THE NEWFOUNDLAND NATURAL HISTORY SOCIETY

P. O. Box 1013

ST. JOHN'S, NEWFOUNDLAND

A1C 5M3

The Hon. Kevin Aylward,
Minister of the Environment,
Dept. of Environment,
Government of Newfoundland and Labrador,
P.O. Box 8700, St. John's. A1B 4J6. 16/II/96.

Dear Mr. Aylward,

Thank you for the copy of the Environmental Impact Statement concerning the proposed Star Lake hydroelectric project, and we are pleased to comment on this EIS.

First of all we disagree with a major premise of the EIS (p.ii, P.18, and other places through the report) that "hydroelectricity is recognised as a clean, and economic source of energy with fewer environmental impacts than a number of energy alternatives". Although hydroelectric developments may be relatively cheap to build, in North America generally hydroelectric developments have had more damaging effects on the environment than any other source of energy generation, and attempts at mitigation have usually failed. Emissions from thermal generating plants can be minimised, and major sources of airborne pollutants are from other sources, such as vehicular traffic. It is mentioned that (p.18), "Small hydroelectric developments are viewed more favorably than large-scale schemes which have become much less attractive both economically and environmentally", but this is because the smaller developments are relatively less damaging because of their size. They still can have severe negative impacts, as is witnessed by other such developments on the island. In the United States no new hydroelectric developments are going ahead, and many are being decommissioned in efforts to restore rivers.

In Newfoundland one of our major potentials is eco-tourism, which will be lessened by developments such as the one described in the present EIS. Therefore the supposed economic advantage of a hydroelectric development as opposed to some other source of energy generation may not be real. We also have reservations about the projected energy demand increasing at the same rate as in the last ten years, as shown in Fig. 3.3. The demand for energy has decreased in recent years, and since the population of the island is still decreasing, extra generating capacity may be unnecessary for the forseeable future.

Since Star Lake is heavily used for recreation, with two commercial outfitting camps in the area, and is recognised as one of the best waters on the island for large brook trout, it may not be a good location for a hydroelectric development. The proponent admits negative effects of the project, but describes them as minor. We believe they would be major.

The proposed impoundment would raise the present water level 8m, and cause flooding of an extra 9.3km^2. In addition the water level in the reservoir will annually vary from natural levels to a maximum of 8m above natural levels (p.45, 3.5.4). With this situation, spawning, rearing habitat and food production for salmonids in the lake would be severely impacted.

"No change is anticipated in the available habitat for spawning and rearing by brook trout and arctic char" (p.160), since there is "less than 10% of type I and II habitat within the proposed flooding zone". In fact no spawning studies were undertaken. The outlet of Star Lake is to be impounded and the remainder of the outlet river (Star Brook) will be dewatered. Usually prime spawning areas are gravel bars at the outlet of lakes. Gravel bars are present on all of the larger tributaries to Star Lake and on Star Brook (Appendix D, p.26, 2.2.1) and these would be lost with the proposed flooding. Arctic char, and sometimes brook trout, where there is spring upwelling, spawn on coarse substrates in the littoral areas of lakes in the fall. These areas would likely become too deep for spawning, as well becoming unsuitable from sediment deposited from the inevitable slumping and erosion of the new shoreline. It is supposed that loss of char spawning habitat would be of "short duration as the littoral habitat re-establishes". Suitable littoral habitat would never establish with the annual water level fluctuations. Studies of similar reservoirs have shown that in such fluctuating situations the eggs would become dry and frozen as the water level reached low levels in late winter, before fry could emerge. In other words the arctic char would eventually be eliminated, and trout recruitment would be severely reduced. We disagree that "overall char should flourish" (p.175).

The most productive areas of lakes are the littoral areas down to about 1m. In fluctuating reservoirs this production is lost and the lake can become almost barren of fish that rely on insects, or on their prey which eat littoral invertebrates. This is well illustrated in several reservoirs on the Avalon which are subjected to such water manipulations. The problem is recognised (p.200), but since a sample of small trout showed that they were feeding predominantly on plankton it is suggested that "the trout in Star Lake do not rely heavily on insect aquatic life stages, so that the result of littoral habitat could be a minor impact to trout productivity" (p.200). The feeding study was of the most cursory type, and cannot be accepted. Although small trout will take plankton, it is not their major diet, which could have been

discovered if they had been sampled through the growing season. No large trout were sampled, which is most extraordinary since the lake is known for its large and abundant trout. The occurrence of large trout is probably best confirmed by the outfitters who take their clients there. In fact a source is quoted (p.201, Hammar and Filpsson, 1985, Institute of Freshwater Research, Drottningholm, Sweden, Report No.62:12-35)) reporting that the brook trout in Star Lake are pisciverous. In this same report, not mentioned in the EIS, the study, in 1984, shows that large brook trout were abundant, up to 50 cm in fork length. The large trout probably prey on small arctic char, as did the trout in the Rangeley Lakes in Maine, before the char there became extinct from fish introductions and hydroelectric developments. We do not believe that "the productivity of Star Lake will remain unchanged" (p.160). If the reservoir is created as planned the present high quality angling will disappear.

It is thought that "mercury content in sport fish will remain unchanged" (p.160), and that "mercury levels will cause a minor impact for recreational harvesting" (p.201). Typically mecury levels are recycled in such environments for decades, and will accumulate and be especially dangerous in larger pisciverous fish. This is bound to have an effect on recreational harvesting. "The mobilization of methyl mercury would be mitigated by reducing available organic material, as described in Table 4.2", where it is stated that "the use of mechanical clearing methods (i.e. bulldozer) will not occur except where it can be demonstrated that there is no merchantable timber and where the resulting terrain disturbance and erosion will not result in loss of topsoil or the sedimentation of watercourses and waterbodies". How can the use of a bulldozer not result in erosion and loss of topsoil?

It is pointed out (p.176) that both forest and peatland provide considerable organic input to the reservoir following flooding (in the paragraph before the one stating that much of it will be removed first), so that with the release of nutrients a trophic upsurge results, producing more numerous and larger fish, and that this would be a positive effect. Although this is true temporarily, the trophic upsurge would be followed by decreased production below previous levels, as has happened in all other such impoundments, so that in the long term effects would be negative.

On p.175, para.2, l.8, it is stated that, "The tributaries to Star Lake produce no brook trout." This must be a mistake.

A major fishing area at the outlet of Star Lake (Fig. 5.27) will be eliminated by the dam, which is to be situated 2.5 km downstream of Star Lake. Outlets of lakes are frequently good fishing areas, as these are the most productive areas of river eco-systems, due to the outflow of seston and the resulting

abundant filter feeding invertebrates suitable as prey items. The angling success at the outlet is more likely due to directed movements of fish there rather than the "stranding " suggested. The suggestion (p.175) that ponds and steadies below the dewatered section of river will be retained by local drainage and therefore that there will be a negligible reduction in total fish production in these areas displays ignorance of stream ecology.

The proposed diversion of Lake of the Hills would create problems. A "minimum flow release" to Otter Brook would still result in some loss of production to the brook. In addition the dyke would prevent fish from Lake of the Hills using the Brook and Otter Pond, and migration between the two lakes, the importance of which is not known. Since juvenile trout, even at the underyearling stage, migrate up streams, even a small barrier would prevent these movements. It is very likely that the large pisciverous trout in Star Lake are a unique genetic stock, and this could be lost by invasion of fish from Lake of the Hills.

Besides the aesthetic loss of Star Brook, its potential for rearing stocked salmon fry (p.156) would be lost. The aesthetic changes in Star Lake will be considerable. The present sandy beaches will be inundated, making them unsuitable for recreation. The swamping of the presently vegetated shorelines in combination with fluctuating water levels will cause slumping and erosion of the shorelines, generally making them unpleasant for recreational purposes.

There is prediction of a minor negative impact on the endangered marten (p.208). There will also be loss of wetlands and waterfowl habitat (p.137). In addition there will be a negative impact on migration of caribou (p.113). The speculation (p.161) that "the migration of caribou to and from the Buchans Plateau may cease in time as a result of natural ecological factors" is unsubstantiated, and most unlikely in this millenium.

Star Lake has heavy recreational use all year (p.159), and has been described by some anglers as providing the best trophy brook trout angling on the Island. This would be destroyed by the elimination or severe reduction of spawning and rearing habitats, and the lowered productivity of the lake. It is a unique ecosystem, and for the reasons given above we believe its loss for a relatively small generation of power would be most unfortunate.

Thank you for your attention.

Yours sincerely,

L. Zedel
President, Natural History Society of Newfoundland and Labrador.

Memorial
University of Newfoundland

Eco-Research Program

25 March 1996

The Hon. Kevin Aylward, Minister
Department of the Environment
Government of Newfoundland & Labrador
P.O. Box 8700
St. John's NF A1B 4J6

Dear Mr. Aylward:

I am writing to express my strong reservations in the matter of a hydroelectric project proposed for Star Lake in west-central Newfoundland. I am a professor of fish biology at Memorial, and my research over the past 25 years has concerned itself, among other things, with the ecology of salmonids in northern ecosystems. It is from this perspective, and also from my present involvement in Memorial's large "Community Sustainability" project, that I write.

Star Lake is possessed of one of those unique strains of fish-eating brook trout that appear but rarely in this species. On the island, the only other well-known area is in the Indian Bay watershed. These strains are characterised by excellent growth and the attainment of very large size, so much so that the waters they inhabit can be truly promoted as areas for trophy angling. Trophy fish, gone almost everywhere else that brook trout occur, are extremely valuable. At this time in Newfoundland's history, particularly, it would be reprehensible to allow any action that might harm such a resource.

The harm hydroelectric projects, including especially the so-called small ones, inflict on trout populations is very well documented. The contention in the Star Lake EIS that the impact would be minimal there is arguably very wrong, and my impression is that the study on which the EIS bases its conclusions was quite inadequate and flawed.

In a climate where we are only beginning to realise our eco-tourism potential here, going ahead with the Star Lake project would be a mistake and a big step backwards. I strongly urge you to turn down the application to proceed with it.

Sincerely yours,

Richard L. Haedrich

St. John's, Newfoundland, Canada A1C 5S7 • Tel.: (709) 737-7551 • Fax: (709) 737-7530 • Telex: 016-4101

Eco-blunder brewing on Star Lake

18/VIII/96.

By BENI MALONE

Telegram Forum

We, the Save Our River Environments Group, are disturbed that the Star Lake hydroelectric project (south of Red Indian Lake) has been approved and it is our hope that public pressure may still be applied in time to save this important ecosystem. Star Lake is the habitat for pine marten which has recently been declared an endangered species, i.e. one step away from extinction.

It is also home to a unique species of brook trout and is an important link in the migrational route of a large caribou herd. Star Lake is a diverse ecosystem with incredible recreational and tourist potential.

This lake is known for its trophy-sized brook trout. The large trout in the lake feed on dwarf arctic char, the only other species present. Piscivorous (fish eating) strains of brook trout are rare, and provide exceptional fisheries in the relatively few areas where they still occur. The Star Lake strain preying on arctic char is probably unique.

A similar race once inhabited the Rangely Lakes in Maine, but is now extinct. The usual strains of brook trout will not eat small char simply because they are present (e.g. as in Cat Arm Reservoir).

Indications are (from studies of salmonid species which have similarly been in an isolated system since the last ice age) that the species has evolved to be genetically different from other stocks of the same species. They differ in their feeding habits and ability to grow to a large size.

Besides providing trophy brook trout angling in Star Lake, these trout are a potential source of enhancement for other systems where dwarf arctic char exist as the only species, or where brook trout are present, but are the more common invertebrate eating strain.

The proposed hydroelectric development would destroy this unique resource and its potential in a number of ways. In other studies where a specific strain of a trout exists in a lake, it homes to and spawns in a discrete location. Such a location has not been identified in Star Lake as spawning studies were not undertaken. But the proposed flooding would inundate present probable spawning grounds.

The Lake of the Hills drainage is to be diverted into Star Lake to augment flows through the turbines. The smaller trout strain will be introduced and there will be interbreeding on some probable new spawning grounds. So the unique Star Lake stock will be lost.

It is well recognized that in fluctuating reservoirs the productive littoral areas are lost. These are areas of shoreline depth at low levels down to about two metres where insect larvae and other invertebrates used for fish food are generated. When the littoral areas are lost, any trout species in such reservoirs disappear or decline dramatically.

In Star Lake the water level drawdown over winter would be eight metres, so despite the increase in area created by the reservoir, there would not be much to fish for. Also arctic char spawn in the littoral areas in the fall, so even if a suitable rocky area for spawning developed, the eggs would be left high, frozen and dry.

In addition, the outlet of a lake is the most productive part of the system, mainly due to a concentration of filter feeding insects, on which fish feed, and this would be lost with the proposed dam. It can be seen that the present fishery would not remain.

Another problem is that the large trout that remained for some years would become unsuitable to eat. In new reservoirs mercury is leached from the rocks and is incorporated and concentrated up the food chain, so that piscivores (fish that prey on other fish) should not be used for human consumption.

The situation would probably last for a generation. For example, in the Smallwood Reservoir in Labrador the piscivores (lake trout and pike) still have high levels of mercury in their flesh, 21 years after impoundment.

There are also other problems, including a barrier between Lake of the Hills and Otter Pond, loss of sandy beaches, loss of waterfowl and pine marten habitat.

The status of the pine marten has been reclassified from threatened to endangered, the next classification is extinct. The eight metre fluctuation in water level will also result in unstable ice conditions during the winter months. Caribou crossing the ice will be at risk of drowning.

The proponent states that adverse environmental effects would be minor. We believe the environmental impact study (EIS) was inadequate, unscientific, and written with an unethical biased in favor of the proponent, and that effects would be major and would constitute in general an economic loss to the province and to global diversity.

We believe that extra power generation at present is unnecessary. The figure in the EIS depicting a continued increase in power demand, at the same rate as over the last 10 years; and the need to generate additional power, beyond the present surplus, by the year 2000, is incorrect, since power demand at present is declining.

If in the more distant future extra power is required, thought should be given to more modern and less environmentally damaging systems, such as gas turbines, wind and solar generators, etc. In fact, we suspect the proposed mini-hydro projects have little to do with energy needs, and more to do with developers and politicians owing each other favors.

Beni Malone writes on behalf of Save Our River Environmentalists, a coalition of environmental groups including Friends and Lobbyists of the Waterford River, the Natural Historical Society of Newfoundland and Labrador, the Virginia River Conservation Society, the Newfoundland and Labrador Wild Life Federation, and the Gander Region Environmental Group. Malone is an environmentalist who co-ordinates projects undertaken by FLOW. For information contact FLOW office at 364 2371.

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PROGRAM: MORNING SHOW (#04)	DATE: TUESDAY, AUGUST 20\96
NETWORK: CBC RADIO	TIME: 7:00 A.M.

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PEOPLE IN SCIENTIFIC & ENVIRONMENTAL COMMUNITIES UPSET STAR LAKE PROJECT HAS MANAGED TO GET THIS FAR WITH SO LITTLE QUESTIONING FROM GOVT.

NANCY WALSH: Abitibi Price has started preliminary work on the Star Lake hydro electric project. The company plans to sell power from the fifteen megawatt generating source to Newfoundland and Labrador Hydro and use the profits to run its Grand Falls paper mill. The project has been given the go ahead by the Province but the Federal Department of Fisheries and Oceans has yet to give its final approval, and some people in the scientific and environmental communities are upset that the project has managed to get this far with so little questioning from Government. Heather Barrett explains.

HEATHER BARRETT: The project calls for Abitibi Price and C.H.I. Hydro Electric Company to dam and flood Star Lake, located southwest of Red Indian Lake in central Newfoundland. 9.3 square kilometers of land around the lake will end up under water. During the year the water level of Star Lake will rise and fall by eight meters. An environmental impact statement prepared by Jacques Woodford Environment for Abitibi Price says the area is rich in wildlife. It's home to the pine marten, an endangered species, it's the site of a caribou migration trail. But the environmental impact statement does not talk about the claim by some scientists that Star Lake is home to a rare strain of fish eating brook trout which are said to eat another

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rare fish, the dwarf Arctic char. Richard Haydrick(?) is a biology professor specializing in fish. He's also the former director of the Ocean Sciences Center at Memorial University. He says a study by Swedish scientists a decade ago and anecdotal evidence by outfitters and cabin owners in the area now proves the rare trout are there. Earlier this year Haydrick wrote Provincial Environment Minister Kevin Aylward expressing his concern over the trout. Haydrick says Government has not taken his claim seriously.

RICHARD HAYDRICK: My personal opinion is that you've got something here which is as rare say whooping crane. It's probably only a few thousand individuals. In Newfoundland and Labrador it's amazing that we have some of the few populations of these large fish eating trout that are left anywhere in the world. But the general tendency, particularly in North America, is to treat brook trout as though they're one species instead of a, what biologists call a polytypic species, that is one that shows up with all kinds of different races and types and so on.

HEATHER BARRETT: In spite of pressure from Haydrick and others to take a closer look at fish life in Star Lake the Provincial and Federal Governments support the Woodford study's claim that none of the rare trout could be found, although the Department of Fisheries and Oceans says some fish life in Star Lake will be lost as a result of the development. Now the fate of the rare Star Lake trout is in the hands of the Federal Department of Fisheries and Oceans. According to the Federal Fisheries Act D.F.O. and Abitibi Price must work out an arrangement to replace any damaged fish habitat or fish stock as close to the original area as possible. Ray Finn is the division manager of Habitat Management with D.F.O. His division is in charge of approving Abitibi Price's compensation offer. Finn would not do an interview on tape. He says he knows nothing about this rare kind of brook trout. Richard Haydrick says the reason the group that did the study didn't find any of the trout is that they didn't look hard enough.

RICHARD HAYDRICK: They did just a very cursory study, looked at a few trout stomachs, found just plankton in it and concluded

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therefore that these fish were feeding on plankton and of course it's, you know, something that if you were going to do a serious study of that you'd have to do alot more sampling, but they also have pointed out that the original terms of reference didn't require any stomach contents. So they have sort of avoided that through a technicality but it's an extremely important point.

