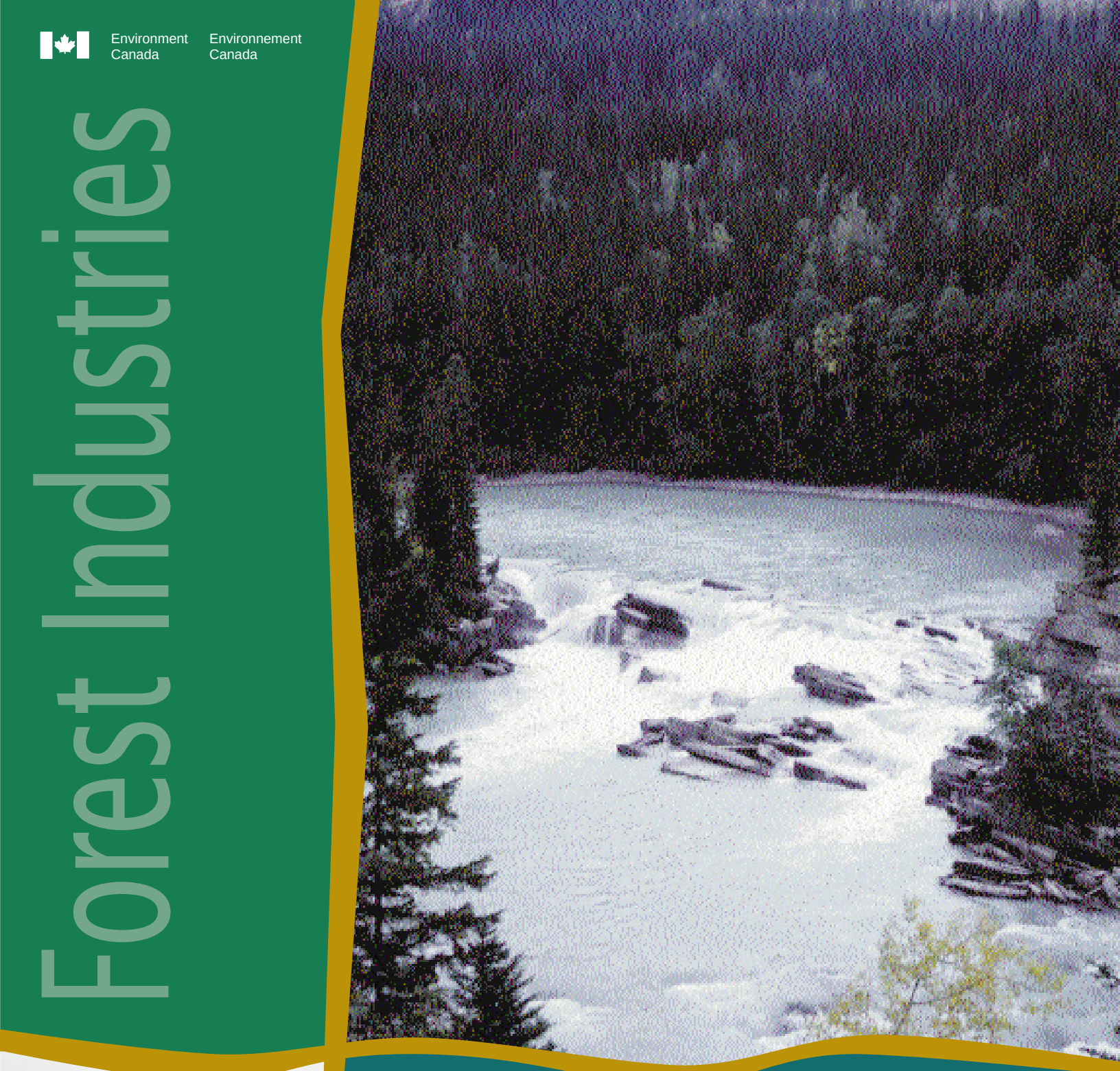
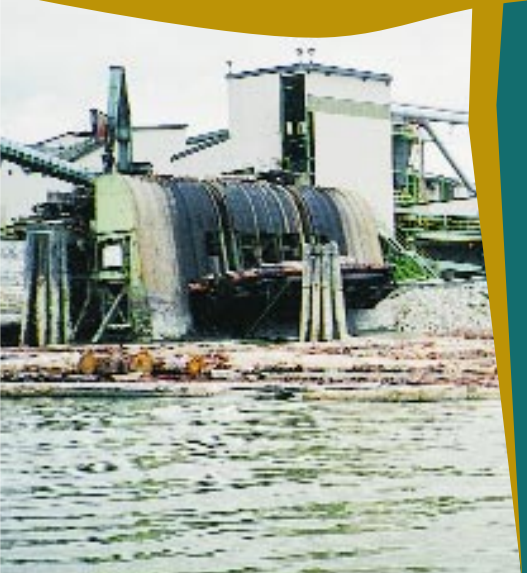
Environment Canada Environnement Canada

