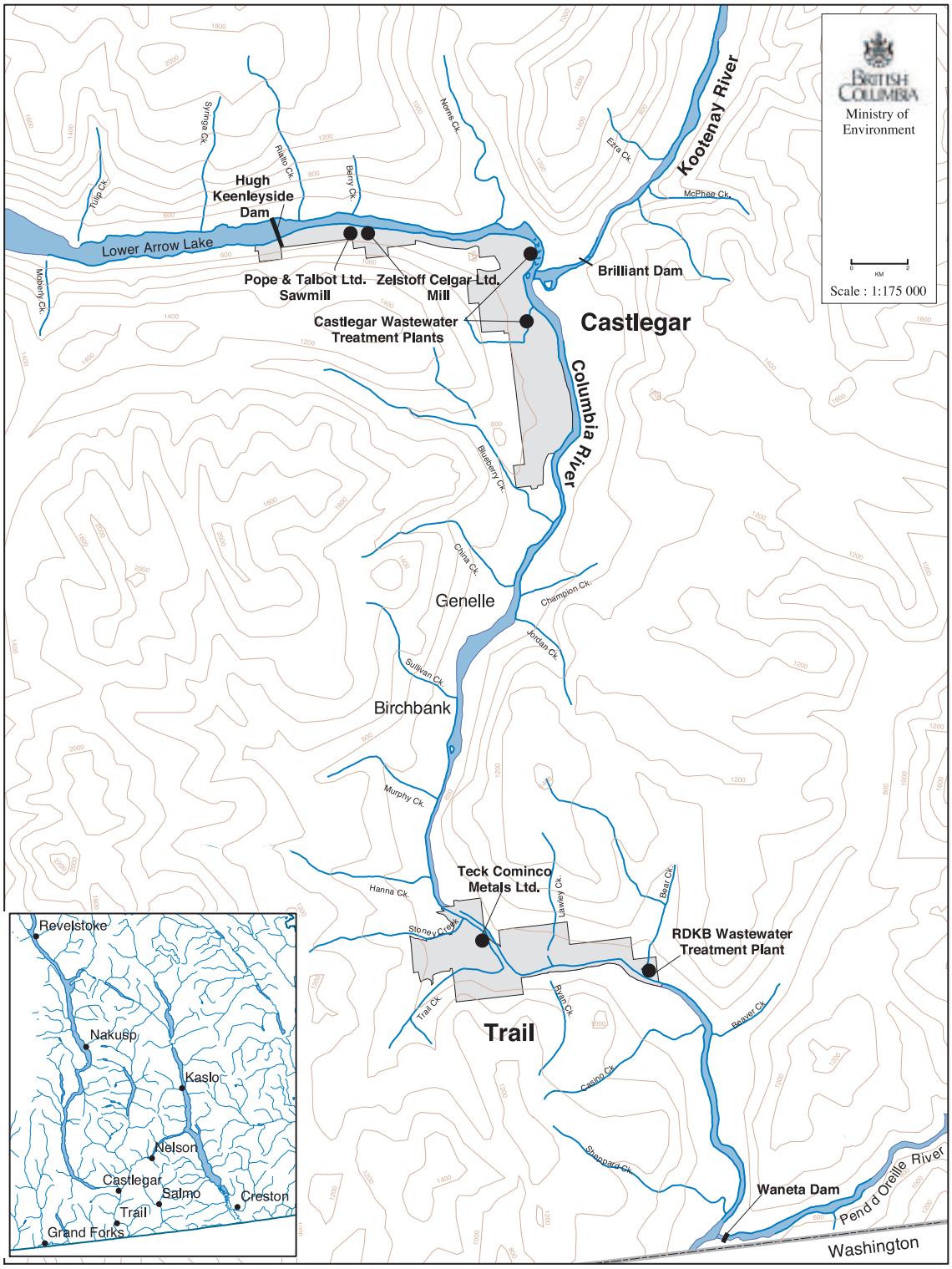
Is the water quality safe for recreational use?
Yes.