HEATHER BARRETT: Haydrick adds that flooding Star Lake for the hydro electric project will kill off the rare trout, but he says no enhancement project will replace them anywhere else.

RICHARD HAYDRICK: It's just so strange to try to replace a race of fish that will be extinct. They will never, never come around again if it's wiped out in this system, and just to say that you can do something somewhere else and offset is the height of arrogance in my view.

HEATHER BARRETT: Haydrick says existence of this trout should be enough reason to halt all work on Star Lake, but that's not going to happen. Ray Finn of D.F.O. says he's heard no objections to the environmental impact statement. He says D.F.O. is considering Abitibi Price's offers of fish habitat replacement projects. D.F.O. has yet to approve an offer it considers scientifically sound. But Finn adds he's open to hearing from people who have more information about these rare trout. Haydrick says there's not much more he can do. He does say some environmentalists are continuing to lobby the Provincial Government and they're considering court action to stop the project. Meanwhile, Roger Pike, an official with Abitibi Price, says his company is confident that it's acting in an environmentally responsible manner. Pike hopes the major contract for work on Star Lake will be awarded in September. That gives D.F.O. only a few weeks to approve an offer that it considers reasonable to make up for the destruction Star Lake is about to face. For the Morning Show I'm Heather Barrett.

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P.O. Box 1504,
St. John's. Nfld. A1C 5M5.

The Honourable Sergio Marchi,
Minister of Environment,
House of Commons, Room 509-S,
Centre Block,
Ottawa. ON. K1A 0E6.

21/VIII/96.

Dear Mr. Marchi,

We would like to bring to your attention a hydroelectric power proposal, which if it went ahead would result in a loss of a unique genetic stock of brook trout, and destruction of habitat of an endangered species, the Newfoundland subspecies of the pine marten, in contradiction to the United Nations Convention on Biological Diversity, ratified by Canada in 1992.

The Provincial government of Newfoundland has recently approved the construction of a 15 MW hydroelectric power development for Star Lake, a large lake of 1566 hectares in central Newfoundland, isolated from downstream drainages by a waterfall. The reservoir would increase the surface area of the lake by 50%, and the water level would fluctuate over a range of 8m.

Star Lake is known for its trophy sized brook trout, and provides other recreational pursuits through the year. The large trout in the lake feed on dwarf arctic char, the only other fish species present. Piscivorous (fish eating) strains of brook trout are rare, and provide exceptional fisheries in the relatively few areas where they still occur. The Star Lake strain preying on arctic char is probably unique. A similar race once inhabited the Rangely Lakes in Maine, but is now extinct. The usual strains of brook trout feed on invertebrates and will not eat small char. Studies of salmonid (the salmon and trout family) species which have similarly been in an isolated system since the last ice age, and where piscivory or some other trait different from the general species is present, have shown that the species has evolved to be genetically different from other stocks of the same species (e.g. Baroudy, A., 1995, Freshwater Forum 5(3):185-192; Ferguson, A., and J.B. Taggart, 1991, Biol. J. Linn. Soc. 43:221-237; Hartman, G.F., 1969, Salmon and Trout in Streams, H.R. MacMillan Lectures in Fisheries, Univ. B.C., Vancouver:53-67). The Star Lake Brook trout grow to an exceptional size, and are said "to look different". It is therefore certain that the Star Lake trout are genetically different from other stocks of brook trout, in their feeding habits and ability to grow to a large size, and may constitute more than one race in the system (for example in Lake Windermere in England there are at least four races of arctic char, and possibly at least thirteen). Besides providing trophy brook trout angling in Star Lake, these trout are a potential source of enhancement for other systems where dwarf arctic char exist, as the only species, or

where brook trout are also present, but are the more common invertebrate eating strain. A number of such systems which would benefit from such enhancement exist in Newfoundland, and elsewhere. The proposed hydroelectric development would destroy this unique resource and its potential in a number of ways. In other studies where a specific strain of a salmonid exists in a lake, it homes to and spawns in a discrete location, or in the case of several strains in the same lake, to different spawning sites, each strain to its own location. Such a location has not been identified in Star Lake as spawning studies were not undertaken, but the proposed flooding would inundate present probable spawning grounds. An adjacent drainage, Lake of the Hills, is to be diverted into Star Lake, to augment flows through the turbines, so that another smaller trout strain would be introduced, which would interbreed on some new spawning grounds, if such were created, and the unique Star Lake stock would be lost.

It is well recognised that in fluctuating reservoirs the productive littoral areas (the shoreline depth at low levels down to about 2 metres, where insect larvae and other invertebrates used for fish food are generated) are lost, and that any trout species in such reservoirs disappear or decline dramatically. In Star Lake the range of water level drawdown over winter would be 8 metres, so despite the increase in area created by the reservoir, few fish would remain. Also arctic char spawn in the littoral areas in the fall, so even if a new suitable rocky area for spawning developed, the eggs would be left high, frozen and dry. In addition, the outlet of a lake is the most productive part of the system, mainly due to a concentration of filter feeding insects, on which fish feed, and this would be lost with the proposed dam. It can be seen that the present fishery would not remain.

Another problem is that the large trout that remained for some years would become unsuitable to eat. In new reservoirs mercury is leached from the rocks and is incorporated and concentrated up the food chain, so that piscivores (fish that prey on other fish) should not be used for human consumption. The situation would probably last for a generation. For example, in the Smallwood Reservoir in Labrador the piscivores (lake trout and pike) still have high levels of mercury in their flesh, 21 years after impoundment (Anderson, M.R. et al., 1995, Water, Air, and Soil Pollution 80:927-930).

In addition a barrier will be constructed between Lake of The Hills and its present drainage into Otter Pond and Otter Brook, decreasing production and interfering with present migrations in that drainage.

Another major problem is that habitat would be lost for the endangered Newfoundland pine marten, contrary to regulations concerning conservation of an endangered species.

The new reservoir also would inundate major migration routes of caribou, and fluctuations in water levels, associated with dangerous ice conditons, could lead to increased mortality in the herds.

There are also problems with loss of sandy beaches, and loss of wetlands and waterfowl habitat. The gradual winter drawdown would make the ice unsuitable for ice fishing and skidooing, both of which are popular on the lake. Cabin owners on the lake are opposed to the proposed development.

The proponent states that adverse environmental effects would be minor and mitigable. Effects in fact would be negative and major, and we would lose a valuable resource before we could know its potential. Some of the replies of the proponent to concerns are quite inadequate. The response to the criticism that the dam at the outlet would eliminate a major fishing area was that the dam would block future downstream movement, leading to a reduction of loss of fish to the lake, ignoring that fish are attracted to lake outlets because of the higher production of food items there, and not necessarily because they are emigrating. It was stated that because in a very cursory feeding study plankton was found in trout stomachs, that the loss of the source of food from the littoral areas would have a minor impact on trout productivity, ignoring that littoral invertebrates are the major food of small trout, and a study in Star Lake by Swedish scientists showed that large trout fed on the char (Hammar, J., and O. Filipsson, 1985, Inst. of Freshw. Res. Drottningholm Rpt No 62:12-35). They reply that the Terms of Reference did not require any sampling of stomach contents. Their comment to the presence of large piscivorous trout was that large piscivorous brook trout have been reported in some other systems, implying that these trout are not very different, but showing their ignorance of the polytypic nature of brook trout and the stock concept. They say that a genetic basis for piscivoury in brook trout has not been proven. However, no one has yet looked, and in other species where a similar situation exists, e.g. brown trout, rainbow trout, arctic char, lake trout, ouananiche, studies have shown genetic differences. They predict that the arctic char will flourish, because they continue to exist in Cat Arm reservoir on the Northern Peninsula. However, no population studies have been done at Cat Arm, so that changes in numbers are unknown, but the population structure has changed, and relatively more of the older and larger char are now taken in gill net tests, indicating that recruitment has diminished. They do not refer to studies elsewhere where the arctic char have been diminished or eliminated in fluctuating reservoirs. They note that there will be a trophic upsurge after impoundment, after which productivity will decline to previous levels, but neglect to mention that other studies have shown that productivity in reservoirs declines to below original lake levels.

We believe the Environmental Impact Study (EIS) was inadequate, unscientific, and written unethically biased in favour of the proponent, and that negative effects would be permanent and major, and constitute in general an economic loss to the Province and to global diversity.

We also believe that extra power generation in Newfoundland at present is unnecessary. A figure in the EIS depicts a continued increase in power demand, at the same rate as over the last ten years, and it is stated that there is a need to generate additional power, beyond the present surplus, by the year 2000. This is incorrect, since power demand at present is declining. If in the more distant future extra power is required, thought should be given to more modern and less environmentally damaging systems, such as gas turbines, wind and solar generators, etc.

We are in general concerned about the gradual erosion of our wilderness resources by

a number of mini-hydro projects across the island, and the loss of biodiversity, frequently unknown, since adequate studies are not usually undertaken. We hope your Department will examine this particular project closely, as if it proceeds, the loss of biological diversity would be tragic.

Yours truly,

Beni Malone
Chairman, Save Our River Environments:
Friends and Lobbyists of the Waterford River;
Virginia River Conservation Society;
Gander Region Environmental Groups;
Natural History Society of Newfoundland and Labrador;
Newfoundland and Labrador Wildlife Federation.

FAXED

Government of Canada / Gouvernement du Canada

MEMORANDUM NOTE DE SERVICE

To / A: Branch Directors

From / De: L. C. Humphries
Director General
Newfoundland Region

Security Classification - Classification de sécurité
Our File - Notre référence
Your File - Votre référence
Date AUG 26 1996

Subject / Objet: Star Lake Hydro Development

The department, through Marine Environment and Habitat Management Division, Science Branch, has been holding discussions with Abitibi-Price and CHI Hydroelectric Company Inc. regarding environmental assessment/habitat issues associated with the Star Lake project. This project has generated some public interest. To facilitate a coordinated response on issues pertaining to this matter, I have requested that Marvin Barnes, Marine Environment and Habitat Management Division, be the Departmental spokesperson for enquiries pertaining to Star Lake and any such enquiries should be directed to him at 772-4912.

Please ensure that this memorandum is circulated to Branch staff.

L. C. Humphries

Copy to MEHA STAFF
RV
04-09-96

An explanation for a political reply.
We are not allowed to make public statements.
Research scientists are not asked by the Management Division to review any of these Environmental Impact Statements.
My public role is to be signed by people like Ben Malone, Jon Tedesco, Murray Chubbo, etc.

RECEIVED
AUG 27 1996
HABITAT MGT. DIV.
R.H.Q.

918

7540-21-798-8998 GC 177 (88/10)

➤ **LETTER**

Express, 4/IX/96

"Incredible" decision by government threatens population of pine marten

Dear Editor:

The Newfoundland pine marten is headed for extinction like the great auk and the Newfoundland wolf before it. The pine marten is about to be wiped off the face of the Earth. Unlike the generations who destroyed the great auk and the Newfoundland wolf, we should know better.

In the mid-'80s, the pine marten was declared a threatened species, with an estimated population near 800. In 1996, a mere 10 years later, it has been declared an endangered species with a population of less than 300 animals. During this period their habitat has been continually destroyed by the pulp and paper companies. While the government of Newfoundland sat back and watched, the pine marten's habitat has been reduced to less than two per cent of its original range. Like the North Atlantic cod, the pine marten has been pushed to the edge of extinction.

The existence of a small population of pine marten has been confirmed at Star Lake. It is incredible that our government can allow the hydro project proposed by Abitibi Price to proceed knowing it is a vital pine marten habitat. Star Lake also contains a rare sub-species of trophy-sized, fish-eating brook trout and is in the path of a migrating caribou herd.

This project brings into focus the inadequacies of an environmental assessment bought and paid for by the proponent and calls into question the need for these destructive small-scale power projects.

Through it all the pine marten stands on the brink. Last year Abitibi Price was among the chief financial contributors to both the Liberals and the PCs. The pine marten, struggling for its very existence, was unable to make a similar contribution. One can only hope that future generations will hold ecological crime trials similar to war crimes trials to convict public leaders responsible for the destruction of entire species.

Oh, yes . . . and jobs. The project at Star Lake will result in two permanent positions. Slightly more than the number of pine marten which will be left in Newfoundland.

Beni Malone
St. John's

Undue worry for Star Lake

By BARRY PERRY

TELEGRAM FORUM

Ken Hannaford raises a number of concerns in his Sept. 8 forum, "Star Lake wildlife threatened by hydro project," among them; the development of mini-hydro projects, the environmental impacts of the Star Lake project near Grand Falls, and the extinction of the Beothuck native peoples.

Hydro-electric power is one of the most environmentally sound forms of energy. The Star Lake project affords both the province and Abitibi-Price a number of benefits: clean, inexpensive power; job creation; and significant cost savings for a major Newfoundland employer which operates in an increasing competitive global economy.

Large hydro projects like Churchill Falls come with their own set of economic and environmental issues, often more substantial and less easily resolved. Star Lake and Churchill Falls are apples and oranges.

The potential environmental impacts of Star Lake have never been taken lightly. Before the project even got off the ground, a comprehensive two year study was conducted with the assistance of the public and field experts. The results were encouraging and both our company and the provincial government are satisfied that fish, caribou, the pine martin, and other wildlife will not be adversely affected.

The study also added to our body of knowledge about wildlife in the area (particularly the caribou and pine marten). This information will be put to valuable use through enhanced monitoring studies to be carried out upon completion of the project.

For example, 50 caribou will be equipped with collars so that the migration patterns can be monitored. The design of Star Lake is balanced to reduce negative impacts and capitalize on positive aspects such as improved salmon migration during dry summers.

As for the Beothuck, the historic resources review component of our study found no evidence of archeological sites in the Star Lake development area. The extinction of the Beothuck peoples is a sad chapter in the history of Newfoundland but one that cannot be related to the modern development of our province.

Barry Perry is the chief financial officer of the International Business Unit of Abitibi-Price. He works in Grand Falls.

FISKERIVERKET
Sötvattenslaboratoriet
Institute of Freshwater Research

Datum

Beteckning

Johan Hammar

October 14, 1996

The editor of
The Evening Telegram
P.O. Box 5970
St. John's, Newfoundland
A1C 5X7 CANADA

Dear Sir or Madame,

Friends from my passed stay as a visiting scientist in Newfoundland during 1984-85 have provided me with bits and pieces of opinions addressed in "The Evening Telegram" on the matter of the Star Lake tragedy. As the fish community structure of Star Lake is a major component in my model of how salmonid fishes interact, I feel it is my responsibility as a scientist to add some detailed and honest information on the ecological processes going on in the lake. In Sweden, I have also been deeply involved with a series of projects evaluating the environmental impact of water-level regulation on salmonids in northern reservoirs. These studies include the consequences of various extensive attempts to restore the losses of littoral fish-food organisms and/or large piscivorous salmonids in reservoirs. There is thus no need to accept arguments from proponents of the reservoir stating that the water-level regulation will have minor environmental effects. I was convinced we had left that kind of lies many years ago.

Enclosed you will find a letter that I hope will fit into your page of opinions. The content is detailed on purpose, as it adds the only scientific information on the Star Lake trout matter that seems available at the moment.

Sincerely yours

Johan Hammar
Research Scientist

Institute of freshwater Research
S-178 93 Drottningholm
Sweden

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The Star Lake tragedy - yet another northern lake of ecological importance turned into a limnic wasteland.

Star Lake, known for its trophy-sized brook trout, represents a highly unique northern ecological system, and it needs to be treated as such in the discussions on the danger of a hydroelectric development of the lake. The scientific literature illustrating the fast loss of large salmonid fish due to water-level regulation is monumental. Draw-down of the water-level during winter and spring causes a major loss of eggs at spawning grounds at shallow bottoms and a rapid deterioration of significant littoral fish food organisms such as amphipods, snails and insect larvae. It does not leave any uncertainty what so ever to what will happen to the brook trout population in Star Lake, if the lake is turned into a hydroelectric reservoir. In addition to an impoverished trout population, the flooding of the drainage area is also presenting a threat to various terrestrial mammals such as the endangered pine marten. Any qualified discussion on the outcome of Star Lake as a reservoir may thus simply be restricted to a comparison of the economic values of the locally short term income from the construction and the operation of a hydroelectric power-generator, and the ecological and social values of a long term loss of a well functioning biological system of major significance to species diversity, food production, human recreation, and scientific research. Actually a very uncomplicated and honest comparison between values of power and values of life, with no need for lies. We do know how to measure the value of a number of megawatts produced, and we have learned that modern power plants are operated from elsewhere offering no qualified local jobs. However, so far we do not know how to measure the value of lost genetic variants, populations or species. Instead we try to meet environmental disasters with emotional evaluations and we emphasize the uniqueness of the diversity of life that we anticipate to be lost. We know that genetic adaptations to local conditions may represent thousands and thousands of year's of directed selection on genes, a process Man is not capable of restoring. In what way is Star Lake and its fish community unique?

Every northern river forms a gradient of ecosystems with fish communities controlled by the order of colonizing species, temperature, nutrient content etc. Along such a gradient of increasing fish species diversity after the ice age, Star Lake is located exactly where Arctic char and (later on) brook trout once managed to enter the outlet and together form a simple fish community. No other fish species managed to colonize Star Lake, and no other fish species has been introduced by Man. Eventually temperature and other environmental factors became optimal to the brook trout, but not to the Arctic char. Natural selection lead to an ecologically very dominant and highly piscivorous brook trout feeding as a young on various littoral insects and crustaceans, and shifting to a diet of small-sized trout and dwarfed char after reaching the size of 200 mm (See enclosed graph). However, going further upstream the gradient, that is moving up towards lakes above the tree-line, where the decreasing temperature tend to favor the Arctic char more than the brook trout, the opposite system of dominance is in operation. In such ecosystems a large piscivorous char feeds on small-sized char and dwarfed brook trout. The fish community of Lake Michel in the Long Range Mountains offers such a case. To study such simple niche shifts and systems of asymmetric interactions between "char" and "trout" in natural lakes, Newfoundland and perhaps some of the northern islands of the Pacific Ocean, seem to be the only geographical sites left where this still occur. In contrast to other northern regions of North America, very few lakes are affected by water-level regulation and gillnetting, and no introductions of alien fish species or fish food organisms have occurred in Newfoundland. Also the study of analogous interactions between Arctic char and brown trout in northern Europe, is in many ways restricted because of extensive water level regulation and introductions of alien species. The fish communities of Insular Newfoundland thus forms a unique dictionary of international significance to the study of natural interactions among different combinations of salmonid fishes.