# Forest Industries





# FRASER RIVER ACTION PLAN

Canada

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# FRASER RIVER BASIN

# FOREST INDUSTRIES AND THE ENVIRONMENT

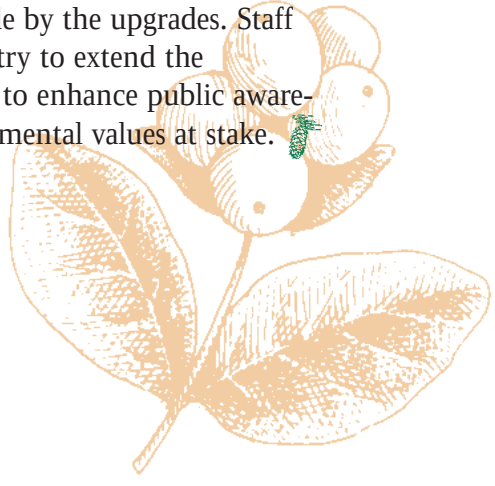
Traditionally a mainstay of British Columbia's economy, the forest industries have three main branches: logging, lumber mills, and pulp and paper mills. These activities differ in their effects on the natural environment:

- Logging can degrade or eliminate fish and wildlife habitat. Clearcuts and logging roads can fragment and remove habitat, promote erosion, clog streams with debris and sediment, and destroy riparian vegetation and spawning beds. The Forest Practices Code of the 1990s represents a cooperative effort by the logging industry and government to reduce unnecessary destruction in forested areas.

- The mills generate toxic residues which find their way into the environment as pollution. Liquid pulp mill effluents are discharged to rivers. Fungicides and wood preservatives used in lumber products can seep into groundwater or run offsite into streams. Pulp mill gases diffuse into the air, as any passerby can tell from the odour. Airborne gases and smoke eventually join the water contaminants when they are washed from the air by rain. In the 1990s, both lumber and pulp and paper mills undertook a huge pollution reduction and cleanup effort.

*EC AQUATICS SECTION*

When the Fraser River Action Plan (FRAP) came on the scene, substantial programs in improved management and clean-up were already underway in the B.C. forest industries to reduce their environmental impacts. FRAP scientists helped track both the harm caused by the old practices and the improvements made by the upgrades. Staff worked with industry to extend the improvements and to enhance public awareness of the environmental values at stake.



EC AQUATICS SECTION

# FOREST INDUSTRIES CUT POLLUTION

In the last 10 years, the forest industries have reduced significantly the amount of toxic effluent they release into the Fraser Basin.

Freshly cut softwood lumber is treated with anti-sapstain chemicals that can be highly toxic

## DIOXINS AND FURANS

In 1992, the federal government, responding to growing scientific and public concerns, introduced much more stringent pulp and paper effluent regulations. These required mills to reduce drastically the amounts of dioxins and furans produced by bleaching processes using new technology. The industry in B.C., which had been in the forefront of developing and implementing this new technology, has now managed to reduce the amount of dioxins and furans in effluent by 99 per cent. Pulp and paper mills within the Fraser Basin were in full compliance with the new regulations by 1996.

## FUNGICIDES FOR SOFTWOOD LUMBER

Freshly cut softwood lumber is susceptible to “sapstain” moulds and fungi and therefore is routinely treated with anti-sapstain chemicals that can be highly toxic to fish (eg sturgeon fry). In British Columbia, about 70 per cent of the softwood lumber industry is in the Fraser Basin. Traditionally, lumber companies would dip pallets of lumber in vats of inexpensive anti-sapstain solutions and then store the wood outdoors, where the chemicals could be washed away by the rain. Little attempt was made to keep these residues from reaching ground or surface waters.

In response to public concerns, new provincial regulations, and intensified government enforcement efforts, the industry invested about $80 million in improved treating facilities and less toxic chemicals. Recycling of chemicals was encouraged by the much higher price of the replacement chemicals. As a result, between 1988 and 1992, the softwood lumber industry reduced its monitored effluent discharge by 99 per cent (from 260 million to only 1.6 million cubic metres a year), and better containment prevents the chemicals from leaking into groundwater or runoff.

ZAHEER MANKI

*With modern technology, heavy duty wood preservation can be a very clean operation.*

A 1996 FRAP inspection program rated the implementation of best management practices in the industry at 87 per cent. However, there is new concern that the replacement chemicals, believed in 1991 to be less toxic than the traditional ones, may also be harmful.

## HEAVY DUTY WOOD PRESERVATION

Wood intended for use outdoors in stressful environments, such as railway ties, telephone poles, and dock pilings, is impregnated with preservatives, such as creosote. The pressure-treated wood was traditionally left to cure in an open yard. There are 14 heavy duty wood preservation operations in the Fraser Basin (19 in all of B.C.). In 1990 they generated an estimated 600,000 cubic metres of toxic surface runoff annually.