Is the river safe for aquatic life?
Overall river health has improved since the early 1990s, although there are historical legacy issues and occasional problems related to industrial spills.

Are there any concerns about toxic chemicals in water or sediments?
Most concerns relate to historic practices such as slag discharge from the Teck Cominco smelter operations at Trail, and fibre discharge from the Zellstoff Celgar at Castlegar. Since these practices ended, sediment and water quality have improved.

Are the fish safe to eat?
Fish consumption advisories for mercury in walleye and dioxins and furans in whitefish were lifted in 1996 based on Health Canada Guidelines. Our local BC Medical Health Officer believes the benefits of eating fish far outweigh the risks that might be associated with current levels of contaminants in Columbia River fish. The Ministry of Environment continues to monitor contaminant levels in sport fish.

Is the status of endangered sturgeon improving?
Concerted efforts are being made to study Columbia River white sturgeon and to provide solutions for their short and long-term management. It's too early to tell how these efforts may be helping.



AREA OF INTEREST

BACKGROUND

What is the Columbia River Integrated Environmental Monitoring Program?

Key stakeholders in the region formed the Columbia River Integrated Environmental Monitoring Program or CRIEMP in 1991 to assess the status of ecological health of the Canadian portion of the Columbia River between Hugh Keenleyside Dam and the US border. The primary objective of CRIEMP is to gather and share environmental information with the public, agencies, and industries in a coordinated and cost-effective manner.

Study Area

CRIEMP monitors the Columbia River from the Arrow Reservoir to the Canada-US border, a sixty-kilometre stretch of river referred to in this report as the Lower Columbia River. This stretch of the river is impacted by many human influences, including:

- Large dams such as Hugh Keenleyside, Brilliant, and Waneta
- Industrial operations including Zellstoff Celgar, Pope and Talbot sawmill, and the Teck Cominco smelter
- Municipal wastewater discharges at Castlegar, Trail, and other smaller communities along the river
- Influence from tributaries including the Kootenay and Pend D'Oreille rivers
- Urban development and some limited agriculture

While damming of the river for hydroelectric generation and flood control provides important economic and social benefits, it has also profoundly changed the nature of the river. Dams regulate about 96 percent of the Columbia River flow at the Canada-US border.

CRIEMP Vision

Our vision of the lower Columbia River embodies a productive ecosystem that enhances the natural aquatic and terrestrial environments and balances these values with human-based values (economic, traditional, cultural, recreational, social, aesthetic and health). The vision recognizes existing constraints, which are a result of historic decisions. Achieving this vision requires an approach to accurately understand and communicate the status and changes in the ecosystem.

Brilliant dam Castlegar, BC

A Changing Environment

CRIEMP conducted a comprehensive environmental study of the lower Columbia River between Hugh Keenleyside Dam and the US Border between 1991 and 1993, and released its results to the public in 1994. The 1994 CRIEMP report identified activities that had an impact on the environmental health of the Lower Columbia River. Since then, the major industries and hydroelectric operators including Teck Cominco, Zellstoff Celgar, BC Hydro, and Columbia Power Corporation (CPC) have made significant operational changes to address these issues. These initiatives have resulted in significant and measurable improvements to overall environmental quality in the Lower Columbia River.

Zellstoff Celgar mill Castlegar, BC

Hydroelectric Dams

Dam operations have changed to further protect fish by reducing potentially harmful levels of dissolved gas in the river downstream *(for details see page 6)*. BC Hydro implemented operational changes that reduced historical gas levels significantly. Upgrades and new facilities at the three major dams – Hugh Keenleyside, Waneta and Brilliant – are designed to increase power generation and to further reduce dissolved gas levels. In addition, BC Hydro manages flows to protect spawning fish and their eggs, in winter for mountain whitefish and in spring for rainbow trout. BC Hydro, in consultation with government agencies, has also developed a protocol to minimize fish stranding associated with fluctuating water levels.

Teck Cominco Lead-Zinc Smelter Trail, BC

Zellstoff Celgar Ltd.