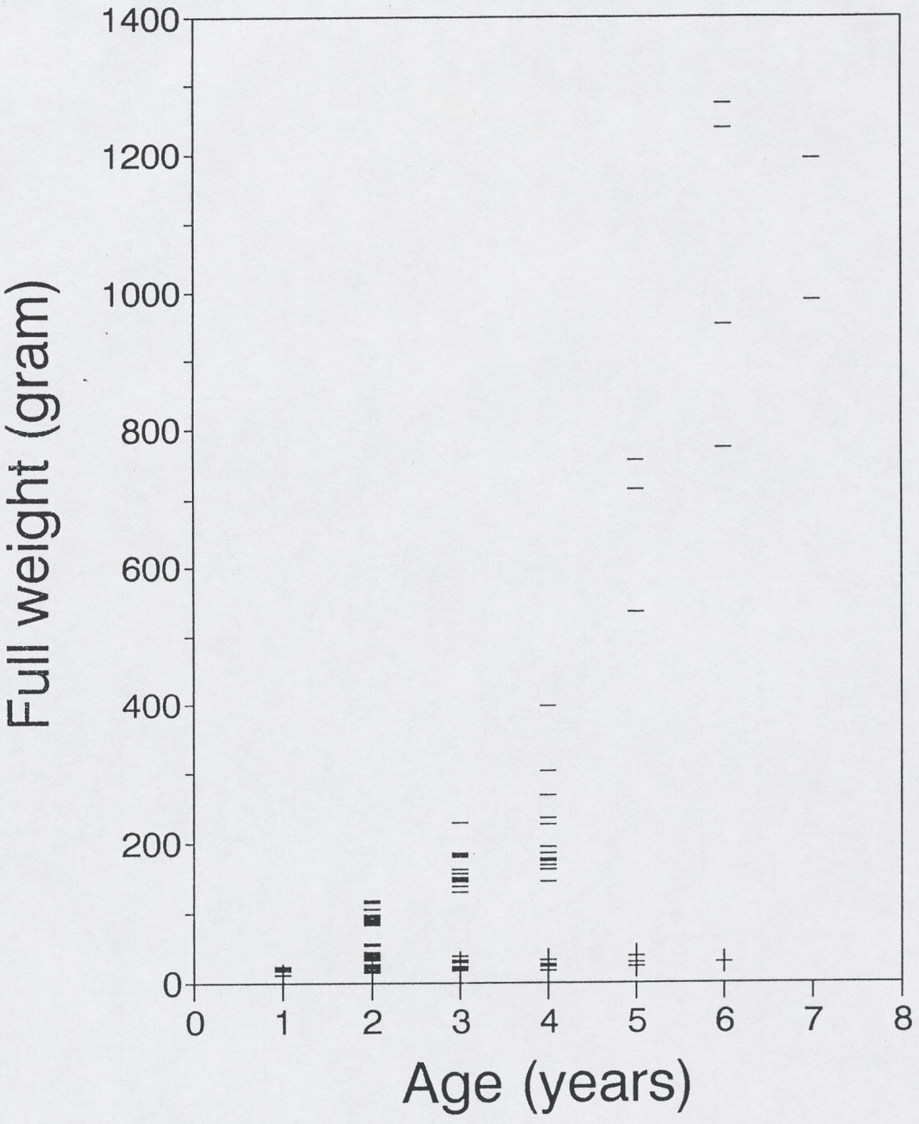
In 1984-85 I was invited to study the distribution, the ecology and the systematics of the Arctic char species complex within the province of Newfoundland. The survey was made possible due to financial support from Department of Fisheries and Oceans in St.John's, a scholarship from World University Service of Canada, and a large private bank loan. The survey comprised a testfishing program

including a large number of lakes in both Insular Newfoundland and Labrador. One of the lakes studied was of course Star Lake. By coincidence I had the opportunity to sample some large-sized trout caught by sport-fishermen already in early July, and later on in October I had the privilege to set a series of experimental gillnets at different depths. Analyses of stomach contents, parasites and age of fish confirmed the brook trout up to a size of ca 200 mm to feed on amphipods, caddies fly and mayfly larvae. Among larger trout the diet also included large proportions of both Arctic char and small-sized trout. As expected, the stomach content of the Arctic char was dominated by large-sized zooplankton species. The parasite analyses, however, revealed the Arctic char to feed on e.g. amphipods during winter time, when a lower temperature restricts the brook trout's ability to maintain its dominant character in shallow waters. The annual winter conditions with cold water, ice and low-light conditions offering a few months of Arctic comfort may thus be the explanation to why the Arctic char is still present in Star Lake. A regulation of the water-level of Star Lake causing a loss of littoral invertebrates may thus also cause a major threat to the Arctic char population.

Johan Hammar

Research scientist with the Institute of Freshwater Research, S-178 93 Drottningholm, Sweden, and Department of Zoology, University of Uppsala, Uppsala, Sweden.

Growth of brook trout and Arctic char
Star Lake, Newfoundland, Oct. 12, 1984



\+ Arctic char, n=42 – Brook trout, n=65

Office of the Newfoundland Chapter

Oct. 15, 1996

Canadian Society of Environmental Biologists

Société Canadienne des Biologistes de l'Environnement

File no. STARLAKE.1

Hon. Kevin Aylward,
Minister, Department of the Environment,
Government of Newfoundland and Labrador,
P. O. Box 8700, St. John's, Nfld.
A1B 4J6

Dear Minister Aylward,

On behalf of the Newfoundland Chapter of the Canadian Society of Environmental Biologists (CSEB), I offer the attached comments pertinent to the proposed Star Lake hydroelectric development.

Members of the Newfoundland Chapter of the CSEB have reviewed the proposed Star Lake hydroelectric development assessment and have asked me, as Director, to submit their collective response. The review by the Newfoundland Chapter of the CSEB is enclosed. The Chapter membership feels that the proposal is environmentally unsound.

The Canadian Society of Environmental Biologists (CSEB) is Canada's largest national, non-governmental association of professional biologists. The overall objective of the Society is to encourage the management of our natural resources based on sound ecological principals. The Society facilitates interaction among its members and between the Society and the public, and thus tries to provide a balanced, well-informed view on environmental issues.

If you wish clarification on any of these matters, please feel free to contact me directly.

Sincerely,

Murray Colbo
Director, Atlantic Region

Biology Dept.
Memorial University,
St. John's, Nfld. A1B 3X9

ph. 709-737-8004
fax 709-737-3018
email MCOLBO@MORGAN.UCS.MUN.CA

Comments concerning the proposed hydroelectric development of Star Lake.

by the

Newfoundland Chapter of the Canadian Society of Environmental Biologists.

The major problems that we see with this proposed development are as follows:

1) The new reservoir would inundate present habitat of the pine marten, endangered on the island, and possibly contribute to its eventual extirpation.

2) The newly inundated areas would cover presently important migration routes of caribou, with probable negative effects on the species.

3) Two species of fish occur in the lake, brook trout and arctic char. The watershed is isolated by an impassable falls, and if similar to other such large lakes which have been isolated since the last ice age, there may be at least one race or subspecies of each salmonid, genetically distinct from other local races. The lake is popular for its large trophy sized brook trout (50 cm or so), which are known to feed on the arctic char, which appear to be a dwarf form. These salmonids are known to home to specific spawning sites, which may be certain littoral areas, which would be lost in a fluctuating reservoir. No genetic studies have been done, and only incomplete or cursory spawning studies have been undertaken.

4) The fluctuating reservoir would damage the littoral areas along the shore which are the most productive area of the lake for plant, algal, and benthic invertebrates and has the highest biodiversity in the lake, resulting in decreased fish food production, as well as reducing spawning and rearing areas for these fish.

5) The mercury which would be released by the new reservoir would be taken up by all fish species, but would be concentrated in the pisciverous trout, and the situation would last for thirty to forty years, rendering the fish unfit for human consumption according to Canadian health standards.

6) Present sandy beaches, wetlands and waterfowl habitat would be lost. Waterfowl nesting, especially for loons, would be severely disrupted by fluctuating water levels in the proposed reservoir.

7) Aesthetically there would be negative effects. At present the surrounding mountains and terrain, and the outlet river with its picturesque falls make this one of the most beautiful lakes in Newfoundland. The shoreline of the proposed reservoir with an 8 m range in water level would become a mess, and the river would be lost. Caving ice through the winter would make the lake unsuitable for winter recreational activities.

Dam's danger minimized

I would like to reply to Barry Perry's letter in The Sunday Telegram, Sept. 29 concerning Star Lake. Perry states that wildlife would not be adversely affected by the Star Lake project.

The proponent's environmental impact study, however, stated that there would be negative effects, although minor. We agree that there would be negative effects, but consider them to be major.

The Newfoundland pine marten is an endangered species with less than 300 animals remaining. The population is being diminished at the rate of one per week. Star Lake is proven valuable habitat for these animals. Since presently only two per cent of the species' original habitat remains, further habitat loss will drive it to extinction.

The lake has a race of largely trophy-sized brook trout which eat the small char. These are most likely a unique sub-species.

If the project goes ahead, the spawning grounds would be eliminated by the changes in level of the reservoir and the trophy brook trout would be lost. In the Rangely Lakes in Maine, a large brook trout feeding on a dwarf char used to exist creating a valuable fishery. But the race was lost by dams and fish introductions. Why do we have to repeat these mistakes?

Also, all fluctuating reservoirs have negative effects on fish since the source of food in the shoreline areas is destroyed. In addition, any remaining trout would become toxic, since the mercury released in the new reservoir would be accumulated in the trout, and recycled for 30 to 40 years.

Aesthetically, this very beautiful lake would be degraded. The outflowing river, with its lovely waterfalls, would be put through a pipe feeding into the turbines, and the shoreline, fluctuating over eight metres, would become a mess.

It is not clear how 50 caribou being equipped with radio collars after the completion of the project would help Star Lake. For example, if it were found that the animals drowned in their migration routes, would this mean that the dam would be removed?

The concept of job creation is tenuous. The station would be remotely controlled, and only two permanent jobs would result. The extra energy is unlikely to create jobs, as there is already surplus energy and demand is declining. Who is going to subsidize the purchase of the extra electricity into a surplus situation?

We appreciate that Abitibi-Price must operate in a competitive global economy, but we ask that they do so without destroying Newfoundland's natural heritage.

Beni Malone
St. John's

13/X/96.

15/XI/96.

Tragedy at Star Lak

By JOHAN HAMMAR

Telegram Forum

Star lake, known for its trophy-sized brook trout, represents a highly unique northern ecological system, and it needs to be treated as such in the discussions on the danger of a hydroelectric development.

Water level regulation causes a major loss of eggs at spawning grounds and a rapid deterioration of significant littoral fish food organisms such as amphipods, snails and insect larvae.

There is no uncertainty whatsoever to what will happen to the brook trout population in Star Lake if the lake is turned into a hydroelectric reservoir. In addition to an impoverished trout population, the flooding of the drainage area is also presenting a threat to various terrestrial mammals such as the endangered pine marten.

Discussion can be restricted to a comparison between the short-term economic values of construction and the long-term loss of a well functioning biological system of major significance to species diversity, food production, human recreation and scientific research.

We do know how to measure the value of a number of megawatts produced and we have learned that modern power plants are operated from elsewhere offering no qualified local jobs. However, so far we do not know how to measure the value of lost genetic variants, populations or species.

Instead we try to meet environmental disasters with emotional evaluations and we emphasize the uniqueness of the diversity of life that we anticipate will be lost. We know that genetic adaptions to local conditions may represent thousands and thousands of years of directed selection on genes, a process man is not capable of restoring.

In what way is Star Lake and its fish community unique? Every northern river forms a gradient of ecosystems with fish communities controlled by the order of colonizing species, temperature, nutrient content etc. Star Lake is located exactly where arctic char and (later on) brook trout once managed to enter the outlet and together form a simple fish community.

No other fish species manâged to colonize Star Lake, and no other fish species has been introduced by man. Eventually temperature and other environmental factors became optimal to the brook trout, but not to the arctic char. Natural selection led to an ecologically very dominant and highly piscivorous brook trout feeding on various littoral insects and crustaceans when young and shifting to a diet of small-sized trout and dwarf char later.

However, further upstream, the decreasing temperature tends to favor the arctic char more than the brook trout and the opposite system of dominance is in operation.

In such ecosystems a large piscivorous char feeds on small-sized char and dwarf brook trout. Newfoundland and perhaps some of the northern islands of the Pacific Ocean, seem to be the only geographical sites left where this asymmetric interaction between char and trout still occurs.

In Newfoundland, very few lakes are affected by water level regulation and gill netting, and no introductions of alien fish species or fish food organisms have occurred. The fish communities of insular Newfoundland thus forms a unique dictionary of international significance to the study of natural interactions among different combinations of salmonid fishes.

In 1984-85, I was invited to study the distribution, the ecology and the systematics of the arctic chair species complex within the province of Newfoundland. One of the lakes studied was, of course, Star Lake. I had the opportunity to sample some large-s caught by sport fish early July. Later on had the privilege to of experimental gill ferent depths.

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Johan Hammar is a scientist with the Insti Freshwater Research Drottningholm, Swede with the department of University of Uppsala.

YOUR SUNDAY SMILE

Nag, nag, nag

BERKELEY, Calif. (AP) — Tired of nagging your kids?

So was Rowena Starling. She recorded her top 24 nags on a compact disc to save herself and other weary parents from the same old refrains: "Clean your room. Take out the trash. Mow the lawn."

The painter said she came up with the idea after telling her eight-year-old son to do something for the umpteenth time.

She is selling I'll Say It Again for $11.95 US.

Every dreadful chore is covered on the recording.

"I put the CD on and my son knows there will be punishment if the chores don't get done," she said.

INSIDE

LOTTO NUMBERS

LOTTO 6/49

Saturday Nov. 30, 1996

4, 13, 21, 23, 30, 40

Bonus Number **3**

TAG Number **639430**

Numbers are unofficial

Hunger strike enters day 19

Gander activist protesting Star Lake hydro contracts

By BOB BENSON
The Evening Telegram

John Lannon's got the anger of a patient man.

For 19 days the Gander community activist has been on a hunger strike to protest the awarding of contracts to begin the Star Lake hydro project in central Newfoundland. He won't end it until the provincial government meets his demands to stop it and have a second look.

The hunger strike is starting to tell on him.

"I can only stand a little and I have to pace myself," Lannon said. "I drink fresh squeezed lemon juice with cayenne pepper, some maple syrup and herbal tea. As long as I keep the fluids flowing, I think I'll be OK. I find myself in prayer which is a form of meditation and I do some yoga stretching and breathing. How long will I go on? Until there's a court injunction to stop it or until the government agrees to a management study. That's all it will take. The study will show we don't need to dam off rivers for projects like this."

The six-week study doesn't have to be done by experts, he said.

"We go to the grassroots," he said. "Whether it's on education, health or the environment, the grass roots can do the work for half the price. All I am saying is save the rivers from extinction. Because we have been given so much Newfoundland, we don't reali how much we've been given un we squander it."

The $54-million Star Lake deve opment is expected to com onstream in 1998.

Environment Minister Kevi Aylward has already said the ben fits of the project outweigh its di advantages. Every possible mea sure is being taken to protect th pine marten, he said.

But Lannon said, "People shou be more aggressive about this. Th minister is ignoring it, hopin everything will go way."

Lannon is convinced hydro-elec tricity projects like Star Lak destroy ecosystems. In the conse vation versus generation equatio the province in the longterm wi get more economic benefits and jo creation by conserving ecosystem rather then exploiting them fo doubtful projects.

Generation projects have highl paid construction jobs which ar not permanent, he said. Economi development, based on the environ ment and ecosystems can hav long-term spinoffs like eco-tourism

Lannon argues the provincia government is aware of the benefit of conservation rather tha exploitation of resources. A stud done by the Mines and Energy department estimates conservatio programs could create about 1,200

Please see ACTIVIST, page 2

Young adults shunning A

AIDS statistics

Some figures about AIDS around the world and in this

By JENNIFER SMITH
The Evening Telegram

Most young people know how to

...community takes interest in crew's plight

because he has nowhere else to go. He returns to court Dec. 16.

Gueorgi Skhirtladz, a Lithuanian native who has been residing in St. John's since 1992 and serves as the crew's translator, said having the TSC Azalija representatives stay aboard the vessel makes for an uncomfortable living arrangement. The owners are deliberately provoking the crew, the men charge.

"The two groups hate each other," said Skhirtladze. "The owner's people have tried to close the kitchen and have taken away the crew's television and VCR. That was their only entertainment."

The 23 crew say they want nothing more than to collect their wages and go home to their families. Cold Ocean is owed money by the Lithuanian owner, but despite the debt, has agreed to pay $26,000 in provisions and fuel if the crew agrees to sail. The crew are refusing because if they return home, they say they've no chance of getting their money from TSC Azalija.

If there is to be a resolution to the problem, it could come from the Canadian Lithuanian community rather than from diplomatic sources. The editors of Lithuanian newspapers in both Toronto and Montreal told The Telegram they will take up the case after discussing the situation with the Lithuanian consulate in Ottawa.

A spokeswoman for the consulate said she thought the matter had been resolved. She promised to initiate action by approaching the Lithuanian community.

Meanwhile, the crew has lost all faith in the International Trawlerworkers Federation (ITF), whose responsibility it is to look after the problems of foreign crews. Chief mate Kazys Dickus said the ITF advised them to go on strike. "That was the easy part. We want them to end it."

The crew wants to fight the owner in a Canadian court, but have no money, said Skhirtladze, their translator. "If the men were just able to make a statement to the courts, they would go home confident they would win the case."