From 1992 to 1997, FRAP invested about $600,000 in a compliance and enforcement program, and the mills invested about $39 million to upgrade their facilities. Storage areas are now paved, and runoff is collected and recycled. A 1996 inspection program concluded that the implementation of best management practices had reached 89 per cent. By 1997, annual environmental releases in the Fraser Basin had been reduced by 95 per cent to 30,000 cubic metres.



# WATER POLLUTION FROM MILLS

## CONTAMINANTS

Dioxins and furans are highly toxic chemicals, very low doses of which appear to cause cancer, birth defects, and harm to endocrine functions in humans and animals. In the 1980s, scientists found an association between dioxins and furans in the tissues of Great Blue Herons and a decline in the birds' breeding success. In recent years their body loadings of these contaminants have decreased and they are better able to reproduce.

FRAP studies also showed that the decline of dioxins and furans in heron tissues has been paralleled by declines of more than 90 per cent in the tissues of other birds and fish and in sediment. All the decreases have occurred since 1991, when pulp mills began changing their bleaching processes. Corresponding to this improvement in best practices and technology, regulations were tightened in 1992. By 1996, all mills in the Fraser Basin were in compliance with the tighter regulations.

When FRAP began its work in 1991, studies of a broad range of wastewater sources showed that pulp and paper mill effluent discharges were the major source of BOD and TSS. These are two indicators of general pollution levels: biochemical oxygen demand is a measure of organic content and total suspended solids are a measure of floating particles. Other pollutants are often found in association with these.

FRAP studies also demonstrated that effluent from the forest industry mills remains a source of a variety of contaminants: metals (zinc, chromium, copper), polycyclic aromatic hydrocarbons (PAHs), resin acids, and chlorophenolics, as well as traces of dioxins and furans. Wastewater from smaller sawmill operations was found to be putting arsenic into the river, while one sawmill was releasing zinc.

FRAP-supported monitoring has shown that the pulp and paper mills have also reduced BOD by 38 per cent and TSS by 39 per cent from 1991 to 1996.

EC AQUATICS SECTION

## ECOLOGICAL EFFECTS

FRAP scientists have pioneered in monitoring benthic (bottom-dwelling) organisms for clues to pollutant effects. These shellfish, worms, insect larvae and other macroinvertebrates are the means by which pollutants move from sediment into the food chain to reach fish and birds, and their community interrelations and relative populations can readily show symptoms of pollution. But such population changes can also reflect the combined result of a variety of impacts within which the effects of pollution may not be easy to distinguish.

NHRI

*Retrieving a study sample from a mesocosm*

For example, FRAP studies found that the benthic macroinvertebrate communities downstream from the pulp mill at Prince George showed signs of disturbance when compared to similar communities in pristine water. This disturbance was likely caused by pollution from the mill. But it might also have been influenced by other changes along the river that affected the sediment as a habitat at the sample site.

EC AQUATICS SECTION

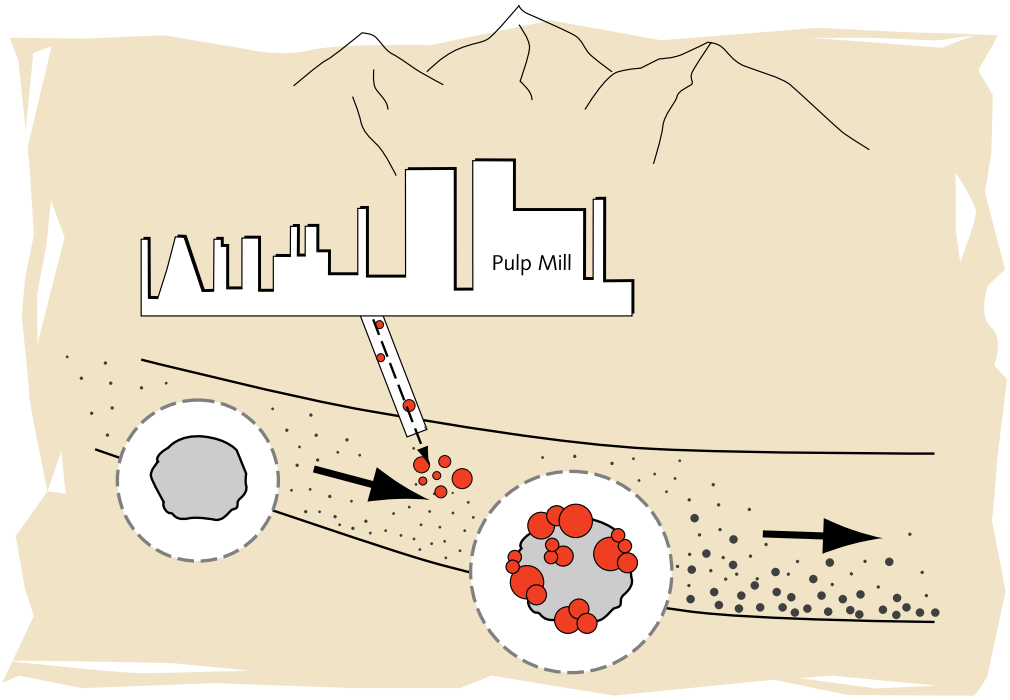
*Collecting benthic organisms for environmental monitoring*