The early 1990s saw major improvements to Zellstoff Celgar's operations in Castlegar, with upgrades to the kiln, recausticizing plant, chemical recovery system, bleach plant, and effluent treatment system. In 1993 Zellstoff Celgar changed their bleaching process from using elemental chlorine to chlorine dioxide. This reduced or eliminated the discharge of dioxins, furans, and other chlorinated organic compounds to the river.

Teck Cominco Metals Ltd.

Teck Cominco has undertaken several upgrades, including installation of a new lead smelter and improvements to effluent treatment systems. The company's phosphate fertilizer plant closed in 1994 and the following year all slag discharge to the river stopped. In 1997 Teck Cominco initiated staged construction of a seepage collection system and landfill cap in the Stoney Creek watershed. These initiatives will significantly improve the water quality of Stoney Creek, a tributary of the Lower Columbia River.

Ongoing Environmental Monitoring Programs

Members of CRIEMP participate in ongoing environmental monitoring in the Lower Columbia River. While some monitoring programs are voluntary, many are required by federal and provincial legislation. Monitoring activities are wide-ranging and include water sampling, flow measurement, monitoring of fish and wildlife in and along the river, as well as air quality testing and more.

LOWER COLUMBIA RIVER ENVIRONMENTAL MONITORING PROGRAMS AND RIVER STUDIES

WHO	WHAT	WHEN	WHERE
Environment Canada; Ministry of Environment	Water quality	Biweekly - **B**, Weekly - **W**	Birchbank **(B)**, Waneta **(W)**
	Flow	Continuous 1968 – present 1984 – present	Birchbank **(B)** Waneta **(W)**
Ministry of Environment	Water and sediment quality, fish tissue	Annually 1998 - present	Several locations between Birchbank and the US border
Teck Cominco Metals	Effluent and air emissions	Regularly (every 6 days)	Upstream and downstream of Teck Cominco discharges Lower Columbia Basin
	Ecological Risk Assessment	Ongoing since 1999	
Zellstoff Celgar	Effluent and air emissions	Regularly	Upstream and downstream of Celgar discharge
	Environmental Effects Monitoring (sediment, plants, aquatic insects, fish)	Every 3 years	
Columbia Power Corporation	Temperature, dissolved gases, fish, flow patterns	Since 1998	Downstream of Arrow Lakes and Brilliant Dam

WATER – Quantity

Overview

Under the Columbia River Treaty signed by Canada and the United States in 1961, the Columbia River was dammed to provide hydroelectric power, water storage, and flood protection for the economic and social benefit of both countries. While dam construction and operation have removed extremes of flood and drought, resulting hydrological changes have affected fish and fish habitat limiting food resources and habitat use and barring fish migration. Humans have also felt the impact of the treaty, losing historic territories and productive, picturesque valley bottoms now flooded through successive hydroelectric dam construction projects.

Total Gas Pressure

In addition to the social, environmental, and economic effects of dams, water that flows through and over them is affected at the molecular level. The force of water passing through dam spillways may increase levels of dissolved gases such as nitrogen and oxygen in the water column, which contribute to total gas pressure (TGP). Elevated TGP may affect fish by causing gas bubble trauma, a condition that, in severe stages, may be fatal. Highest TGP levels occur during the peak of freshet or snowmelt when river flows are highest or during periods of significant spill. Because gas levels do not dissipate quickly, TGP tends to increase progressively downstream when there are several dams on a system.

TGP levels in the river have decreased since the early 1990s as a result of operational changes and upgrades at the dams and construction of the Arrow Lakes Generating Station (ALGS) at Hugh Keenleyside Dam. The BC TGP Water Quality Objective of 110% is met most of year, and exceeded only on occasion when spill volumes are greatest. A 1999 CRIEMP study, pre-dating construction of the ALGS powerplant, reported that there are fewer days of elevated TGP, although the maximum TGP levels had not decreased. Other studies conducted since the early 1990s by BC Hydro and the CPC have also shown considerable reductions in TGP and associated risks to fish.