...available next year

wear condoms or practice monogamy, and better living conditions so that young people have a reason to believe they have a future worth protecting.

Even in Newfoundland, developments such as the female condom can help slow the rate of infection among women, who now account for 40 per cent of HIV infections.

"She doesn't need the man's permission or co-operation (to use it)," said Howlett. "The female condom puts some control into the hands of the woman."

The female condom will be available in Newfoundland in 1997.

...ram

Activist hopes to enlist help of Sierra Club in Star Lake debate

Continued from page 1

jobs a year until 2000 and 480 a year afterwards.

Lannon also believes Canada has a moral obligation to conserve ecosystems and biodiversity. The nation was one of the first signatories to the Rio Earth Summit in the early 1990s which means the province has to recognize it too.

"Every country must abide by it and it covers everything from cod and caplin depletion off our coast to the pine martens," he said

Lannon has been concern about the environment ever since he was a boy growing up in Gander.

"I think I was the youngest [illegible] Audubon member in Gander," he said.

"I got involved in community economic development and in the environmental network because I knew there would be more jobs of value at processing our resources," he said.

Lannon has the full support of his family and friends.

Support also pours in on the Internet from people who have heard about his cause across the country and in the U.S.

He can be reached at jlannon@newcom.net. and he is considering setting up his own home page on the Internet.

He hopes to have the Sierra Club of Canada and the Canadian Environmental Defence Fund to publicly support him shortly.

Youth, Communities and Environment

CARS
CANADIAN AQUATIC RESOURCES SECTION
SECTION DES RESSOURCES AQUATIQUES CANADIENNES

The Literal Zone

AFS

The Newsletter of the Canadian Aquatic Resources Section of the American Fisheries Society

Volume 5, Number 4 | *Fall* | *November 1996*

PRESIDENT'S MESSAGE

To say that we are experiencing a time of rapid change is to acknowledge the dramatic effects that technological development is having on all aspects of our lives. Communications, travel, recreation, employment and careers are changing rapidly and in unprecedented ways. Technological changes are causing enormous social pressures because effectively our world is becoming smaller while human populations continue to expand. How do we respond to the environmental challenges that these changes are forcing upon us? Society leaders are responding by recognizing the need to reach out to a much broader constituency than ever before. AFS President, Chuck Coutant, has chosen "Interfaces" as the theme for this year's work program and for the annual meeting in Monterey, California. This could well be the theme for the next decade and beyond because the need to work together among disciplines, societies, cultures, jurisdictions, organizations and governments at all levels will continue to grow as we struggle to achieve global ecological sustainability.

AFS, CARS and many other Society subunits have been leaders in tackling problems at the Interfaces of complex issues. The Sustainable Fisheries Conference, Victoria, BC, April 1996 and The Aboriginal Fisheries Conference, Wahta Mohawks First Nation, Bala, ON, September 1996 are examples of CARS supported or facilitated initiatives which have reached beyond disciplinary and cultural boundaries to seek new understanding and solutions to difficult issues. Partnership between CARS and

continued page 2

Introducing the 1996-97 CARS EXCOM

Congratulations to John Casselman, new Vice-President and to David Rodgers, new Assistant Newsletter Editor. Their biographies were in the August 1996 issue of *The Literal Zone*.

John and David join a veteran CARS EXCOM consisting of President Dana Kinsman, President-Elect Bill Franzin, Secretary-Treasurer Bob Buchanan, and Newsletter Editor Dave Conley. CARS owes Dave Conley a special thanks for continuing on as Editor for an extra year beyond his original commitment.

Dave Evans retires as President after an extremely busy and successful year with CARS, however the new EXCOM can turn to him for advice in his capacity as Past-President.

Brian Nakashima

Aquaculture As Ecological Threat - A Rebuttal

Dear Sir:

I am writing regarding the article in the last edition of *The Literal Zone*, Vol.5, No.3, August 1996 by Jack Christie, citing aquaculture as an ecological threat. There were a number of points which deserve clarification before there can be reasonable debate on the subject.

Ontario did not de-regulate aquaculture recently. On the contrary, before the 1994 amendments to the Game and Fish Act, there was no prohibition on culture of any species. The associated regulation provided for licensing of an expanded species list in 1995. Approval of any species is based on presence/absence of a species, genetic/ecological concerns and facility security.

continued page 3

INSIDE

Hydroelectric Development Threatens Unique Ecosystem

Star Lake, a 1,566 hectare lake in central Newfoundland and home to a unique sub-species of pisciverous brook trout, is slated for hydroelectric development. The provincial government's recent approval for construction of a 15 MW power plant will result in damming of the outlet river, increasing the lake area by 50%, and producing a reservoir providing an 8-meter drawdown over winter.

Opponents to the project have voiced a number of concerns, but so far to no avail. The Environment Minister, Kevin Aylward, is quoted as saying, "In this case, we have some small hydro development that is left on the island. If we move ahead on some of it, we will alienate it for other purposes more than likely, but at the end of the day we still have a lot of protected area, a lot of resources that can still be used by people for a whole variety of other purposes."

Dr. Johan Hammar, a research scientist at the Institute of Freshwater Research in Drottningholm, Sweden, has conducted fish ecology studies at Star Lake. In his view, the project is "The Star Lake Tragedy, yet another northern lake of ecological importance turned into a limnic wasteland."

Dr. Hammar cites the loss of the trophy-sized pisciverous brook trout that eat dwarf Arctic char, and their probable uniqueness as a subspecies, as worthy of consideration. The loss of their spawning grounds and the introduction of another race from an adjacent system, whose feeding habits are unknown but are most likely the usual invertebrate feeders, will destroy the unique ecosystem. The Arctic char are generally littoral spawners in the fall and will be negatively affected by the 8-meter winter drawdown.

Beni Malone, representing the Save Our River Environments Group, lists a variety of other negative impacts resulting from the planned project.

"For example, after the trophic upsurge, the lake productivity will decline below previous levels, due mainly to loss of littoral production of invertebrates. Temperature and hydrological regimes will be drastically changed. The large pisciverous trout will accumulate mercury, which judging from the Smallwood reservoir in Labrador, will make the fish unfit to eat for twenty to thirty years (by which time they will have gone anyway!)."

"The endangered subspecies of pine marten, the Newfoundland pine marten, has gone from about 800 animals to a presently remaining population of about 300 animals in the last ten years, and only 2% of its original range remains. The proposed impoundment would destroy further habitat. The impoundment would also interfere with caribou migrations and negatively affect water-

continued page 5

ed - *The Literal Zone* and CARS is in need of your input.

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tor for compiling and publication in future issues.

The EXCOM has briefly discussed the idea of designing a CARS Web site and is looking for volunteers to help with this project. Many other AFS Sections are now up and running on the Web and providing members with an electronic version of their newsletters plus a wide variety of information that would be too expensive to provide to the members in print.

The EXCOM is also searching for people to head Special Committees as well as topics for the committees to work on. Some suggested Special Committees include: CARS Strategic Planning; Canadian Concerns; Revision of the Fisheries Act; Environmental De-regulation; Marine Fisheries Concerns; Cooperative Management; CARS Visibility Plan (see Fisheries Vol.21, No.2); and Professional Concerns (re. Engineering and Geosciences legislation, see p.3 this issue).

Please contact any of the EXCOM listed on the back page of this newsletter to find out how to become involved.

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AQUA

Are Acid-Da

By John Gunn

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quality continues to deterior
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cal factors appear to be c
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Fortunately for us in
Ontario, there is evidence
chemical recovery occurring
covery of damaged lakes ap
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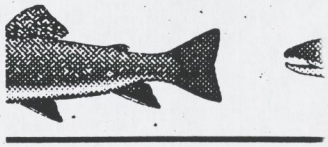

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The AFS Groundfish Ste
tee was disbanded in Se
The Committee was unable
cient funding to organize
stakeholders, fishery man
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Return Of The Mayflies To The Bay Of Quinte

On the evening of June 14, 1996 I sighted a shimmering cloud of insects near my lakeshore home on the Bay of Quinte near Glenora, Ontario. I recognized this as the nuptial dance of the Burrowing mayfly (*Hexagenia*). In 40-some years observing the Bay of Quinte I had never seen a swarm, and considered occasional summer sightings of individual adult mayflies as noteworthy events. As though to confirm this was more than a chance event, two days later found some 60 adult mayflies resting on my house. Last week, Al Mathers, a biologist with the Ontario Ministry of Natural resources observed "windrows" of the cast-off juvenile skins of emerged adult mayflies on the surface of the Bay of Quinte near Indian Point. Even further afield, on June 23rd there was an electricity "brown-out" in Toledo Ohio, which was attributed to short-circuits caused by Lake Erie mayflies. We don't know when the Bay of Quinte mayflies disappeared but it was a very common animal towards the

continued page 7

Acid Deposition - Sulfate Reduction Is Not Enough

Until recently, the solution to acid rain was to reduce emissions, particularly sulfur emissions, but new evidence suggests that this may not be enough. Although the initial evidence from the Sudbury region indicated that many lakes responded relatively quickly to a reduction in acid loading, this may have been a special case, and may not apply to other parts of North America. In examining long-term data from the Hubbard Brook Experimental Forest in New Hampshire, Likens *et al.* (Science 272:244-246) determined that large quantities of calcium and magnesium have been depleted from the soil complex. The depletion of these base cations from the soil results from a combination of removal by acid rain and declines in atmospheric deposition of base cations. As a result, the recovery of soil and streamwater chemistry in response to decreases in emissions and acid deposition will be significantly delayed.

Hydroelectric Development

continued from page 2

fowl habitat and nesting of loons."

"The 8-meter fluctuation of the reservoir would make the shoreline unsuitable for recreation, and winter drawdowns would make the ice cave and dangerous for ice fishing and skidooing. Cabin owners are opposed to the project."

"Star Lake is slightly larger than Lake Windermere, England's largest lake, is about the same age, and could provide the same scientific, angling and recreational opportunities if and when (if conserved) it is discovered. It has lovely mountains in the background and is generally in a beautiful area."

Editor's Note

Beni Malone brought this issue to my attention to make it known to the CARS membership, especially professional fisheries scientists with expertise in these issues. He is interested in receiving advice or help to save this unique ecosystem.

For more information, contact:
Beni Malone, 19 Waterford Bridge Road, St. John's, NF, A1E 1C5. Tel: 709/753-6542; Fax: 709/722-1915.
Dr. Johan Hammar, Research Scientist, Institute of Freshwater Research, S-178 93 Drottningholm, Sweden. Tel: +46 8 620 04 24; Fax: +46 8 759 03 38.

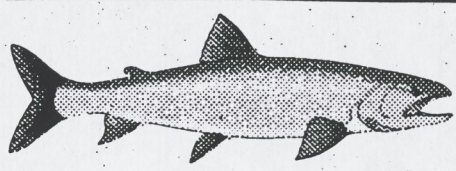
First Call For Papers

Catfish 2000, the First International Ictalurid Symposium

The Program Committee invites contributed papers for this conference scheduled for **23-28 June 1998** in Davenport, Iowa. Sessions will cover biology & management of channel, flathead, blue and white catfish, as well as smaller members of the family. Special focus on presentations regarding: population dynamics including age-growth, recruitment, reproduction, and mortality; assessments of stockings of public waters; genetic relationships among catfishes; catfish behavior & sensory capabilities; movement & migration studies; population characteristics in large rivers, streams, lakes and reservoirs; human dimensions including socioeconomic analyses, angler attitudes, competitive fishing, and edibility & consumption advisories; sampling techniques; effects of rod-and-reel angling, non-angling techniques of fishing like "noodling", and non-rod-and-reel methods including limblines, trotlines and jug fishing; commercial fisheries; habitat requirements; effects of habitat alteration on populations; and harvest management through regulations. However, all submissions will be considered.

Please submit abstracts of 150 to 350 words, typed or sent electronically via FAX, modem or e-mail. Send inquiries and submissions to Steve Eder, Missouri Department of Conservation, by 1st February 1997.

Hard Copy: PO Box 180, Jefferson City, MO, USA 65109-0180
E-mail:
eders@mail.conservation.state.mo.us
FAX: 573/526-4047



Dave Conley
Fax: 604-339-7469

☐ PROVINCIAL AFFAIRS

The bigger pic

PROVINCE HAD TO LOOK AT THE GREATER GOOD IN DECISION TO ALLOW STAR LAKE TO PROCEED

BY CURTIS RUMBOLT
EXPRESS STAFF

The province had much to gain and little to lose when it decided to allow the Star Lake hydroelectric project to proceed, says Environment Minister Kevin Aylward.

Initially, the proposed 15-megawatt hydroelectric project located in Central Newfoundland will create hundreds of construction jobs. When its giant turbines begin generating power in the summer of 1998, dozens will be employed to keep the plant operational.

The project will also help keep its developer, Abitibi-Price, competitive on the world's newsprint markets, helping preserve more than 1,000 jobs at the company's Grand Falls-Windsor mill.

Those benefits far outweigh the costs, Aylward says, particularly since the province believes it can limit the negative aspects of the development — such as environmental damage due to flooding and threats to the pine marten and a unique trout species found only in the lake.

Government has to consider the bigger picture, Aylward says.

"In this case, we have some small hydro development that is left on the island," the minister says. "If we move ahead on some of it, we will alienate it for other purposes more than likely, but at the end of the day we still have a lot of protected area, a lot of resources that can still be used by people for a whole variety of other purposes."

What the province gains by allowing the project to go ahead is development, jobs and tax revenue, Aylward says.

The $54-million Star Lake project is one of four hydroelectric projects currently proposed for the island portion of the province.

The province's hydroelectric potential has been traditionally developed through the crown-owned Newfoundland and Labrador Hydro — in its recent history at least — but the four projects currently proposed are all driven by the private sector. They came about in response to a tender call issued three years ago by Newfoundland and Labrador Hydro to develop more electricity on the island.

Star Lake is the largest of the developments. A project on the Northwest River by the Belle Isle Power Corp. will supply 12 megawatts. A proposal for the Southwest River by Frontier Hydro Development will generate seven megawatts. The Rattle Brook project proposed by Algonquin Power will create an additional four megawatts of power.

> *"In this case, we have some small hydro development that is left on the island. If we move ahead on some of it, we will alienate it for other purposes more than likely, but at the end of the day we still have a lot of protected area, a lot of resources that can still be used by people for a whole variety of other purposes."*
>
> ***— Environment Minister Kevin Aylward***

Newfoundland and Labrador Hydro's latest electrical load projections say increased demand will see a 38-megawatt shortfall on the island by 1999. (That estimate doesn't include the extra demands the company will face if a Newfoundland site is selected as the location of the Voisey's Bay nickel smelter.) The four private developments will produce 38 megawatts.

Abitibi-Price struck a 25-year agreement to supply power generated from Star Lake to Newfoundland and Labrador Hydro.

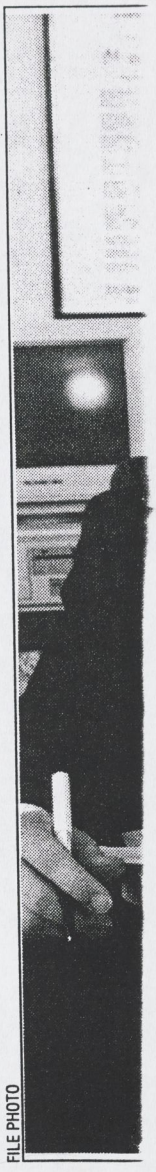
The pulp and paper giant's public relations manager for this province, Roger Pike, was unavailable for comment last week.

In the past, Pike has said the hydro project will help Abitibi-Price maintain jobs in this province.

Those jobs will be preserved through improving the company's bottom line which, in turn, will bring down the mill's per tonne cost, keeping the operation's newsprint competitive on the world market.

"We've been here since 1909, and we're committed to Newfoundland," Pike was recently quoted in the Grand Falls *Advertiser*. "We want to be sure our investment in Grand Falls-Windsor is solid."

Star Lake is located due west of the lower portion of Red Indian Lake.



FILE PHOTO

8/XII

Hunger strike won't stop Star Lake: Aylward

By BOB BENSON
The Evening Telegram

Gander environmental activist John Lannon is down some weight, but he's as upbeat as ever when it comes to continuing his hunger strike to conserve ecosystems.

"I'm losing about a pound a day," Lannon said as he entered his 26th day of the strike.

Lannon started his hunger strike to protest the province's environmental green light to the Abitibi Price Ltd. paper company to construct a hydro-electric dam at Star Lake.

But Environment Minister Kevin Aylward said Lannon's hunger strike won't stop the project.

"I've talked with Lannon briefly and he has been in the media," Aylward said.

"Every individual has a right to do what they want to do, or have to do, but we dealt with all of this in the environmental review process. The process was open to the public. It was an extremely open one and we made our decision on it."

Aylward said the Star Lake project has been released from environmental assessment after two years of evaluation.

"There were component stud on wildlife, and the fede Department of Fisheries a Oceans has also been releas from the environmental asses ment. Price Newfoundland nc has to negotiate with federal fis eries for a habitation compensati package and to have a mitigati plan for caribou before actual co struction can proceed. Those tall are now ongoing."

Lannon is not impressed.

He's convinced hydro-electri projects like Star Lake destro ecosystems. In the long run, base on conservation versus generatio management, the province will ge more economic benefits by con serving the environment rathe than exploiting it for doubtful eco nomic projects.

Lannon said economic develop ment based on ecosystems and the environment can have long-term spinoffs like eco-tourism.

He said his major concern is to drum up public support for his cause.

He said he has been having some preliminary talks with lawyers about court action to halt the project.

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SALMONID ASSOCIATION OF EASTERN NEWFOUNDLAND
P.O. BOX 1522, STATION C
ST. JOHN'S, NEWFOUNDLAND A1C 5N8
PHONE (709) 722-9300 FAX (709) 722-9320

December 17, 1996

Hon. Kevin Alyward
Minister of Environment and Labour
P.O. Box 8700
St. John's, NF
A1B 4J6

Dear Minister:

RE: STAR LAKE HYDRO PROJECT

As you know SAEN's response to the above project in 1996.02.23 expressed concerns with an number of issues as it would affect the environment and ecosystem.