FRAP scientists also developed a mobile tool for experimental analysis of industrial effluents. Called a mesocosm, it puts populations of benthic organisms in open-air tanks which can then be filled with varying effluent concentrations in controlled conditions of temperature, duration, agitation, etc. The mesocosm experiments confirmed that pulp mill effluents can affect such populations. At effluent-to-river-water concentrations of 1 to 3 per cent, which can be experienced in the river at low flow conditions, the organisms showed extra growth apparently due to nutrition. At somewhat higher concentrations (5 per cent), the organisms showed no extra growth and exhibited symptoms of toxicity.

## FLOCCULATION

Contaminants often adhere to particles and therefore travel with suspended sediments. Suspended particles tend to settle out in quiet water, while swift water can lift them from the bottom and get them moving again. Larger particles settle faster, and particles can get bigger by flocculating (clumping together). Any substance that promotes flocculation will thus accelerate sedimentation.

FRAP studies show that pulp mill effluents promote flocculation. Suspended sediment collected upstream of a basin pulp mill




*Effluents encourage particles to stick together and settle out.*

typically consists of fine, single particles, whereas suspended sediment collected downstream of a mill will have a significant fraction of larger, flocculated particles.

## FRAP studies show that pulp mill effluents promote flocculation

These aggregate particles will settle out sooner than the single particles, especially in low flow conditions during the fall and winter. Therefore the area downstream of a pulp mill tends to receive deposits of sediments affected by mill effluent.

Since mill contaminants tend to adhere to particles, the intensified sedimentation downstream of pulp mills means a greater concentration of chemicals in the riverbed sediment in those locations and therefore a greater effect on benthic organisms who live in and feed on those sediments. These effects will be most pronounced where flows are low, that is, in backwaters rather than swiftly running reaches and in fall and winter rather than spring and early summer.

Another indicator of localization in pollution can be found in osprey, which eat fish and can show the effect of biomagnification of contaminant concentrations going up the food chain. During 1992–94, FRAP scientists counted the numbers of hatched eggs and measured fledgling success in osprey nests, comparing nests upstream from pulp mills with those downstream. Only in the first of the three years did there seem to be

a small advantage for young birds to live upstream. The researchers concluded that the effect was not great and was diminishing, probably reflecting the effluent clean-up occurring at the time.

Scientists also detected pulp mill contaminants in bed and suspended sediments and in the tissues of fish, tree swallows, mink, and river otter. The levels were low enough to be thought safe, but the findings indicate the ease with which pollutants work their way through living systems.

*RALF BÜRGLIN*

## REPLACEMENT CHEMICALS

To kill moulds and fungi, lumber mills used highly toxic PCP (pentachlorophenol) until it was banned in 1991. Having experimented with some less toxic substitutes, the industry has come to rely heavily on two, DDAC and IPBC, which now account for 90 per cent of anti-sapstain use in B.C.

These replacements are only 1/20th as toxic to fungus and mould as PCP, so industry is using more of them. In 1987, the annual consumption of the chemicals used in anti-sapstain processes was 300 to 400 metric tons a year. By 1994, three years after PCPs were banned, the amount had risen to 846 metric tons. By 1997, well over 1000 metric tons were being used. DDAC has become the third most heavily used pesticide in British Columbia.

But DDAC illustrates the uncertainties involved in trying to determine the danger posed by a pollutant. DDAC is more toxic to some life stages of species than to other stages and species. FRAP researchers have found DDAC to be highly toxic to sturgeon in its early life stages (40 to 60 days old), though less so to some other fish, such as the starry flounder, found in the same parts of the Fraser estuary. There is also evidence that DDAC adheres readily to particles and gets deposited quickly. This reduces its direct exposure to fish in the water but raises concerns about concentrations in sediment settling areas.

Because of these concerns, a DDAC water quality guideline for the protection of fish and invertebrates is being reviewed by the Canadian Council of Ministers of the Environment. Meanwhile, scientists want to know more about the distribution of DDAC-sensitive fish at different life stages.

They want to be sure that laboratory tests aren't missing something, such as species with unexpected sensitivities or pockets of sediment with concentrations much higher than the proposed guideline. When a guideline is adopted, more stringent limits on effluent concentrations may be needed for the Lower Fraser where the chemical is most widely used.