Outlook

Within the framework of the Columbia River Treaty, dam operations continue to be adjusted to reduce TGP. At each of its facilities BC Hydro has undertaken Water Use Planning (WUP) which reviews how operations are managed, taking into account related water resource issues including fish, wildlife, water quality, recreation, and social and economic benefits. The WUP process has also included modifications to Hugh Keenleyside Dam operations to benefit fish and wildlife. Reductions in TGP levels are also anticipated once a new generating station at CPC's Brilliant dam becomes operational. Monitoring will be conducted to evaluate whether the initiatives at Keenleyside and Brilliant dams are resulting in lower TGP levels and protecting fish and wildlife from the effects of dissolved gases. While the BC TGP Water Quality Objective is under review and may be changed in the future based on more recent studies, improvements at CPC's Brilliant dam and at BC Hydro dam operations as a result of the WUP process are expected to further reduce fish stranding and egg exposure in the Lower Columbia River.

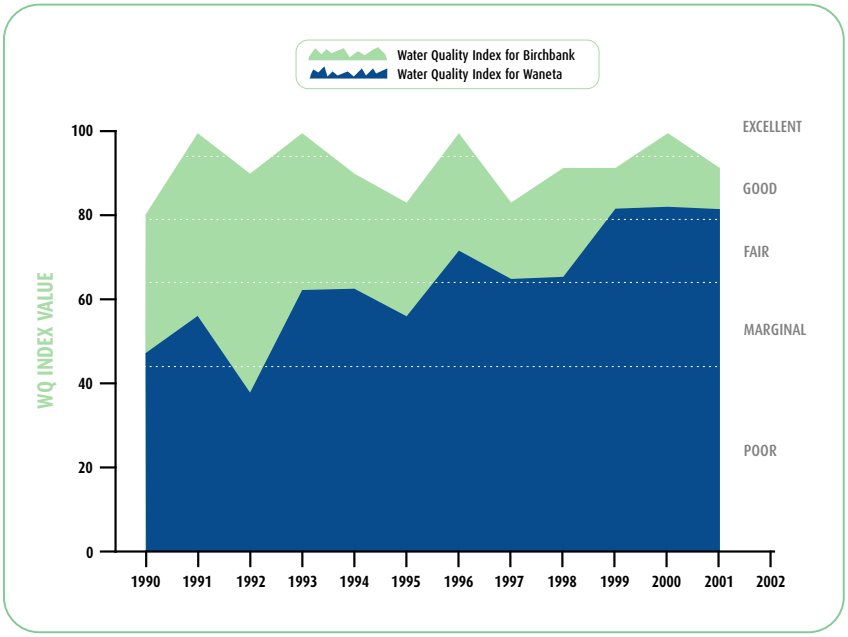
WATER – Quality

Background & Issues

Water from the Columbia River is used for many purposes including agriculture, industry, and human consumption. The river also receives discharges from what are known as point and non-point sources, and which may affect water quality. Point source discharges, for example from Teck Cominco, Celgar, and municipal wastewater plants, may degrade water quality through the addition of metals, nutrients, and organic matter. Non-point source runoff, such as that from roads, residential and agricultural areas, may introduce sediment, pesticides, hydrocarbons, and other contaminants.

Water Quality Index

The federal and provincial governments monitor water quality for metals, coliform bacteria and other important water quality variables in the Lower Columbia River at Birchbank and Waneta. For this report, this information has been assessed using the Canadian Water Quality Index, which is calculated by comparing the data to water quality objectives designed to protect water for aquatic life, drinking, and recreational uses. The Water Quality Index is a useful tool because it summarizes large amounts of information into simpler terms providing a broad overview of environmental performance. This index provides a descriptive water quality ranking (excellent, good, fair, marginal, poor). The index was calculated using established measures for fecal coliforms and a number of selected trace metals of concern.



Water quality at Birchbank, located between Castlegar and Trail, has been rated as good to excellent since the early 1990s *(see left)*, which means that conditions are very close to ideal. Water quality at Waneta, located downstream of Trail near the US border, was rated as poor to marginal during the early 1990s, indicating that water quality was frequently impaired. Water quality rose to a "fair" ranking in the mid to late 1990s, and has been ranked as good for the last four years. The improvements in water quality at Waneta likely can be attributed to improvements, modernization, and termination of discharges at upstream industries, resulting in lower concentrations of contaminants in the Columbia River.