We did not oppose the project outright because we genuinely believed from information provided in the EIS these concerns could be mitigated to a satisfactory degree.

It now appears from the weight of scientific evidence and respected scientific opinion coming to the fore in recent months, many issues of concern in the EIS were dealt with in a slipshod and unscientific manner; or worse; not at all.

The whole Environmental Assessment process falls apart if the Proponents consultants are incompetent or are prevented from doing their work in a thorough and scientific manner.

Previous research on the Star Lake Arctic Char population leads to the conclusion they will be decimated because of the changes in littoral habitat associated with the 10 meter water fluctuations in the reservoir.

This issue was not investigated or even discussed in the EIS, even though reference was made to the scientist who's published papers and research supports such a conclusion.

This issue and others have surfaced over the past few months since the provinces approval yet there has been no reply or rebuttal to our knowledge from your departments assessment committee, the proponent or their consultants. Silence is not a virtue in this instance.

You may be assured if this project is going to kill the present char population in Star Lake or any other valuable component of the ecosystem, SAEN would have expressed our outright opposition to the project.

Yours truly,

Rick Maddigan
President, SAEN

c. Hon. Fred Mifflin, Minister of Fisheries & Oceans

SALMONID ASSOCIATION OF EASTERN NEWFOUNDLAND
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December 17, 1996

R. John Gibson, Ph.D.
28 Carpasian Road
St. John's, NF
A1B 2R1

Dear John:

SAEN acknowledges receipt of your letter of 96.11.19, in relation to our recent article in our Newsletter concerning the Star Lake Hydro Project, and would offer the following reply.

Our review of the Star Lake EIS was based solely on the information provided in that document, not from any first hand knowledge of the river system, nor from any previous scientific research in relation to Arctic Char or any other salmonids. To the extent that the EIS was a failure as it applied to the Fishery Resource Component or any other component, this would have been reflected to a considerable degree in our response to the provincial Minister of Environment.

It would have been more helpful if knowledgeable Fishery scientists such as yourself, could have made countervailing or additional information available to members or any of our Directors prior to our response in February 23, 1996.

Information such as that which accompanied your letter would have undoubtedly influenced the narrative. We make no apology for the statement in our newsletter referring to the "time for raising concerns is before the project is approved not after" if it is hoped to have the response seriously considered by governments . No one likes to have to back away from a position publically taken, least of all politicians, as you must know from your years in the public service.

We raised a number of concerns with the provinces Environment Minister and genuinely felt that these could be mitigated to a satisfactory degree , otherwise the project should not be approved.

There was and is no direct comparison of this project with Northwest River in Terra Nova National Park (other than both are hydro) for a variety of reasons, which would serve no useful purpose to go into here.

Please be assured it was not a "defeatist" or "uncaring" attitude concerning the Arctic Char which played any part in our response. As you know nothing was mentioned in the EIS concerning the potentially disastrous effects the 10 meter water fluctuation in Star Lake will have on the littoral habitat as it applies to the survival of the Arctic Char. The first time most of our Directors had heard about this problem was when your letter arrived some months after our response was provided to the provincial Minister and long after the provincial approval was announced.

We are of course quite willing and intend to bring this new concern to the Federal Minister and express our complete opposition to the project if it means the ultimate demise of the Arctic Char population. We will again write the provincial Minister and specifically refer to this issue and the shoddy unscientific manner in which the EIS was developed. Belated though it may be in the scheme of things, we very much appreciate you bringing this important issue to our attention.

Yours truly,

Tom Bursey
Chairman, Hydro Committee

28 Carpasian Rd.,
St. John's. Nfld. A1B 2R1.
E-mail: gibson@athena.nwafc.nf.ca
Tel.no.: (709) 772-4466;
Fax: 772-3578

Eric Palmer,
Newsletter Editor,
Atlantic International Chapter, AFS,
Vermont Fish and Wildlife Dept.,
184 Portland Street,
St. Johnsbury. VT 05819

Jan. 20th, 1997.

Dear Eric,

I hope this comes through. I am just sending it as a WP file. I've again made a couple of tiny changes, but nothing of import.

Newfoundland

The salmon angling was in general good in 1996, especially earlier in the season when waters were higher and cooler, and most fish counting facilities had increased counts over 1995. The increase was not predicted, since runs have been low in recent years, and smolt outputs in 1995 remained low. Sea survival was better however, probably related to milder marine conditions. It is unclear whether this critical effect on survival is effected mainly at the post-smolt stage shortly after entry into the sea, or at a later stage. Angling is restricted to grilse (1-sea-winter fish) on the island, and large salmon (>63 cm) must be returned. Because salmon stocks had become so low, probably mainly due to habitat loss and degradation, and overexploitation of the reduced stocks, a moratorium was declared on commercial fishing in 1992, for five years, and angling pressure reduced. Large salmon subsequently increased relatively more in numbers, both maiden 2 sea-winter fish and repeat spawners, since the commercial fishery had selectively taken the larger fish. The 3+ smolt (the major component in many rivers on the island), which resulted from the spawning escapement in 1992, have shown increases in the 1996 smolt emigration in some rivers, so that increased grilse runs are expected in 1997, especially in rivers in the northeastern part of the island. Most commercial fishermen were bought out in 1992, but 100 retained their licenses, and are hoping to resume fishing in 1997.

Of major concern is that the Provincial Government has requested proposals from private developers for small hydroelectric developments across the island, with power purchase guarentees and water rights provided. A number therefore have been proposed. About 60% of the island's power is presently generated by hydroelectricity, and much damage (unquantified) has already been done to the salmon resource by dams and diversions of watersheds. Although a power surplus exists, pressure for increased demand is being applied since a nickel smelter and refinery is to be built at Argentia, west of St. John's, although remaining potential hydroelectric sources would not be able to supply the total extra projected demand. Public pressure has a large influence on decisions concerning the implementation of these hydroelectric projects. This has had an effect on a proposed hydroelectric project on the Northwest River, a salmon river going through Terra Nova National Park, and is presently on hold, mainly due to strong opposition from the Salmonid Association of Eastern Newfoundland (SAEN). However corporate pressures have a strong influence. For example, a hydroelectric development has been proposed for Star Lake, a

large 15.7 km^2 lake in central Newfoundland. Timber, mineral and water rights of 2000 square miles in central Newfoundland, including Star Lake, are leased from the Provincial Government at an annual rent of $2 per square mile by Abitibi Price Inc., an international syndicate. The company runs two pulp and paper mills in the Province, but the sale of power to Newfoundland Hydro would augment profits. Star Lake presently provides an unusual trophy brook trout fishery, and is in a beautiful area bordering the Long Range Mountains. The only competent scientific study of the lake was undertaken some years ago by Johan Hammar, a research scientist at the Institute of Freshwater Research at Drottningholm, in Sweden, and he discovered that only two species were present, a dwarf arctic char, and the brook trout, of which the larger ones were pisciverous on the char and on small trout. Star Lake is isolated by a falls impassable to anadromous fishes. The outlet would be dammed, and another watershed diverted into the system, increasing the area of the reservoir by 50%, which would have an 8 m drawdown over winter, to create a generating capacity of 15 MW. Johan Hammar has pointed out that the project, similar to others where regulation causes large water level fluctuations, would cause a major loss of spawning grounds and a rapid deterioration of significant littoral fish food organisms. In addition mercury levels in the pisciverous fish would increase beyond acceptable health levels. The project has been opposed unanimously by professional limnologists, including by the Newfoundland and Labrador Chapter of the Canadian Society for Environmental Biologists and the Canadian Nature Federation. Although the project would cause loss of a valuable resource, both scientifically and economically, a remarkably superficial and inept Environmental Impact Study (EIS), concluded that the effects would be minor and mitigable. This was accepted by the Provincial Government, and preliminary work on construction has started. The proponent funds the EIS, and the proponent has no further liability once the project is approved, and these studies in general are unscientific and biased in favour of the proponent. There has been much public opposition to the Star Lake project, although SAEN did not initially oppose it, as they at first believed the report that impacts would be minor and could be mitigated; however as scientists presented more valid information they did later oppose it, and are vigorously opposing several other potentially damaging hydroelectric projects planned for salmon rivers. One group (Save Our River Environments) is threatening a court injunction to stop the Star Lake project, so it will be interesting to see how it all develops.

Ironically Newfoundland this year is celebrating discovery 500 years ago by John Cabot, who when he arrived on these shores described the abundance of the fisheries and the mammal and bird life. Now that these have been devastated it is probably appropriate, although not officially part of the Cabot 500 celebrations, to celebrate the environmental changes since arrival by white man by destroying one of our major lakes!

Two contacts, if anyone is interested in more information, are: Beni Malone, Chair, Save Our River Environments, 19 Waterford Bridge Rd., St. John's, NF, A1E 1C5; Tel: 709 753-6542; Fax:709 722-1915; and Dr. Johan Hammar, Research Scientist, Institute of Freshwater Research, S-178 93 Drottningholm, Sweden. Tel:+46 8 620 04 24; Fax: +46 8 759 03 38.

Sincerely, R. John Gibson

[Apr 1997]
[Star Lake]

Hammar lake — L. Michael
upstream
reverse large charr
dominant. prey on brook trout

Portage L (adjacent next to Star)
bt - charr pred - prey

all lakes Next to Star
bot 1 - charr

Red Indian L.
bt, charr, salmon, stickleback

Apr 1997

Proposed Hydroelectric Developments Meet With Opposition

The Newfoundland Provincial Government has requested proposals from private developers for small hydroelectric developments across the island, with power purchase guarantees and water rights provided. A number of projects have been proposed. Although a power surplus currently exists, a nickel smelter and refinery is to be built at Argentia, west of St. John's. Remaining potential hydroelectric sources would not be able to supply the projected demand.

One proposed hydroelectric project on the Northwest River, a salmon river going through Terra Nova National Park, is presently on hold, mainly due to strong opposition from the Salmonid Association of Eastern Newfoundland (SAEN). Another hydroelectric development has been proposed for Star Lake, a large (15.7 km^2) lake in central Newfoundland. A scientific study of the lake was undertaken some years ago by Johan Hammar, a research scientist at the Institute of Freshwater Research at Drottningholm, in Sweden. He discovered that only two species were present, brook trout and dwarf arctic char. The larger brook trout were found to be piscivorous on the char and small brook trout. The Star Lake hydroelectric project has been unanimously opposed by professional limnologists, including the Newfoundland and Labrador Chapter of the Canadian Society for Environmental Biologists and the Canadian Nature Federation. SAEN did not initially oppose the Star lake project, as an early report said that impacts would be minor and could be mitigated; however, after scientists presented additional information SAEN decided to oppose the project. One group (Save Our River Environments) is threatening a court injunction to stop the Star Lake project.

For more information contact: Beni Malone, Chair, Save Our River Environments, 19 Waterford Bridge Rd., St. John's, NF, A1E 1C5; Tel: (709) 753-6542; FAX: (709) 722-1915; and Dr. Johan Hammar, Research Scientist, Institute of Freshwater Research, S-178 93 Drottningholm, Sweden. Tel:+46 8 620 04 24; Fax: +46 8 759 03 38.

R. John Gibson

MEETINGS OF INTEREST

Northeastern Division of AFS - Annual Meeting -

April 27-30, 1997. Framingham, Massachusetts. Contact Henry Booke, P.O. Box 796, Turners Falls, MA 01376; (413) 863-9475; FAX (413) 863-9810

EDITORS LINE

There has been a change. After many years of faithful service as Newsletter Editor, Scott Decker has hung up his printer with the intention of serving the AIC in other ways in the future

With this issue comes a new editor. My name is Eric Palmer; I work as a district fisheries biologist for the Vermont Fish & Wildlife Department. You may send future newsletter submissions to me at: **VT F&W, 184 Portland Street, Saint Johnsbury, VT** 05819. Or by e-mail to: **<epalmer@anrstj.anr.state.vt.us>**

I would like to thank Scott Decker for helping me get this first issue off the ground. I have borrowed extensively from Scott's earlier newsletters for formatting and lay-out. I would also like to thank all of the people who submitted news items.

The deadline for submissions for the next issue is **July 1, 1997** (Canada Day). Submissions sent on diskette or by e-mail attachment in WordPerfect, version 6.1 or earlier, are greatly appreciated.

Proposed Small Hydro Developments Under Consideration.

Project	Capacity	Location
1) *Garia Bay / Northwest Brook*	15 MW	Southwest coast of Newfoundland, on the Northwest Brook - Garia Bay; approximately 13 km northeast of Rose Blanche.
2) *Northwest Arm Brook / Connoire Bay*	15 MW	South coast of Newfoundland, at the mouth of Northwest Arm Brook (Connoire Bay); approximately 30 km northwest of Burgeo.
3) *Northwest River*	12.8 MW	East coast, along the Northwest River; approximately 4 km north of Port Blandford.
4) *Rattle Brook*	4 MW	On Rattle Brook. a tributary of Big Arm Brook, approximately 4 km northwest of Jackson's Arm, on the Great Northern Peninsula.
5) *Rose Blanche Brook*	5.5 MW	On Rose Blanche Brook, on the southwest coast; approximately 5 km north of Rose Blanche and Harbour LeCou.
6) *Southwest River*	6 MW	East coast; approximately 25 km northwest of Clarenville.
7) *Star Lake*	15 MW	West-central Newfoundland, on the southeast edge of the Long Range Mountains; approximately 45 km southwest of Buchans.
8) *Torrent River*	27 MW	On the Torrent River, on the Great Northern Peninsula; approximately 20 km east of Hawkes Bay.

28/VIII

Will the pine marten follow the Great Auk?

OPINION

By MAURA HANRAHAN

The Labrador duck, the Great Auk, and the Newfoundland wolf. All of these beautiful animals were hunted to extinction since our ancestors settled here hundreds of years ago. This is not a proud legacy.

Even sadder is the fact that another species may soon be added to this list. Abitibi-Price has begun work on a mini hydro-electric development at Star Lake which involves the construction of a 250-metre long, 18-metre high dam. If it goes ahead as planned, the Newfoundland pine marten will become extinct. Once this animal is gone, we can never get it back.

Less than two per cent of the pine marten's habitat remains. Since the Environmental Impact Study for this project was released, the pine marten's status has moved from threatened to endangered. Attempts to resettle it have been unsuccessful.

Not only that. The Save Our River Environments coalition has warned that a rare breed of trout also lives in Star Lake. These trout actually eat other trout, and dwarf arctic char, thus making them unique. If they disappear, we can never replace them.

While Abitibi argues that the project is necessary, this is simply not so. The EIS states that the demand for electric power will increase by the year 2000. However, power use is declining at present and it is very likely to continue to do so.

When our ancestors came over from Europe, they had to hunt and catch everything that moved, just for survival. They also believed that the abundance of wildlife would never end. Scientist Bill Montevecchi says that this approach carried on until early this century before it was finally seen as short-sighted and inadequate. At that time, market hunting was forbidden and laws protecting wildlife were strengthened.

But it seems that we haven't learned a great deal since then. Or else we've forgotten. Look at what happened to the codfish. And what may be happening to crab and other previously "underutilized" species. National Geographic refers to the Atlantic as "the graveyard of oceans" for a good reason.

Our ancestors rejected the wildlife exploitation system they had experienced in England. There, the aristocracy enjoyed a monopoly over land, hunting and fishing. Wildlife represented sports hunting for the lords and ladies while many working class people in England went hungry.

The system was blatantly unjust. Our collective memory of this injustice probably gave rise to our conviction that it's our god-given right to hunt moose or catch cod. This belief was understandable at one time but now we really need to revisit it.

Nature has value not just because money can be made by exploiting it; nature has an inherent value, a value for its own sake. And we don't have a god-given right to drive animal species into extinctio Seems to me that such a t would go directly against will of any god.

If Abitibi refuses to do t right thing and stop this destructive development, governments should put a to it. It was Newfoundlan Hydro that encouraged all these mini hydro-electric jects to begin with. DFO should protect endangere species like the Star Lake trout or shut down. At the least, this project should l put on hold.

We should also rememb that there are other anima species living on the edge Newfoundland. The pereg falcon, which nests in the Voisey's Bay area, is figh its way back from endang status.

The tiny piping plover i fighting for survival. The lequin duck is in trouble. would be a needless trage Newfoundland's list of ex animals were to grow lon Enhanced protection of ou environment could also c many badly needed jobs.

Maura Hanrahan is a w and sociologist in St. John Her next column appears 11.

Fisheries and Oceans | Pêches et Océans

P.O. Box 5667,
St. John's. Nfld. A1C 5X1.

Dr. Robert J. Behnke,
Department of Fishery and Wildlife Biology,
Colorado State University.

Your file Votre référence
April 8th, 1997.
Our file Notre référence

Dear Bob,

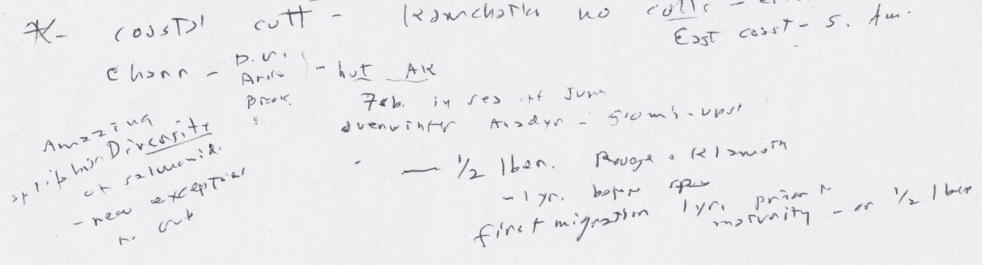
Thank you very much for your letter and the enclosed papers, which I find fascinating. I have taken advantage of sending copies to our Management Division, in the hope that some sensible decision can be made about Star Lake. When I phoned (Michelle Roberge, who is assessing the "compensation package") the first reaction was, Oh is it of interest down there? So I said yes it was, since this was of global importance. What I'm hoping is that if there is enough public interest they will have to do a real Environmental Impact Study, or at least make the compensation package so expensive that they will put it off.