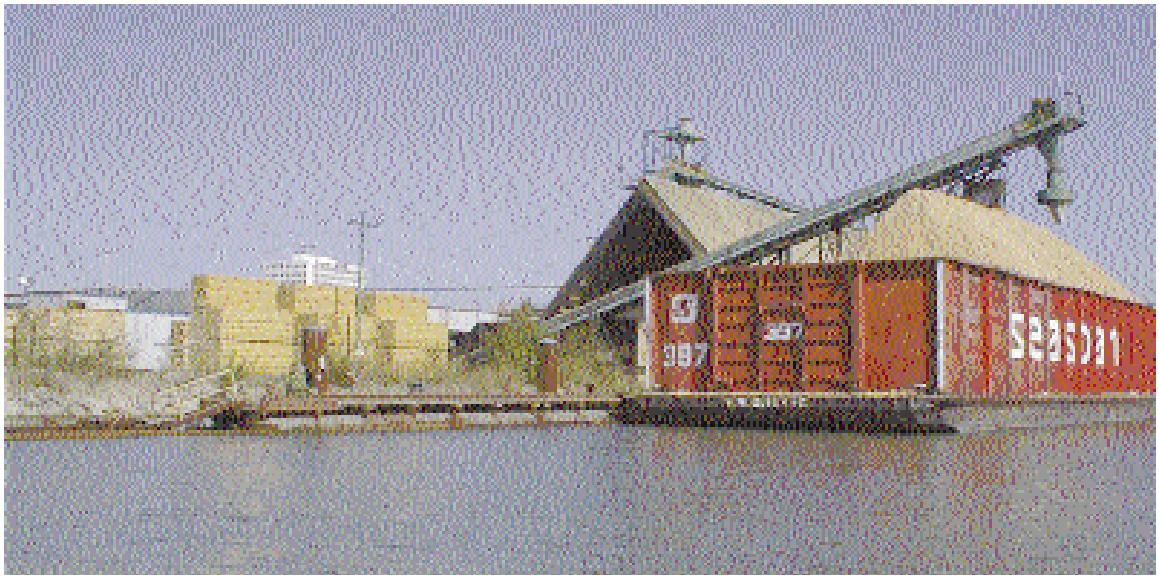
## Researchers have found DDAC to be highly toxic to sturgeon in its early life stages

The lumber industry is understandably concerned about more restrictions on the use of a chemical on which it relies so heavily. The chemical's manufacturer is also concerned because DDAC is being introduced in the Great Lakes to control the zebra mussels that clog water intakes of industries, municipalities and power plants.

## WOOD WASTE

A FRAP inventory established that the lumber industry accounts for about one-fifth of the 4.3 million cubic metres of unused wood waste generated annually in the Fraser Basin. This fraction is diminishing rapidly as the industry adopts recycling. With provincial regulations phasing out beehive burners, lumber companies increasingly divert former wood waste into pulp chips, cogeneration projects, livestock bedding, and remanufactured products, leaving only bark and very rough material as residues.

Analyses of the types and sources of wood waste and of potential uses for it have helped encourage greater recycling.



EC AQUATICS SECTION

*Forest industry waste is increasingly converted to useful products (pulp chips, fuel, particle board).*

RIVERSIDE FOREST PRODUCTS

## RIVERSIDE FOREST PRODUCTS

Sustainability will increasingly depend on the efforts of individuals and private companies. FRAP pollution abatement staff worked with private companies to promote sustainability initiatives.

One example comes from Riverside Forest Products, owner of the mid-sized Williams Lake Sawmill, which produces kiln-dried dimension lumber. The company undertook a pollution prevention planning process, involving a public advisory committee, which generated 48 options for consideration. The company intends to implement all but eight. The plan includes targets and a monitoring process to track implementation.

Highlights include:

- Reducing vehicle emissions, greenhouse gases, and road dust, through on-site speed limits, vegetation windbreaks, dust suppression, and a shift to propane fuels.
- Combatting riparian habitat erosion through stormwater management planning, culvert upgrading, and water conservation measures.
- Reducing contaminant releases by cleaning up old equipment, minimizing lubricant use, using biodegradable hydraulic oils in high-risk areas, replacing underground tanks with above-ground double-walled tanks, separating oil/water/sediment in waste streams, implementing a hazardous materials management plan, and eliminating onsite sewage disposal.
- Managing wood waste by cutting in half the volume of wood waste landfilled by 2000, introducing new equipment to reduce log handling and therefore waste, and covering a portion of the landfill to reduce leachate.
- Reducing plant noise by eliminating outdoor shift whistles, improving chip blower procedures, and lining metal conveyor troughs with plastic to reduce metal-to-metal contact.

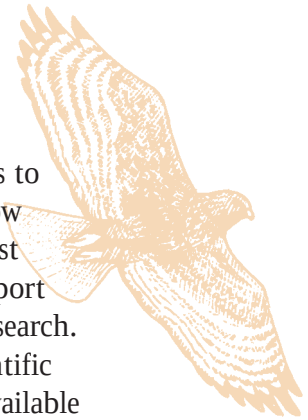
This example of forward-thinking environmental management shows how a company can voluntarily keep pace with best management practices.