Outlook

Water quality in the Lower Columbia River has improved greatly over the past decade. This trend is expected to continue as impaired sites are remediated, and industries improve their facilities and their practices. However, some gaps remain in water quality data for the Lower Columbia River, particularly for contaminants from diffuse, non-point sources such as pesticides and other organic contaminants, and pharmaceutical compounds that make their way into the river. CRIEMP plans to address a number of these gaps when it embarks on future monitoring programs, and water quality will continue to be monitored in the Lower Columbia River to ensure the river is safe for aquatic life, wildlife, and people.

SEDIMENT QUALITY

Overview

As with water quality, point and non-point source discharges have affected sediment quality in the Lower Columbia River. Point source discharges from major industries have resulted in visible deposits in the river. Discharges from Zellstoff Celgar have resulted in a fibre mat downstream of the mill, containing wood fibre, fly-ash, and chemicals (dioxins, furans, chlorinated resin acids). Teck Cominco discharged slag, a metal-containing waste product, into the river from the early 1920s until 1995. The black glassy material tended to settle in a number of areas, including Waneta, burying natural sediments. Both the fibre mat and slag were toxic to test organisms in laboratory sediment bioassays. Contaminants in these deposits can directly affect organisms living in the sediment, and also can bioaccumulate through the food web as organisms lower in the food chain are eaten by other organisms.

The Ministry of Environment (MOE) monitors metals and other compounds annually at Birchbank and Waneta. Zellstoff Celgar and Teck Cominco also analyze sediment along the Lower Columbia River. Results of both monitoring programs are compared with BC sediment quality objectives for the Lower Columbia River – limits established to protect the environment and human health. Monitoring results show that sediment contaminant levels downstream of industrial and non-industrial discharges have decreased since the early 1990s.

Zellstoff Celgar Ltd.

Celgar's Environmental Effects Monitoring studies showed a decrease in the area and levels of sediment contaminants between 1994 and 1999. Dioxin and furan levels in sediment downstream of Celgar have met the provincial sediment quality objective since 1998. Levels immediately downstream of Celgar (within 120 metres) are decreasing but remain higher than the objective. Bioassays of sediment toxicity showed decreased survival and growth of laboratory organisms in samples taken in the fibre mat (1998) when compared to a reference site. However, in 2002 when sediment toxicity tests in the near-field or site of the historical fibre mat downstream of Celgar were again compared to the reference site, survival and growth of laboratory organisms had improved.

Teck Cominco Metals Ltd.

Arsenic, copper, lead, and zinc levels in sediments continue to exceed objectives downstream of Teck Cominco, although decreases have been noted since 1992. Varying levels from year to year make it difficult to confirm trends. Mercury, cadmium, and chromium levels meet or are close to meeting the provincial sediment quality objectives *(see table at right)*. Bioassays of sediment toxicity showed decreased survival and growth of laboratory organisms in samples taken in areas of slag deposits (1995, 1999). More than half the sediment bioassays conducted by the MOE between 2000 and 2002 showed reduced survival and growth in samples taken at Waneta, a result perhaps related to contaminant levels as well as to physical sediment characteristics (low food supply, particle size and shape).

MEETS SEDIMENT OBJECTIVE?

	Birchbank	Waneta
Dioxins	Yes	Yes
Furans	Yes	Yes
Arsenic	Yes	No
Cadmium	Yes	Close
Chromium	Yes	Close
Copper	Yes	No
Lead	Yes	No
Mercury	Yes	Yes
Zinc	Yes	No

Outlook

The improving trend for sediment contaminants is likely to continue in the Lower Columbia River given the ongoing erosion or burial of the fibre mats and slag. As a result of changing industrial practices (improved effluent treatment system at Celgar, elimination of slag discharge at Teck Cominco), slag and fibre mat deposits are decreasing in size, although they may still have localized impacts. Monitoring of contaminants in these deposits continues.