Anyway, I am sending copies of what I have on file about Star Lake, no doubt more than you want to hear. I did send off a reprint a few days ago of the study we did on those tiny landlocked salmon, and hope it will arrive soon, despite Canada Post. I think I told you, an M.Sc. student here, Steve Sutton, supervised by Dick Haedrich, and I am on his committee, is studying a salmon with an unusual life history strategy, on the northeast coast of the island, which behaves very much like a sea trout. They feed in the estuary, and in the sea, some eating smelt, but do not overwinter at sea, returning in the fall, so they are of all sizes. I suppose if we look hard enough we will find any life history we can think of. I am also enclosing a review on freshwater stages that I wrote a few years ago which you might find interesting. *

I am glad to have finally met you. Thanks again for the papers.

R. John Gibson

Catherine Gulson



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(1) CJFAS 1995 52: 179-85
(2) - 1991 - Journ. Fish Biol. 39
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[Star Lake
- 1999]

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- Floods Pond

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Mount Merrion,
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Professor R.J. Behnke,
Colorado State University,
Department of Fishery and Wildlife Biology,
Fort Collins, CO 80523.

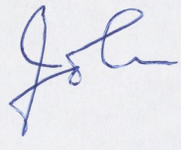
Aug. 1st, 1999.

Dear Bob,

I thought you might like to have a copy of that Star Lake imbroglio. It's too bad that we couldn't stop the project, and a shame that there was no proper scientific study. However, I think it was worth presenting the paper. The CSEB is well recognised in Canada, and there were some quite nice papers published in the "Proceedings" from the conference last Fall, so there may be some positive impact on future Environmental Impact Studies. As you are aware, it is important to foster public awareness to get things done. The paper helped make some good recommendations at the conference. Thank you very much for all your help.

I hope the summer is going well for you.

All the best,



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The Star Lake Hydroelectric Project - an Example of the Failure of the Canadian Environmental Assessment Act

by

R. John Gibson (1), Johan Hammar (2), and Greg Mitchell (3)

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Abstract

Star Lake is a large (15.7 km^2) lake in central Newfoundland, draining by Star Brook (length 5 km) into Red Indian Lake, but isolated from upstream migration of fish by waterfalls. The fish community consists of two salmonid species, brook trout (*Salvelinus fontinalis*), and Arctic char (*Salvelinus alpinus*). It is unknown how many subspecific taxa of these two species occur in Star Lake, but a large piscivorous form of the brook trout feeds on dwarf Arctic char and small brook trout, providing a popular trophy trout fishery, with probably the largest brook trout on the island. The ecosystem is unique and can be considered as an Evolutionary Significant Unit. The lake is presently being converted into a reservoir for a 15 MW hydroelectric project. The project was proposed in 1992, and registered in 1993. The Environmental Impact Statement (EIS) was accepted by the Provincial Government in 1996, and by the Federal Government in 1998, but with mitigation for loss of fish habitat by a hatchery. The approved project will create an impoundment estimated to be 25 km^2 in area. An adjacent lake (Lake of the Hills) will be partly diverted into the new impoundment, and the water level of the reservoir will fluctuate 8 m over the winter. Habitat presently used by the endangered Newfoundland pine marten will be inundated. The EIS predicted that effects on fish would be minor, mitigable and in fact positive.

Apparently tributaries provide insufficient spawning habitat for the two fish species. Therefore the loss of the lake's littoral regions and outlet river, caused by fluctuating water levels and the construction of the dam, will result in failure of spawning. In addition crucial perennial taxa of invertebrate prey items will be lost from the littoral region. Furthermore other studies indicate that a hatchery will not conserve genetic diversity or compensate for loss of lake productivity. Negative environmental effects will consequently be major. The dam and diversion channel were constructed in 1997, before final approval to proceed was given, destroying the outlet river and trapping spawning fish, and creating massive amounts of silt downstream.

Although the project is contrary to the meaning of the Canadian Environmental Assessment Act, the Fisheries Act and to Canada's position on conserving biodiversity, it is legally proceeding. This situation is an illustrating example of the failure of the Canadian Environmental Assessment Act, which has failed to prevent another ecological disaster, and suggests that immediate changes are

needed. We suggest that the EIS for similar mega-projects should be peer-reviewed by research scientists in the field in question, and that decisions be recommended by an independent agency of competent scientists. In addition the proponent should be obliged to invest in an insurance policy or post a bond, so that if unforeseen negative impacts result, resources would be available for instant mitigation measures, or for restoration of the ecosystem to its previous condition.

Introduction

The Canadian Environmental Assessment Act of 1995 (CEAA) and the Canadian Fisheries Act (with amendments in 1991) were designed with the view that developments should proceed without causing destruction of natural ecosystems, and so as to protect Canadian natural resources for the benefit of the country, economically, socially and culturally. On an international scale, remaining natural ecosystems should be preserved where possible, in the light of loss of major ecosystems in many parts of the world, due to population pressure and technological advances associated with unenlightened ideas of progress. The consequences of the latter have been loss of traditional ways of life and cultures, increase in diseases and early mortalities (e.g. Goluber 1996), and loss of economically important species (e.g. Mowat 1984, Wilson 1993, Kerr and Ryder 1997, Hutchings et al. 1997, Safina 1998, Stiassney 1996). As the world's population doubles in the next few decades it is essential to conserve the background to our genetic and social evolution, both morally and to preserve resilience in the natural world, and to prevent collapse of inter-related ecosystems, related by as yet unknown interactions, which could have major consequences on human quality of life. Fuentes-Quezada (1996) points out that it is in the global interest to keep as much biodiversity as possible at the genetic, species, and ecosystems levels. Canada signed the International Convention on Biodiversity in 1992, recognising that resilience of an ecosystem depended on the species that had evolved to build its parts and ensure its efficient function, and that this included genetic diversity, to allow responses of a species to stochastic events and for evolution to proceed, and commits Canada to an environmental assessment of any activity that impacts on biodiversity. It is recognised that although ecosystem function depends on biological diversity, we do not yet have the knowledge of how many species exist, or of the genetic diversity that is essential for resilience of all the components. The conservation of biological diversity is recognised also as necessary for providing new species and genetic types for aquaculture, agriculture, recreation and medicine. Conservation of natural resources is therefore necessary for the preservation of the Canadian high quality of life, and Canadian environmental laws and regulations are exemplary in recognising that the country's natural ecosystems must be left intact, and be guarded against unbridled economic pressures. The CEAA establishes procedures for full assessments, including the cumulative environmental effects of any activity, as well as its social, economic and cultural impacts.

Canada has for many years been internationally recognized as being a forerunner and a country worthy of imitation in terms of its conservation policy and conceptions of life.

The Fisheries Act is explicit in its policy that there be **no net loss of fisheries habitat**. The Fisheries Act (Section 34 [1]) defines fish habitat as: "spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life

processes". Section 35 stipulates: "(1) No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat". Section 36 deals with injury to fishing grounds and water pollution. Section 36(3) stipulates: "Subject to subsection (4), no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where such deleterious substance or any other deleterious substance that results from the deposit of such deleterious substance may enter any such water." Subsection (4) allows deposition of pollutants, or deleterious substances of allowable concentrations. Unavoidable losses in habitat productive capacity are to be evaluated on a case by case basis and compensated for by habitat replacement or gains in productive capacity of existing habitat. Once the Department of Fisheries and Oceans (DFO) determines that a project would cause harmful alteration, disruption, or destruction of fish habitat, a compensation plan will become a requirement as part of the authorization issued under Subsection 35(2) of the Fisheries Act.

It is a political decision to choose whether the gain in power from hydroelectric development and the economic values of the locally short term income from the construction, is worth the loss of long term ecological and social values of a well functioning biological system of major significance to genetic diversity, food production, human recreation, and scientific research and understanding. It is an uncomplicated and honest comparison between values of power and values of life, with no need for lies.

Although Canadian laws are explicit in their meaning to conserve natural environments, we give an example of the destruction of a unique ecosystem, Star Lake, in central Newfoundland, possibly due to political pressures, where the CEAA, the Fisheries Act and Canada's official position on Biodiversity have all been contravened, and we suggest means to help enforce the Acts and prevent such destruction in the future.

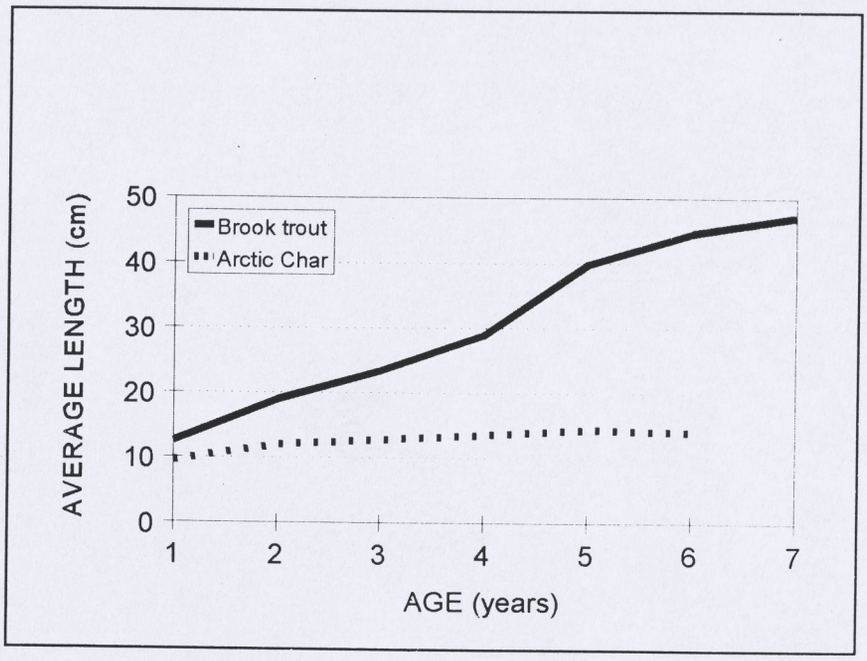
Star Lake

Star Lake is in central Newfoundland (48°57' N, 57°30' W) adjacent to and east of the Long Range Mountains , draining 5 km via Star Brook into Red Indian Lake, which is part of the Exploits river system. Star Lake has an area of 15.7 km^2, mean depth of 4.4 m and maximum depth of 21 m (Jacques Whitford Environment (JWE) 1996). The lake was investigated in 1984-85 (Hammar and Filipson 1985, Hammar 1987, Hammar unpubl. data) as part of a study investigating the distribution, the ecology and the systematics of the Arctic char species complex, *Salvelinus alpinus* (L.), in Newfoundland and Labrador. Waterfalls on Star Brook prevent upstream migration of fish from Red Indian Lake, and only two fish species occur in Star Lake, Arctic char and the brook trout, *Salvelinus fontinalis* (Mitchell). Five experimental gillnets were set at three different depths, 1.5, 3 and 6 m. The proportion of Arctic char and large sized brook trout increased with depth. The arctic char were small sized. Forty two were sampled, ranging from 95-157 mm in fork length, and 9-38 g round weight, and 1+ - 6+ in age. Sixty five brook trout were sampled, ranging 121-486 mm in fork length, 17-1275 g round weight, and 1+ - 6+ in age. The proportion of ripe and spent brook trout in the sample suggested that the sampling days (October 11-12) coincided with spawning. The

dominance of spent female Arctic char in the gillnets also indicated this species to be spawning, but presumably elsewhere. The presence of roe in the stomachs supported this conclusion. Previously in early July, 7 brook trout were sampled from a local angler's catch (206-423 mm, 91-990 g, age 2+ -6+). Two individuals, the smallest being 210 mm, were cannibalistic, the remaining trout had exclusively been feeding on insect larvae related to running water (Simuliidae, Ceratopogonidae, Ephemeroptera, Trichoptera), suggesting that the trout had been caught in the vicinity of a stream, possibly Star Brook.

The growth pattern of the two species differed, and the divergence could already be noticed among one year old fish (Fig.1). While the growth for brook trout demonstrated a steep and S-shaped curve, typical for piscivorous salmonids, the growth of the Arctic char levelled off at a size below 150-160 mm.

Figure 1. The growth of brook trout and Arctic char in Star Lake, Newfoundland, sampled Oct. 12, 1984.



The stomach analyses from October, which demonstrated the same profiles as in July, confirmed the brook trout larger than 200 mm to feed on fish (25%), both Arctic char and small sized brook trout, caddis fly larvae (56%), molluscs (11%), and amphipods (4%). The remaining volume comprised mayfly larvae and *Eurycercus*, a large benthic cladoceran. Brook trout smaller than 200 mm had fed on amphipods (22%), caddis fly larvae (45%), and mayfly larvae (20%). The remaining volume comprised mollusca, chironomids, aquatic beetles, and *Eurycercus*. The parasite profile supported the diet analyses, with the numbers of *Diphyllobothrium* spp. and *Eubothrium salvelini* boosting in

piscivorous trout (larger than 200 mm), and acanthocephalans showing high infestation rates in both small and large trout.

As expected, the stomach contents of Arctic char were dominated by large sized zooplankton species (*Daphnia* (85%), *Leptodora* (6%), and an additional 6 species of benthic cladocerans, including *Eurycercus*). Besides low intensities of *Diphyllobothrium* spp. and *Eubothrium salvelini*, the mean numbers of *Proteocephalus* spp. and acanthocephalans were higher. The presence of the latter parasite, which exploit amphipods as their intermediate host, revealed the Arctic char also to feed on amphipods, presumably during the winter and spring seasons, when a lower temperature restricts the brook trout's ability to maintain its dominant character in shallow waters. The large trout therefore are piscivorous, feeding on small char and trout, and provide a popular and well known trophy trout fishery, also supporting two outfitters on the lake (Power 1996).

The depth distribution and the diet and growth of the trout and char fit the pattern of interspecific interactions and segregation seen in general in Newfoundland, and also in northern Europe where the brown trout (*Salmo trutta* L.) is the ecological equivalent of brook trout. To document the interspecific segregation in terms of habitat choice and diet during different seasons more specifically, the sampling program would need to be repeated during the winter, spring and summer as well. The landlocked populations of Arctic char and brook trout in central Newfoundland have been isolated from other populations for many thousands of years, and local differences in selective forces have generated unique gene pools with very special characteristics. Although we do not have data yet to identify any specific or unique gene pools of trout or char in Star Lake, their seasonal asymmetry in interspecific interactions makes Star Lake a unique ecosystem for this reason alone.

Star Lake represents a unique northern ecological and evolutionary system, for other reasons. Every northern river forms a gradient of ecosystems with fish communities controlled by the order of colonizing species, temperature, nutrient content etc. Along such a gradient of increasing fish species diversity after the last ice age, Star Lake is located exactly where Arctic char and (later on) brook trout once managed to enter the outlet and together form a simple fish community. No other fish species managed to colonize Star Lake, and no other fish species has been introduced by man. Eventually temperature and other environmental factors became optimal to the brook trout, but not to the Arctic char. Natural selection lead to an ecologically very dominant and highly piscivorous brook trout feeding as young on various littoral insects and crustaceans, including amphipods, caddis flies and mayfly larvae, and shifting to a diet of small sized trout and dwarfed char after reaching the size of *ca.* 200 mm. The stomach contents of the Arctic char was dominated by large sized zooplankton species. Parasite analyses, however, revealed the Arctic char to feed on amphipods during winter time, when a lower temperature restricts the brook trout's ability to maintain its dominant character in shallow waters. The annual winter conditions with cold water, ice and low-light conditions offering a few months of arctic comfort may therefore explain why the Arctic char is still present in Star Lake. However, going further up the gradient, that is moving up towards lakes above the tree line, where the decreasing temperature tends to favour the Arctic char more than the brook trout, the opposite system dominates. In such ecosystems a large piscivorous char feeds on small-sized char and dwarfed trout. The fish community of Lake Michel in the Long

Range Mountains demonstrates this. Newfoundland seems to be one of the few geographical sites left where it is possible to study such simple niche shifts and systems of asymmetric interactions between "char" and "trout" in natural lakes. In contrast to other northern regions of North America, very few Newfoundland lakes are affected by water-level regulation and gillnetting, and few introductions of alien fish species or fish food organisms have occurred in Newfoundland. The study of analogous interactions between Arctic char and brown trout in northern Europe is often restricted in various ways, because of extensive water level regulation and introductions of alien species. The fish communities of Insular Newfoundland thus form a unique dictionary of international significance to the study of natural interactions among different combinations of salmonid fishes. Behnke (1972) points out that postglacial salmonid communities are typically fragile and highly susceptible to disruption or destruction, and he emphasizes that every effort should be made to protect the genetic diversity of a species.

Isolated fish communities over time evolve genetic differences, and lakes the size and age of Star Lake may have several life-history forms, which spawn in discrete areas, depths and periods, so that genetically different demes, strains or subspecific taxa may remain genetically distinct. The differences can be expressed in adaptations to different environments such as with life history strategies of age at maturity, adult size, growth rate, feeding, or competition and predation on other species in the community. Recent studies have even documented adaptive differences in piscivory and cannibalism between different populations of Arctic char (Amundsen et al. 1995, Amundsen at al. in press, Hammar unpubl. data). It has generally been thought that these different forms of the same salmonid species occurred due to differing environmental factors, reflecting various forms of phenotypic flexibility. The notion of adaptiveness of intraspecific diversity was downplayed or was rejected, but it is now known that heredity plays a major part (Behnke 1997a, Ricker 1972). Sympatric coexistence of reproductively isolated populations of Arctic char has been documented in several northern regions of Asia, Europe and North America. Some populations may have evolved post-glacially, others represent multiple colonization events.