# HABITAT CONSERVATION AND FOREST PRACTICES

The effects of forest practices on habitat can be complex. Sometimes the destruction of one kind of habitat creates a new and different kind of habitat. Advocates of clearcutting, for example, argue that it actually leads to diversified vegetation as new growth sequences spring up, encouraging different animal and bird populations than flourish in mature forests. Opponents of clearcutting counter that such changes are outweighed by the habitat destruction caused by removal technologies for bulk fibre. In British Columbia these are controversial topics, with many nuances to be considered.

FRAP has sponsored a wide range of activities to research issues, encourage environmentally sensitive forest practices, and protect sensitive areas.

## HABITAT RESEARCH



FRAP sponsored a number of studies to develop a better understanding of how birds use forested areas and how forest practices can affect them. FRAP support was essential to the extensive field research. The results will be published in scientific journals and reports, will be made available to resource managers and planners and the forest industry, and will help in the design of forest management guidelines.

*KATHLEEN MOORE*

Here are descriptions of several of these studies:

## Habitats are not created equal

In British Columbia the forests consist mainly of conifers. However, areas that are logged or burned by forest fires are rapidly recolonized by broad-leafed, deciduous trees. Since they are of less economic value and are believed to compete for space, light, and water with the slower-growing conifers, foresters tend to regard them as weeds and remove them to accelerate conifer growth. Sometimes they then spray the stumps with herbicide to prevent regrowth, permanently removing deciduous trees from the landscape. Such practices affect bird species that depend on the broad-leafed trees for forage, shelter, and concealment from predators.

The removal of broad-leafed vegetation drove away species dependent on it

A four-year experiment sponsored by FRAP was conducted in young conifer plantations near Salmon Arm to investigate the effects of removing deciduous trees on breeding songbirds. In designated areas, broad-leafed trees were cut down with power saws. In some plots, the stumps were left alone and were soon sprouting vigorously. In other plots, the stumps were sprayed with the herbicide glyphosate to prevent regrowth. In control plots, the deciduous trees were left untouched.

The removal of broad-leafed vegetation drove away species dependent on it. However, as the deciduous stumps resprouted in the manually thinned plots, the deciduous-dependent species returned, showing their flexibility in dealing with habitat changes. They even increased in number and improved their nesting success.

The herbicide-treated plots were a different story. The broad-leafed vegetation did not return, and the bird community was transformed. There were more birds of common generalist species that prefer to feed in open forests. But birds dependent on broad-leafed vegetation had disappeared, and there were fewer species overall. Permanent removal of deciduous trees thus encouraged bird species that were already very common.

A more alarming finding was that the common species that came to predominate in herbicide-treated areas had great difficulty raising their young. These areas no longer were able to support a self-sustaining bird community. The numerous common birds in the herbicide-treated plots were immigrants, born elsewhere, able as adults to take advantage of the plots but unable to reproduce there. Therefore even the few generalist species that seemed to benefit from the herbicide treatment were at long-term risk.

Another study in the same area has cast doubt on the belief which justifies the removal of broad-leafed trees in the first place: the idea that deciduous trees compete for resources

with conifers. Scientists have found that conifer seedlings benefit from the presence of deciduous trees by the intake of nutrients through interconnected root systems. So commercial conifers, as well as birds, may benefit from the maintenance of deciduous trees in conifer plantations.

## Riparian riches: the value of streamside habitat for birds

The shoreline of a lake, pond, stream, or river has moist and fertile soil supporting lush and varied vegetation not found farther from the water. This riparian vegetation usually offers a wide selection of food for animals and abundant cover and nesting sites. Wildlife surveys show that in British Columbia, a majority of wildlife in a landscape relies on this waterside environment. But most studies have taken place in southern areas of the province, and the value of riparian habitat in more northerly parts of the Fraser Basin was largely unexplored.

In all seasons, the riparian zone supports a greater density of birds than the forest

A study in the coniferous forest of north-central British Columbia observed the species of birds using streamside habitat and analysed changes in patterns of use through the seasons. At the study sites on

*A forest in the Stuart Lake / Takla Lake region*

*Chipping Sparrow*

some streams near Takla Lake, north of Fort St James, the upland conifer forest grew right to the water's edge, and the riparian zone consisted of a dense deciduous understory of alder, dogwood, and willow.

In two years of observation, 77 bird species were identified. Of the 46 most common species, one quarter were year-round residents and three-quarters were migratory. Four kinds of habitat preference were observed:

- Riparian breeding: during the summer breeding season some species build nests in the streamside bushes, concealed from predators.
- Riparian migration: some species frequent the rich streamside food sources when fattening up for long-distance travels, but for breeding they prefer to nest in trees.
- Generalists: with a broad diet, some species find food and shelter easily anywhere in the forest, so they neither prefer nor avoid the riparian zone.
- Non-riparian: some species nest and forage high in the forest canopy or in the open forest floor and avoid the low, dense riparian shrubbery.

Most generalists and non-riparian species are year-round residents. However, the birds that breed or fatten in riparian zones in warmer seasons tend to be migratory, and they are attracted to the riparian areas by their richness in forage and shelter. The heavy use of riparian zones by migratory birds suggests that these narrow bands of habitat may function as corridors — migration highways — through the coniferous forest.