PRODUCTIVITY – NUTRIENTS, ALGAE, BENTHIC INVERTEBRATES

Overview

Productivity refers to the capacity of plants and animals to grow and reproduce. Algae growth requires both sunlight and nutrients, such as nitrogen and phosphorus. Benthic invertebrates eat periphyton (attached algae) and are an important food source for fish.

Algae and benthic invertebrates are good indicators of change within aquatic ecosystems. These changes may include contamination, altered nutrient levels, and fluctuations in flow regimes. Construction of dams on the Columbia River has reduced productivity as nutrients are retained in the reservoirs behind the dams. Other factors influencing nutrient levels in the Lower Columbia River include closure of the Teck Cominco phosphate fertilizer plant, municipal wastewater discharges, and use of fertilizers in the watershed.

Zellstoff Celgar Ltd.

Celgar has conducted three cycles of Environmental Effects Monitoring. These studies found periphyton communities were similar near and far from the discharge. Benthic invertebrate communities were healthy and diverse, although the samples downstream of the mill had lower density relative to those collected further downstream near Genelle, indicating possible impacts on benthic invertebrate communities from mill effluent. Cycle Four of Celgar's Environmental Effects Monitoring, slated for 2005/2006, will further investigate these potential mill impacts.

Teck Cominco Metals Ltd.

Teck Cominco has conducted several studies of algae and benthic invertebrates in the last ten years, before and after major industrial upgrades at the smelter. Improvements in the periphyton community downstream of the smelter were noted between 1995 and 1999, although localized effects were noted in both years. Although results for benthic invertebrates were less conclusive and localized impacts were observed, pollution-sensitive aquatic insects were present at all sites.

Didymosphenia geminata

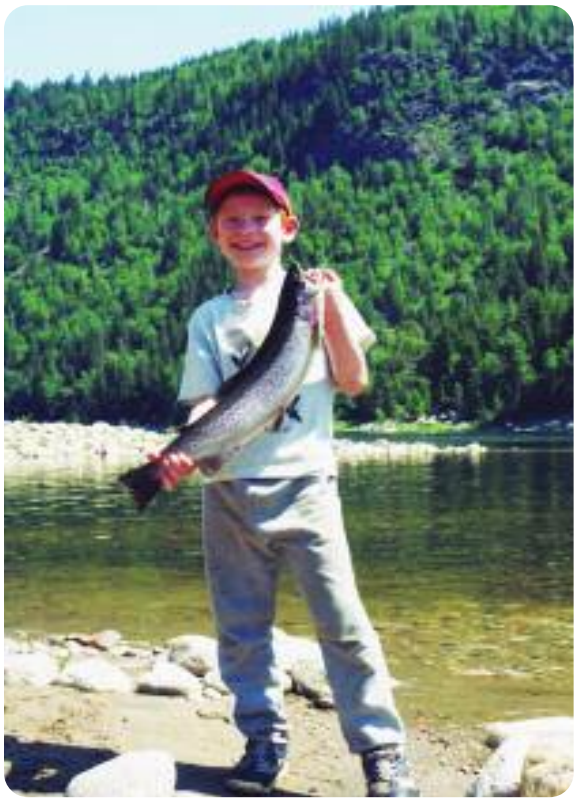
Dense periphyton mats *(Didymosphenia geminata)* are visible in some years, particularly in shallow areas. Although their visibility and resemblance to sewage discharge or wood pulp may raise public concern, they are considered a natural occurrence rather than a symptom of stress.

Municipal Wastewater

Municipal wastewater discharges from the cities of Castlegar and Trail and other smaller communities along the river may also contribute to increased periphyton growth in the Lower Columbia. Integrated monitoring and assessment will continue in order to investigate potential impacts of these discharges.

Outlook

Under current discharge conditions, localized effects on aquatic communities downstream of some discharges are expected, however, improvements in effluent quality continue to lead to smaller and less pronounced effects. Effects of flow regulation on productivity are expected to be studied further under BC Hydro's Water Use Plan.