In Scotland, Loch Rannoch has at least two populations of Arctic char which demonstrate a genetic distance being large enough to have evolved pre-glacially (e.g. Gardner et al. 1988, Walker et al. 1988). In Sweden, lakes with sympatric Arctic char populations are common and predominantly found in areas allowing postglacial colonization from different directions (e.g Nyman 1972, Nyman et al. 1981, Hammar 1984). In Iceland, the four distinct life-history forms of Arctic char coexisting in Lake Thingvallavatn have been suggested to have evolved post-glacially (e.g. Sandlund et al. 1992, Jónasson et al. 1998). Also in Lake Windermere in England (slightly smaller than Star Lake), studies of the Arctic char have shown that there are several genetically different strains, each spawning in a different part of the lake (Baroudy 1995, Child 1984). In the large Irish lakes two, three, or sometimes more strains of brown trout exist in the same lake, differing from smaller plankton feeders to very large piscivorous, ferox, forms. At one time these forms were considered to be genetically the same, but it is now known that they are distinct types, and remain genetically segregated by spawning in different parts of the system, (Crozier and Ferguson 1986, Ferguson and Mason 1981, Ryman, Allendorf and Ståhl 1979). In order to help preserve the diversity of these

stocks it is suggested that some of these morphotypes should each be given specific status (Cawdrey and Ferguson 1988).

Only limited studies have addressed the concept of sympatric coexistence of races of brook trout, although genetic surveys have demonstrated introgression (gene flow) and intermediate forms of brook trout and Arctic char (Hammar et al. 1991, Bernatchez et al. 1995). In Newfoundland little work has been done on the biodiversity amongst the salmonid stocks. The few studies that have been done have been interesting. For example, in some rivers near Cape Race, on the southeastern part of the Avalon Peninsular, adjacent brook trout stocks showed differences in growth rates, size and age at maturity, and relative survival, and these stocks were shown to be genetically different (Ferguson et al. 1991). Similarly, in a few studies on ouananiche (landlocked salmon, *Salmo salar*) unique genetic differences amongst stocks in different watersheds have been found (Verspoor and Cole 1989, Gibson et al. 1996). Salmonids generally consist of polytypic species displaying high genetic diversity, and there is no doubt that Newfoundland brook trout stocks in various systems similarly must have evolved genetic diversity amongst various races. The fact that at least one strain of brook trout in Star Lake has evolved to grow to a large size and prey on the dwarf arctic char present in the lake indicates that the stock is fundamentally distinct from most other stocks (Hammar and Filipsson 1985). For example, brook trout and small Arctic char co-exist in some other lakes where the trout do not feed on the char, such as in Cat Arm reservoir, where both the trout and char remain small. The argument that there is no evidence that the Star Lake piscivorous trout are genetically different from other brook trout (a response from the proponent to public comments, ignoring the fact that no genetic studies were done) is fallacious. The precautionary principle, accepted at the Earth Summit at Rio, is that the absence of absolute scientific proof should not be used as an excuse for inaction.

The Star Lake Hydroelectric Project

The Star Lake hydroelectric development was proposed in 1992, and was registered pursuant to the CEAA in June, 1993 (JWE 1996). In June of 1996 the Minister of Environment and Labour, Government of Newfoundland and Labrador, accepted the Environmental Impact Statement (EIS) of January 1996, with addendum (May 1996) and the Fisheries Resources Component Study (May 1996), followed by Cabinet approval in July 1996. This was followed in January 1998 with approval by the Federal Government for the project to proceed, but with mitigation for loss of fish habitat by a hatchery. Star Lake (drainage basin 431 km^2) is being converted into a reservoir for a 15 MW hydroelectric development by a partnership of Abitibi-Consolidated Inc. and CHI Hydroelectric Company. The outlet river (Star Brook) was dammed in 1997, and water from an adjacent system (Lake of the Hills, catchment 33 km^2) is being diverted into the reservoir to supplement flows. The area of the reservoir will increase from 15.7 km^2 to an estimated 25 km^2, and the water level will fluctuate over a range of 8 metres, with maximum drawdown in early spring. Star Brook has been diverted through a channel, tunnel and penstock system into a hydroelectric power house at the outlet of Star Brook.

Consequences of the Project

The grade and quality of the environmental price in regulation for hydro-power production is correlated with the relative amplitude, the seasonal regulation regime and the structure of the biological community. Shallow lakes are more affected than deep lakes, and at northern latitudes the diversity, and quality of salmonid fish production is severely impaired. The actual basis for the salmonids highly advanced adaptation to be able to exploit cold and low-productive river systems, in order to reach individual size and age being optimal to survival, is removed. Star Lake would be considered in the category of lake ecosystems where maximal damage would be expected because of its shallow bathymetry, its susceptible littoral invertebrates and the complicated interactions within the fish community. The 8 metre overwinter fluctuations in the water level of the new reservoir of Star Lake will drastically reduce, and probably eliminate significant components of the present fish community (e.g Nilsson 1961, 1964, Hammar 1998). Most of the invertebrates that constitute the dominant food of brook trout, and of the younger stages of the piscivorous brook trout, are generated in the littoral areas of the lake (shallower edges, down to about 2 metres), which are the most productive area of the lake for plant, algal, littoral plankton and benthic invertebrates, and has the highest biodiversity of the lake, and these food items are impoverished and some eliminated by such fluctuating water regimes (e.g. Smith et al. 1987). In other words, reservoirs with artificially fluctuating water levels are unproductive for trout. If small Arctic char are feeding only on plankton, their food may not be affected. However in Star Lake the Arctic char in winter feed also on amphipods, a group adversely affected by fluctuating water levels. In addition, spawning and recruitment of both species is likely to be negatively affected. Although a spawning study was not undertaken in Star Lake, it appears from the cursory surveys that were done that the inlet streams are not suitable for spawning for the two fish species present. Spawning areas in the outlet river have been eliminated by the dam. Spawning is likely also to take place in the littoral areas, a common situation with both brook trout and non-anadromous strains of Arctic char (Johnson 1980, Power 1980, Curry and Devito 1985). Since spawning for both species is in the autumn, when the lake levels are high, and the reservoir drawdown is over the winter, the eggs will be dessicated and frozen, and would not survive (e.g. Fürst and Hammar 1984). Since both trout and the char are known to "home" to specific spawning sites (e.g. O'Connor and Power 1973, Baroudy 1995), if there were several races of each species (a high probability in such a large lake) with their spawning in discrete areas, or if they spawn in new or created spawning areas, the genetic diversity of such strains would be lost, and interbreeding would occur. In addition little information is available on the success of using artificial spawning grounds. However, when a reservoir was created from Flood's Pond, in Maine, new artificial spawning areas were constructed for the Arctic char present, but were unsuccessful since the fish would not use them (pers. com., Professor R.J. Behnke, Colorado State University).

After a few years' "damming effect", with organic and inorganic material leaching out from flooded areas causing a temporary surge in nutrient levels, and thus a short term increase in zooplankton and pelagic fish production, the long term consequences lead to oligotrophication, a dramatic loss of benthic fish production and a decline of pelagic fish production to levels below original levels of production. With reference to char-trout studies, benthic species such as brown trout / brook trout

decline considerably in both size and abundance, whereas Arctic char benefit somewhat from a release in interspecific interactions, and barely survive on a diet of zooplankton, a resource being restricted to the summer season. This leads to declining growth in the char, and also increased burdens of cestode parasites using a group of zooplankton as their intermediate hosts.

So far no successful means of compensation have been demonstrated. Introductions of new fish-food organisms (*Mysis relicta* etc.), or new species of fish (lake trout (*Salvelinus namaycush*), rainbow trout (*Oncorhynchus mykiss*), splake (brook trout X lake trout hybrid), etc.), have caused serious problems. The evaluation of introductions of new fish-food organisms, however, revealed the loss of littoral food-organisms to be of larger significance, than the loss of downstream spawning facilities. Although they are controversial, experiments with nutrient additions to mitigate oligotrophication in reservoirs are presently carried out in Canada (BC), Sweden and Norway.

In the U.S., many unique strains of Pacific salmonids have been lost, or reduced in fitness (and consequently their productivity), due to dams and hatchery introductions etc. Therefore in the light of more recent knowledge the concept of "Evolutionary Significant Unit" has been devised to conserve important strains (Waples 1995), and if a population of a species is classified as such, the Endangered Species Act should be implemented, in order to preserve the range of life-history types, and adaptations to different environments.

Canada ratified the United Nations Convention on Biological Diversity in 1992 in Rio de Janeiro, and the Canadian Biodiversity Strategy (1995, Environment Canada) states that "Conserving biodiversity and sustainability using biological resources are fundamental to achieving sustainable development". It also states that, "the global decline of biodiversity is now recognised as one of the most serious environmental issues facing humanity". The Strategy describes the three components of biodiversity to be, ecosystem, species and genetic diversity, and defines conservation as the maintenance or sustainable use of the earth's resources in order to maintain ecosystem, species and genetic diversity and the evolutionary and other processes that shape them. The piscivorous brook trout of Star Lake, and probably also the Arctic char population(s), could be designated as at least one Evolutionary Significant Unit. Unique genetic strains and an important ecosystem are likely to be destroyed, contrary to Canada's declaration on conserving biodiversity.

The loss of the Star Lake brook trout is regrettable, morally, scientifically, and economically. The evolution of the trout and char interrelationship is important in understanding heredity potentials of the two species. The genetic bank for these species will be further diminished, so that the possibility of using these stocks in aquaculture or for managing lakes for angling, for example by introducing piscivorous trout where only small char were present, will be lost, before adequate scientific studies have been undertaken. The tourism possibilities of managing the trophy trout in Star Lake will be lost. Up to about a hundred years ago in the Rangeley Lakes in Maine a similar situation to that which presently occurs in Star Lake existed; a large brook trout preyed on a dwarf Arctic char. Apparently the Rangeley Lakes brook trout differed from ordinary brook trout by an older age at maturity, a longer life span, and a special adaptation to feed on fish in deep water; all traits resulting in the attainment of a large maximum size (Behnke 1993). Star Lake trout may be similar. Suitable

studies have not been made, but anecdotal observations suggested that the trout matured at a relatively large size, and the consulting company concerned failed to collect sufficient spawning fish for brood stock in the autumn of 1998 because many of the trout were immature, although of a size that would have been mature with ordinary trout (pers. com., C. Bourgeois, DFO). An economically important tourist industry was associated with the Rangeley Lakes fishery. Through ignorance of the ecological consequences in that period, the fishery became extinct, as a result of dams and introductions of other species. The Rangeley Lakes story was written up by R. Behnke in the autumn 1993 issue of *Trout* magazine, and in articles by T. Williams and R. Behnke in the 1997 summer issue of *Trout*. Professor Behnke (Colorado State University), who is the leading international authority on salmonid systematics, stated in a letter to us, " I had assumed that such a coevolved brook trout-charr predator-prey system was unique to the Rangeley Lakes, and when the charr went extinct in the Rangeleys, this was the 'extinction' of this type of evolution. It's ironic, now that another has been discovered in Star Lake, it's threatened with extinction." A massive amount of fish habitat is being destroyed as the development of Star Lake as a fluctuating hydroelectric reservoir proceeds. Habitat may be harmfully altered, disrupted or destroyed under section 35(2) of the Fisheries Act, but a requirement before authorization is that losses are compensated by either habitat replacement or restoration. Compensation for a unique ecosystem by restoration or replacement of habitat of this magnitude is virtually impossible. As a probable unique example of a large brook trout - Arctic char predator-prey system, loss of this biological system is irreplaceable.

There are other negative effects of the development, which have not been satisfactorily addressed. These include: loss of habitat for beaver and for the endangered Newfoundland pine marten; inundation of existing migration routes of caribou; loss of existing sandy beaches, wetlands and waterfowl habitat; and waterfowl nesting, especially for loons, will be severely disrupted by the fluctuating water levels. Aesthetically, too, there are negative effects. The surrounding mountains and terrain, and the outlet river with its picturesque falls, make Star Lake one of the most beautiful lakes in Newfoundland. The shoreline of the reservoir, with an 8- metre range in water level, will become a mess. The river has been lost. Caving ice due to reservoir drawdown through the winter will make the lake unsuitable for winter recreational activities. In a cumulative effects assessment, using a modified Delphi procedure, a panel of 40 anonymous experts compared eight "Valued Ecosystem Components" on eight proposed small hydroelectric projects in Newfoundland. Star Lake had the highest impact index, and the second highest effect index for fish resources (the highest was for North West River, for which a dam had been proposed in the middle of an anadromous salmon river, diverting a large section of the river) (Bonnell 1997).

The Environmental Impact Statement

The international scientific literature illustrating the consequences of water level regulation - the oligotrophication process, the loss of littoral invertebrates, and the indirect loss of benthic and large salmonid fish - is monumental, and the reported principles should at least be acknowledged and treated as highly likely consequences in any trustworthy impact study dealing with such systems.

An environmental impact study (EIS) thus needs to provide comprehensive information on abundance, structure and diversity of the lacustrine fish community, its interspecific interactions, the zooplankton community, and the littoral invertebrate community. In a case such as the Star Lake project, the specific prey of importance to the lake dwelling populations of brook trout and Arctic char, the two "Valued Ecosystem Components" of significance, need to be identified in all the lakes being affected. Information should also be provided on the specific spawning sites and periods of spawning for the specific fish populations and gene pools of concern. If a transfer of fish between systems is expected, then genetic, parasitological and pathological studies need to be further studied.

The study performed by JWE during 1994 (JWE 1995) focused largely on the tributaries, and on the physical and chemical properties of Star Lake. The bathymetrical survey using echo sounder recordings suggested the maximum depth of the lake to be 21 m, and the mean depth 4.4 m. The lake is thus rather shallow. The water analyses indicated Star Lake to have low levels of dissolved nutrients, pH just below 6.5, low alkalinity, and a brownish water colour.

Both aerial and ground surveys have in detail assessed the proportion of possible spawning and rearing habitats within the tributaries, and estimated their biomass of present fish, using criteria and methods presented by DFO personnel. Actual spawning utilization could not be verified. Only young and small-sized brook trout were recorded in the streams, and a total of 282 individuals ranging from 34-249 mm in length, 0.1-157 g in weight and 0+ - 3+ in age were caught alive using electrofishing. An additional 9 brook trout collected during an angling survey were of the same size range. The biomass figures assessed were remarkably high, and a standing stock of 28 kg/ha was recorded in the outlet, Star Brook.

About 8% of the spawning and rearing habitat recorded during the survey in the Star Lake tributaries was predicted to be inundated by the proposed flooding. The predicted flood zone was also assumed to provide access to rearing habitats further upstream of waterfalls, although ample spawning and rearing habitat had been identified within the present range. Based on the hypothesis that standing water habitats are 3-20% more productive than stream habitats, the projected increase in flooded area (1500 ha) was suggested to increase the production of the system with an equivalent of 45-300 ha of stream habitat. Since the calculated loss of tributary habitat will be just under 40 ha, a theoretical net gain of productive habitats was emphasized.

The information on the lacustrine fish community was collected using gillnets with either a combination of 25, 51 and 76 mm mesh sizes, or a standard mesh of 38 mm. Different mesh sizes were set at different depths (3-15 m) near the shore for a duration of 1-3 hours in mid-day, tended and monitored hourly. This exceptional testfishing method used by JWE was defended as producing more general sampling than the technique used and recommended by Hammar and Filipson (1985), and to prevent excessive mortalities of fish. Two Arctic char and 20 brook trout were caught, and the presence of both species was thus confirmed in Star Lake, and also documented in Lake of the Hills, where 4 Arctic char and 5 brook trout were captured. The Arctic char measured 110-137 mm in Star Lake, and 160-170 mm in Lake of the Hills. Unlike the catch in Star Lake, the brook trout

collected in Lake of the Hills included a large individual, 445 mm, 802 g, and 6+. Variations in results were related to sampling methods, net locations, time of day and other factors. Nevertheless, the "catch statistics" were compared to other lakes which have been studied by JWE.

The stomach analyses revealed both the Arctic char and brook trout in Star Lake to feed on zooplankton and insect larvae, with the zooplankton species dominating in trout to be *Leptodora*. This species also predominated in the zooplankton diet of the Arctic char caught in Lake of the Hills, whereas the brook trout had fed on both insect larvae and zooplankton. The reports thus concluded "both brook trout and Arctic char in Star Lake to feed predominantly on zooplankton (*Leptodora*), suggesting that the choice of zooplankton may indicate scarcity of insects and that the trout in Star Lake may thus not rely heavily on insect aquatic life stages". The parasite analyses revealed all the brook trout sampled in Star Lake to be infested (e.g. by acanthocephalans, and cestodes). No further treatment of this highly significant information was presented.

The examination of 60 specimens of brook trout (collected by electrofishing in a tributary of Star Lake, and the outflow of Lake of the Hills) for a series of bacteriological and virological diseases indicated no such presence, with the exception of IPNV, which was found in both populations. Apparently none of these fish were sampled for other information. A total of 30 fish from the gillnet catches were examined for mercury. The content of 19 brook trout ranged from below detection (<0.04 ppm) to 0.27 ppm. Two Arctic char had 0.31 and 0.56 ppm mercury, with the latter thus exceeding the 0.5 ppm limit for safe consumption.

The extensive sandy areas in Star Lake were suggested to restrict shoal spawning, as well as providing limited benthic food resources. The ground level surveys suggested that "rocky shores could support spawning and would provide excellent substrate for benthos. With an increase in amplitude of 8 m, there will be a 50% increase in surface area. Overall, char should flourish with the creation of a reservoir and a corresponding increase in shoreline".