ERVIO SIAN

*Golden-crowned Kinglet*

Overall, the riparian zone has more species than the surrounding forest in spring and fall, though not in summer or winter. But in all seasons, the riparian zone supports a greater density of birds than the forest.

ERVIO SIAN

*Black-capped Chickadee*

## Cavity-nesting bird communities

Many birds (and some squirrels and bats) nest in cavities in tree trunks. A FRAP study in the Cariboo-Chilcotin region of the Fraser Basin identified 32 species of cavity-nesting birds. It found that interdependencies among the species created a kind of community in which some species were crucial.

ERVIO SIAN

*American Redstart*

Trembling aspen is one such crucial species, accounting for

*Yellow Warbler*

*Red-breasted Nuthatch*

95 per cent of cavities used by nesting birds. Few cavities were excavated or used in conifers.

The 32 cavity-nesting species of birds subdivided into 8 species of primary excavating woodpeckers, 4 species of weak excavators such as nuthatches and chickadees, and 20 species of dependent non-excavators (ducks, sparrows, birds of prey). Two primary excavating species, northern flickers and red-naped sapsuckers, have a keystone role, providing 75 per cent of the nest holes used by other species.

The species tend to live together. Where primary excavators are abundant, so are secondary cavity nesters. A nest web, creating a hierarchy like a food web, seems to be an important factor in structuring forest bird communities. This means that impacts on nesting sites and excavating species can ripple through the community.

A lesson to be drawn from this study is that certain species have special importance to biodiversity. The large population of cavity-nesting birds in this ecosystem is almost totally dependent on one deciduous tree species and two woodpecker species.

## ENCOURAGING ENVIRONMENTALLY SENSITIVE FORESTRY

With many partners, FRAP supported development of a variety of tools to help forest managers better understand and address ecological issues. They include the following:

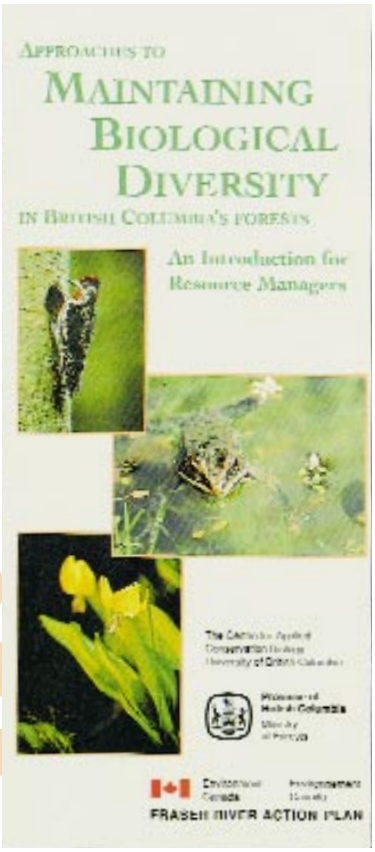
### Operational pamphlets on biodiversity

FRAP supported the design and production of four pamphlets on forest biodiversity issues developed by the UBC Centre for Applied Conservation Biology and the provincial Ministry of Forests: Bald Eagles; Maintaining Biological Diversity in British Columbia's Forests; Rotten Luck: The Role of Downed Wood in Ecosystems; and Broad-leaved Trees: Unsung Component of British Columbia's Forests. Based on a review of

FRAP supported development of a variety of tools to help understand ecological issues

scientific literature and presented concisely and factually, they were designed to guide operational forest managers, planners, private property owners, and the interested public.

Thousands of copies of these pamphlets were distributed throughout the Fraser Basin to government agencies, companies, and schools.




## FORTOON

This educational game puts high school students in the role of the Chief Forester, making decisions about where and what type of logging will be allowed in forest stands. Students learn about clearcutting, partial cutting, and other aspects of forest management and try to make decisions that will maintain jobs, profits, and wildlife habitat. FRAP supported development of the wildlife aspects of the supporting materials. The game will be distributed to schools by the National Film Board.

*KATHLEEN MOORE*

## Riparian management workshop

In 1993, FRAP cosponsored a workshop on riparian habitat management which drew 140 participants, mainly federal and provincial biologists involved in riparian management and research. The purpose was to review the current state of knowledge and to develop recommendations for management. The workshop proceedings and summary document were published by FRAP and have become an important reference tool. The discussions and recommendations were used in developing guidelines under the provincial Forest Practices Code.

## Biodiversity Training Module

FRAP sponsored development of toolkits and presentation materials for workshops on biodiversity. The intended audience was councils, boards, and staff of municipalities and regions, school trustees, environmental non-governmental organizations, land developers, and interested members of the public. The workshop materials explained biodiversity, described its range and state in British Columbia, and highlighted mechanisms to conserve it, especially in urban settings. A number of workshops were then held across the province using the material. Participants were enthusiastic, and many who were civic officials cited actions taken as a result, such as development guidelines, protection for riparian areas in subdivisions, and revisions to park plans to encompass biodiversity conservation.