FISH

Overview

Fish are one of the most studied and visible indicators of river conditions, as they are economic, recreational, and ecological resources. At least 28 fish species are found in the Lower Columbia River, including rainbow trout, kokanee, mountain whitefish, and lake whitefish. The area is also home to a number of species-at-risk, including white sturgeon, Umatilla dace, and mottled sculpin. Forage fish found in the river are dace, sculpin, sucker, pike minnow, chub, and shiner species. Introduced walleye and other species are also present. Walleye are increasing in abundance as they colonize northward from Lake Roosevelt toward the Arrow Lakes, which is of concern as these fish appear to be preying on, and displacing native fish.

Hydroelectric Operations

Over the past ten years, BC Hydro has changed operations at Hugh Keenleyside Dam to minimize impacts on fish and fish habitat. These include changes in flow to protect spawning and egg incubation, and development of a fish stranding protocol to minimize impacts from rapid decreases in water level. In addition, an ecosystem-based fish community study aimed at distinguishing effects of flow regulation from other natural and human influence is also taking place as part of the Water Use Planning Process. Sculpin and Umatilla dace populations, considered threatened in this region, are also expected to be studied.

Industrial Impacts

As a result of industrial discharges, fish consumption advisories for mercury in walleye and dioxins and furans in whitefish were issued in the late 1980's. Dioxin and furan concentrations in whitefish have been below the Health Canada consumption guideline since 1992, resulting in removal of the whitefish advisory in 1996. Average mercury concentrations in walleye are approximately half the Health Canada consumption guideline. Therefore the fish consumption advisory on walleye was lifted in 1996. A fish consumption advisory is in effect in the State of Washington recommending that women and children limit the number of meals of walleye from Lake Roosevelt to two per month. The MOE will continue to monitor and assess contaminant levels in sport fish.

White sturgeon are endangered, and sturgeon fishing has been banned in the Canadian portion of the Columbia River since 1996. Flow regulation at dams, contaminants from industry, loss of habitat and predation by the introduced walleye may be contributing factors to poor survival of young sturgeon. The Upper Columbia White Sturgeon Recovery Initiative (UCWSRI) was formed in 2000 to address sturgeon decline. The status and fate of this white sturgeon population appears to be a good indicator of the complex factors affecting the Columbia River.

Outlook

Although subjected to impoundment from dams and contaminants from various sources, most fish populations appear to be healthy and stable. BC Hydro will assess effects of river regulation on fish populations through long-term monitoring under the Water Use Plan process. The situation for white sturgeon is more tenuous and will depend on the success of the UCWSRI to identify and address poor reproductive success. Increased walleye populations are a concern, given their increasing abundance, influence on other fish species, and skill as predators.

LINKS, CHALLENGES, & FUTURE INITIATIVES

Links to Community, Emerging Issues & Challenges

A coordinated approach is necessary to address current and future river health. Scientific and monitoring information is best integrated with decision-making processes, and communities must be involved in decisions that affect the Columbia River. As such, public education and involvement are important in protecting the river as ecosystem and resource. While CRIEMP partners deal primarily with well-defined industrial and municipal discharges and their effects, a variety of diffuse environmental impacts exist. These unregulated impacts arise from road and other surface runoff, storm water discharge, use of pesticides and herbicides, removal of bank vegetation and other watershed activities. Community awareness and action are important to limit and reduce impacts from such activities.

Future CRIEMP Projects

Several CRIEMP initiatives are underway. CRIEMP is constructing a new website to increase public access to monitoring activities (**www.criemp.org**), as well as a database that compiles monitoring activities within the study area. A planned Cumulative Effects Assessment will provide an integrated assessment of river health, looking at the causes and interaction of multiple stresses affecting the Columbia River. Member organizations will also continue with their own monitoring programs and focused environmental studies.

CRIEMP Contacts

For further information on CRIEMP activities in the Lower Columbia River, visit our website at **www.criemp.org**, or contact Robyn Roome, CRIEMP Committee Chair at **Robyn.Roome@gov.bc.ca.**

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