WAYNE BELZER

EC AQUATICS SECTION

## PROTECTING SENSITIVE AND IMPORTANT HABITAT

### Protecting habitat in provincial land use planning

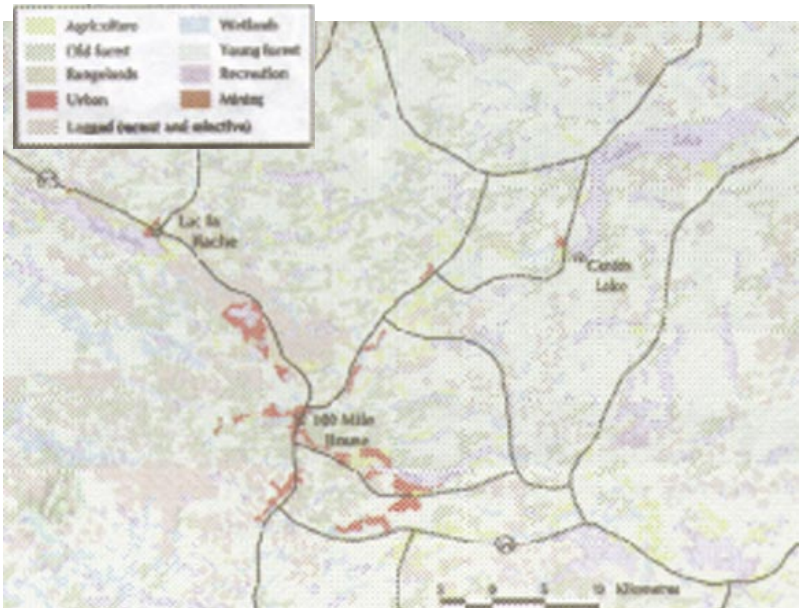
FRAP provided advice and information to provincial land use planning authorities for the regional Commission on Resources and the Environment (CORE) and the subregional Land and Resource Management Planning (LRMP) processes. FRAP's contributions

**Migratory bird habitat and sensitive ecosystems are being identified and protected**

led to greater recognition of the significance of sensitive habitats and ecosystems, such as wetlands, riparian areas, estuaries, and endangered species habitats. The importance of protecting migratory bird habitat was entrenched in the guiding policy document for LRMP. FRAP also cosponsored the first workshop for LRMP practitioners in Prince George, which brought together representatives from all sectors and contributed to the development of an LRMP manual for stakeholders. As a result, migratory bird habitat and sensitive ecosystems are being identified and protected throughout the Fraser Basin.

CHRIS LAUSTRUP

FRAP also contributed to the development of an LRMP training manual on First Nations issues. The module helps LRMP participants learn about First Nations' concerns and goals and work to develop First Nations' participation in the process.




BC MINISTRY OF ENVIRONMENT, LANDS AND PARKS

*A baseline thematic map*

## Baseline thematic mapping

Maps of wetlands and other sensitive habitat do not exist across most of British Columbia because of the high cost of aerial photography and interpretation. This project, cosponsored by FRAP and the provincial Ministry of Environment, Lands and Parks, assessed the feasibility of using satellite imagery to map land use and vegetation cover. The project correlated satellite imagery with precisely known land use and vegetation information for two plots in the Quesnel Lake and Bonaparte Lake areas of the Fraser Basin. In this way, imaged features were linked with known physical characteristics, providing a reference that enables such images to be more easily interpreted.

EC AQUATICS SECTION

The success of the project persuaded the provincial government to extend the mapping process across the entire province. The result will be maps capable of identifying wetlands as small as 15 hectares in size to assist resource managers in planning for habitat conservation.

## ECONOMIC INSTRUMENTS

In many areas, FRAP has investigated the feasibility of using economic instruments as an alternative to regulation. The idea is to alter behaviour not by prohibition and enforcement but rather by altering prices, which usually do not reflect true environmental costs. An example is to encourage recycling by charging for garbage disposal.

FRAP commissioned background research on opportunities for using such techniques in managing forest landscapes. One study suggested that measures such as variable stumpage rates or privatization of wildlife rights might be effective alternatives to regulation. A workshop on the issue brought interest and recommendations for further investigation.

FRASER BASIN COUNCIL

*Our forests represent many values.*

# WHAT'S NEXT

## environmental management

The forest industries face strong international competition at the same time as they are under increasing public pressure to reduce their environmental impacts. In the last decade they have responded vigorously with costly pollution-reduction programs that have brought dramatic results. They have proved that environmental management is consistent with maintaining competitiveness. The industry has developed and is benefiting from a new, cleaner image.

There is need for integrated research on the use of riparian habitat by birds, fish, and small and large mammals. The effects of forest practices on habitat remain controversial. Again, important improvements have begun, but continuing improvement will be required. Much further research on habitat, and the effects of forest practices, will be needed.