A major problem is that the EIS displayed inadequate scientific work, biassed in favour of the proponent, resulting in inability to quantitatively assess the environmental changes that would result from the project, and furthermore made unscientific assumptions. For example, it was stated (p.160) that "No change is anticipated in the available habitat for spawning and rearing by brook trout and Arctic char", and that, "the productivity of Star Lake will remain unchanged", noting that there will be a trophic upsurge after impoundment, after which productivity will decline to previous levels, but neglected to mention that other studies of fluctuating impoundments have shown that productivity declines to below original levels. The EIS even claimed that a net gain in fish production was expected due to inundation of tributaries and shorelines providing excellent substrate for benthic fauna. A very small sample of small trout was taken which had plankton in their guts, so it was concluded (p.200) that "the trout in Star Lake do not rely heavily on insect aquatic life stages, so that the result of (disrupted) littoral habitat could be a minor impact to trout productivity". It is known that with new reservoirs over acidic rocks, as in Precambrian areas, mercury is released which is accumulated up the food chain and can reach levels in piscivorous fish to make them unhealthy as food, lasting for more than twenty years (Anderson et al. 1995); nevertheless, it is

stated that "mercury content in sport fish will remain unchanged" (p.160). In boreal systems the outlets of lakes are very productive, due to relatively stable temperature and hydrological regimes, but primarily due to the outflow of seston (plankton etc.) which is used by filter feeding insects (e.g. Gibson and Galbraith 1975). These insects provide food for trout, which therefore are frequently abundant at the outflow of lakes (Gibson et al. 1984). This is the most likely reason for the popular fishing area near the outlet; however it was thought that since access was from upstream, these fish were stranded, and that the dam would block future downstream movement, leading to a reduction of loss of fish from the lake. It was also stated (p.175) that "ponds and steadies would remain along the dewatered section, recharged by local drainage", the conclusion from this being that "there would be negligible reduction in total fish production", a statement that displays surprising ignorance of stream ecology. It was claimed (p.175) that overall the Arctic char would flourish, as in the Cat Arm reservoir on the Northern Peninsula. However, no studies were done on the population numbers before and after flooding in the Cat Arm reservoir, although follow up net samples have shown that the population structure has changed, with relatively more of the older and larger char taken in gill nets than in earlier samples (JWE 1994), indicating that recruitment has diminished. It is stated in several places that the net residual impact on fisheries resources will be minor (geographical extent of impact <1ha; duration of interaction <1 year). It was stated (p.173) that "Direct construction impacts on water quality will be negligible", although massive silting has occurred as a result of the construction of the dam and road infrastructures. The general conclusions (p.220) that "the potentially adverse environmental effects that may be caused by the Star Lake development are at worst minor or are mitigable with known approaches or technology, and will not put the integrity of any species, groups or activity at risk" are prejudiced and false, and show ignorance of limnology and speciation.

General Comments

The conclusions in the "Fisheries Resources Component Study" (JWE 1995) and the fisheries sections of the EIS (JWE 1996) essentially predict only minor changes on the production of brook trout. No reproductive restrictions are anticipated, and the Arctic char are expected to flourish like as in other reservoirs where JWE have made environmental impact studies. A net gain in production due to inundation of tributaries and shorelines providing excellent substrate for benthic fauna, and the construction of an inter-lake channel suitable for spawning and rearing, are suggested to compensate for the minor loss of trout. The present salmonids were found not to be depending on benthic invertebrates. Instead a large zooplankton species, *Leptodora kindtii*, was concluded to be a key prey organism. Large piscivorous trout were considered to be history because of over-fishing, and this problem was suggested to increase due to better access to Star Lake following the construction work; it was thought however (p. 205) that increased access would benefit anglers and hunters.

Earlier studies from 1984 verify that the prey dominating in brook trout and Arctic char sampled in July and October, and the information on their dietary niches obtained via their parasite profiles, consists of a series of highly crucial, littoral invertebrates known to be eradicated by water level regulation. The interference in Star Lake will no doubt be destructive to the recruitment of Arctic

char and downstream brook trout, and to the production and diversity of littoral invertebrates, and thus a crucial element in the summer-autumn diet of the brook trout, and the winter-spring diet of the Arctic char.

Although we consider the fisheries component impact study to have failed to fulfill the objectives required under the Terms of Reference in describing the fisheries resource and fish habitat in the studied lakes, our comments focus on three main issues: (1) the lack of information on lacustrine fish, (2) the negligence of the trophy trout concept, and (3) the attempts to imply that the alteration of lower stream habitats and littoral zone would result in a gain to fish production in reservoirs.

1. Information on the lacustrine fish community is merely lacking. The accomplishments and methods applied to collect lacustrine fish data have been highly inappropriate, and the arguments that *additional gillnet collections to further document abundance of trout and char or to investigate the presence/absence of ouananiche would lead to additional mortalities of game fish that would be hard to justify*, in an impact study of the present kind stand out as hypocritical and irrational. In fact by regularly tending the gill nets set during a few hours in broad daylight, the possibilities of catching larger specimens were minimized. There is a remarkable discrepancy in the information gathered from a single night's effort with five gillnets in 1984, and the information provided by a major "environmental study" in 1994, although the methods used by JWE were stated to be more general than the ones used by Hammar and Filipsson (1985). By avoiding collection of comprehensive data on the lacustrine community of fish, and even manipulating sampling methods, the expected impact on the fish community of Star Lake may not appear as destructive as it is likely to be.

2. The presence of a piscivorous population of brook trout, by many referred to as being of trophy size, has consequently not been documented. The study only refers to such evidence as being history, reported by others. Interviews with cabin owners and residents of Buchans were used to support that over-fishing has reduced the mean size of the brook trout in Star Lake during recent years. Angling may certainly affect the abundance of cannibalistic trout in large streams. However, the piscivorous trout feeding on Arctic char in greater depths, in a lake of the size of Star Lake, is unlikely to be removed by anglers in ten years, the length of time between the studies by Hammar and by JWE.

A crucial component of the environmental impact study should obviously have been to identify the ecological conditions generating a trophy-sized brook trout, and the possible consequences for these factors in a reservoir. Do all trout have this potential, or is the piscivorous behaviour restricted to certain gene pools? Where do these trout spawn? Downstream spawners in lake outlets are generally known to spawn in areas of superior rearing conditions, etc. The relationship between the importance of specific spawning sites and the impact of impoundment is far more crucial to the estimation of spawning success, than to state that only 8% of the spawning grounds of the tributaries will be flooded.

3. The "Fisheries Resources Component Study" seems to have maximized efforts to provide information on spawning facilities in tributaries, and minimized their efforts to provide information on facilities for brook trout spawning downstream. In general stream habitats are considered more productive than lacustrine habitats (Hynes1970), and in a recent review Randall et al. (1995) reported average community fish production at river sites to be three times greater than in lakes. Higher production in rivers resulted from higher densities of fish (14 times) and greater biomass (2 times). To suggest that the lower part of a river exposed to water level regulation, with flooding occurring during the winter season, should result in increased production, and to forecast a total gain in fish production in a reservoir, is unscrupulous and unethical.

Fish Habitat Compensation Agreement

In response to comments from DFO it was recognised by JWE (November 1997 fish habitat compensation plan) that fish habitat would be lost in Star Lake equivalent to 2,637 stream units (1 unit = 100 m^2), for which compensation would be made. An agreement was made on the 16th of January, 1998, between the Star Lake Partnership and DFO on compensation measures, "To ensure no net loss of fish habitat productive capacity of Star Lake and its inflow tributaries affected by the hydroelectric development, the Partnership is committed to a Fish Habitat Compensation Program, and in particular, to use artificial propagation and rearing of Star Lake fish to supplement the fisheries resource being affected."

The fish habitat compensation program describes the requirements for "Fish Breeding and Rearing" as follows:

a) A scientifically sound and technically feasible breeding and rearing program for brook trout will be submitted to DFO on or before April 30, 1998.

b) The fish breeding and rearing program will be designed for long-term maintenance of the genetic variability in the wild fish populations of Star Lake and include, but not be restricted to, providing specifics on brood stock collection, breeding methods, and mating strategy.

c) The breeding and rearing program for brook trout shall provide for fingerling production targets to be achieved in order to compensate properly for the lost brook trout habitat productive capacity in Star Lake.

d) the fish breeding and rearing program shall be designed such that it can address the needs for Arctic charr production, if the fish population monitoring program demonstrates a negative effect on the Arctic charr population in Star Lake.

The document also states: "In addition a detailed monitoring program is to be developed to determine the suitability and success of the brook trout breeding program, the long term survival of the fingerlings, and the assessment of the status of brook and Arctic charr in Star Lake."

Under "Further Work" it is stated that "If the Monitoring Program indicates to DFO that the breeding program and/or incubation and rearing facilities are not functioning as necessary to ensure the maintenance of the productive capacity of brook trout and Arctic charr populations in Star Lake, the Partnership will carry out any modifications deemed by DFO to be reasonably necessary".

Hatchery techniques have been shown to be useful for aquaculture, introduction and restoration, "put and take" angling, and for sea ranching, but they have been shown repeatedly to fail in supplementing wild stocks, in which frequently the result is a deterioration of the original genetic variability and general fitness of the population, with a consequent reduction in the population (e.g. Bowles 1995, Hillborn 1992, Hindar et al. 1991, Jorstad and Naevdal 1996, Pepper and Crim 1996, Ryman and Ståhl 1980, White 1995, Gillis 1997). We foresee problems and pose the following questions in the present compensation plan:

i) How will be identified the various gene pools of brook trout, especially the piscivorous deme, and their spawning sites?

ii) At what genetic level will these analyses be carried out?

iii) How are mortalities to be avoided, when sampling for eggs?

iv) How will an effective population size be maintained?

v) How will introgression and loss of genetic diversity be avoided?

vi) How will the loss of crucial invertebrates in the littoral zone be compensated?

vii) How will the oligotrophication process, and the loss of nutrients be compensated?

In October of 1997 as Star Brook was being dewatered many fish were stranded, so approximately 3700 brook trout were collected and released in Star Lake above the dam. Since heavy siltation was being caused by construction of the dam at the time, feeding fish would probably have dispersed from the area, and since this would be at spawning time it is likely the fish were spawning. Since trout home to specific spawning sites, which are now lost in this case, genetic characteristics of this sub-population will be lost. Since the appropriate studies were not undertaken before flooding of the reservoir, as we intimate in (i) it is unlikely the commitment in (b) of the compensation plan to maintain long term genetic variability of the wild populations can be fulfilled. Also it is unlikely that the commitment in (c) to compensate for lost habitat productivity by stocking can be fulfilled, since after "trophic upsurge" the carrying capacity of the lake will decrease below original levels. We were unable to find out the extent of modifications that would be made if the breeding programme did not maintain the productive capacity of brook trout and Arctic char populations in Star Lake, as required under "Further work" in the compensation agreement, but we suspect that they would not involve restoration of the lake.

The EIS did not include studies of the diversity and the abundance of invertebrate organisms, zooplankton and benthos, and the expected outcome for the crucial fish-food organisms such as amphipods, ephemeropterans, trichopterans and molluscs. In what way will the change in the littoral invertebrate community be documented? How will the loss of crucial invertebrates in the littoral zone be compensated? At least two species of amphipods and a series of crucial insect and mollusc taxa may be lost. What will the released hatchery fish be feeding on in the reservoir? How will the oligotrophication process, and the loss of nutrients be compensated for?

Public Participation and Project Implementation

Under the CEAA, assessments are subject to a public review. There was much public opposition in the media to the Star Lake project proceeding, (e.g. Malone 1996), and also comments in favour of the project (e.g. Fenwick 1996), the latter generally accepting that the EIS was a competent study, and in favour of job creation. However all public comments in favour of the project were made by non-scientific individuals who were under the impression that damage would be minor and mitigable. There were numerous reviews and comments by individual scientists (e.g. Drs. R.L. Haedrich, J. Hammar, R.J. Gibson, M.H. Colbo, L. Zedel, R.J. Behnke) and by conservation groups (Canadian Nature Federation, Natural History Society of Newfoundland and Labrador, the Newfoundland Chapter of the Canadian Society of Environmental Biologists, the Salmonid Association of Eastern Newfoundland, the Canadian Aquatic Resources Section of the American Fisheries Society, Save our Rivers Environmentalists), all of whom were critical of the project proceeding, but none of whom had any influence on the decision. A major problem of the official (internal, rather than public) review process was that no research scientists, either within government or outside, were asked to review and comment on the EIS. We believe therefore that the decision to exploit Star Lake as a reservoir and allow its unique fish community to be destroyed was a political one, and taken at an early stage of the process.

Public Participation

Public participation is a key objective of the CEAA, which "encourages public involvement by ensuring that the public has an opportunity to review and comment on proposed class screening reports ... before any decisions are taken" (Information Fact Sheet No.3, Canadian Environmental Assessment Agency, 1995). No public mechanism was provided by DFO for public input on the Screening Report on Star Lake dated November 4/96. Many comments received by DFO prior to the Screening Report appeared to be ignored. By the time the Screening Report was written DFO had been advised by many individuals and groups that, in all likelihood, a unique strain of brook trout inhabited Star Lake (Prosecution Brief No.1 Mitchell vs. Abitibi et al.).

In an interview with Heather Barrett on CBC radio on Aug 20/96, Dr. R.L. Haedrich, a scientist at Memorial University, pointed out that the unique race of trout at Star Lake would be wiped out because of the fluctuating reservoir. During the provincial assessment the previous winter, Dr. Haedrich had advised the Provincial Minister of the Environment regarding the possibility of a

unique strain of fish in Star Lake (personal interview, and a letter, to Hon. K. Aylward from Dr.R.L. Haedrich, March 25/96). DFO was a member of the provincial assessment committee. On Aug. 20/96 the Division Manager for Habitat Management with the DFO refused a taped interview, but made the comment that he knew nothing about any rare strains of fish at Star Lake. Seven days later, the Regional Director of Science at DFO advised the Star Lake Partnership that the Department would issue a Section 35(2) Authorization, pending a Compensation for Losses Agreement. Ironically, this was the same day that the DFO received a letter from a coalition of five provincial environment groups citing scientific evidence to substantiate the claim of the unique strain(s) of fish (letter to Hon. F. Mifflin from B. Malone, Aug. 23/96). In the same letter to the proponent, DFO (Aug. 27/96) advised that the project construction could proceed, provided fish habitat was not altered, disrupted or destroyed. This letter essentially gave the proponent the green light before the screening process was complete, without any direct public involvement, and long before the compensation was decided. As it turned out, the Compensation Agreement was not finalized until more than two years later and after the dam was built. The status of the genetic diversity of the brook trout stock(s) is yet to be determined. This piecemeal assessment process contravenes the CEAA, which requires that all components of a project be assessed together.

Several weeks before the Screening Report under CEAA was finalized (Nov. 4/96), one of the authors of this paper wrote a letter to the *Evening Telegram* in St. John's, warning that the fluctuating Star Lake reservoir would destroy a unique fish community (letter to Evening Telegram from Dr. Johan Hammar, Oct. 14/96). Later, requests made under the Access to Information Act revealed that DFO personnel were aware of these claims, but appeared to have dealt with the information only in a cursory manner. A plethora of scientists and groups called for further study of the fish at Star Lake and made their views known to DFO. Nevertheless, the Screening Report was written claiming that, "the project is not likely to cause significant adverse environmental effects (take action to allow the project to proceed)". In an interdepartmental memo to the Branch directors of DFO on Aug.26/96, the Director General appointed a single spokesperson on the Star Lake issue, from the Habitat Management Branch, so that the Department could have a "coordinated response" to public interests on the project. This was effectively the gag order to DFO personnel who did not agree with the Star Lake development. The lack of opportunity for public involvement, and turning of a blind eye to public opinion, demonstrated a failure on the part of DFO to exercise their mandate under the CEAA.

Public input for the compensation for losses agreement was no better. For example, the nine compensation proposals for lost fish habitat were never discussed in a public forum. In contrast, DFO had numerous meetings and consultations with the Star Lake Partnership (letter to Star Lake Partnership from the Regional Director of DFO, Nov. 14/96).

Although the dam construction began in May of 1997, the first glimpse of a proposed compensation plan was only made public in November of 1997 at an open house session and only in one community in the Province, Grand Falls. By the time the proposed compensation plan for losses was made public, the dam had been constructed and the reservoir was only several weeks from the flooding (Reports of the Env. Surveillance Officer, NDOEL).

Only two days notice was given of the "open house" meeting in Grand Falls on November 13/97 with little time for the public to prepare. An extension was requested, and a new deadline was announced, November 19. With the day fast approaching, a public lobby group, the Friends of Star Lake, sought input on the proposed compensation plan from several fish biologists and limnologists, as well as from members of the public, both individuals and groups. Many comments were sent to the consultant, JWE, before the deadline (e.g. J. Hammar sent a detailed criticism of the Star Lake project and the compensation plan to JWE, 18 November, 1997) . Several months later, it was learned that the Compensation Plan on which the legal and binding agreement was settled was dated November 14, five days before the deadline given to the public. It was very obvious that public input and scientific information had not been considered. A letter to the federal Fisheries Minister by one of the authors of this paper (G. Mitchell) pointed out this insult and asked that the Compensation Agreement be revoked so that open and meaningful consultations could be conducted. This letter went unanswered.

The second public meeting, to exhibit plans for the proposed hatchery, was held the day before Good Friday (April 9/98) and was not intended for public input, but a demonstration of a *fait accompli*, according to a CBC interview with a representative of the Star Lake Partnership (CBC interview with Mr. B. Perry, Abitibi, March 31/98).

Mitigation

The mitigations proposed for Star Lake with respect to siltation of waterways are outlined in the Environmental Impact Statement, the Environmental Protection Plan, DFO Letters of Advice and a number of Permits of Approval from the Province. These documents were, for the most part, simply a paper exercise. Practically none of the commitments given on paper were followed in the field. For example, both the EIS and the EPP state clearly that an environmental monitor would be on the site at all times. Instead, a monitor was only onsite once a month. The EIS also states that the onsite monitor would produce regular reports. The provincial Environment Department received no compliance reports (pers.comm. M. Crewe and J. Eason) nor, apparently, did DFO (failure to disclosure in an Access to Information request No. ATIP/2526).

It is usual for DFO not to allow construction in waterways from Sept. 30 until June 1, because of the potential to impact fish habitat, especially over the salmonid spawning and incubation periods. The only limiting factor on instream construction for the Star Lake project seems to have been the weather. Construction on the dam and penstock continued until December/97 and resumed in March (pers. comm. D. Whitten, contractor representative). Construction took place in spite of reported siltation incidents and an ongoing investigation by DFO concerning a private prosecution for alleged breaches of the Fisheries Act (Oct/97).

The 'paper exercise' documents (EIS, EPP, Letters of Advice, Permits) also make numerous promises that: (1) silt should not enter the stream, (2) mitigative procedures such as silt fences, settling ponds, etc. will be installed and maintained and (3) reporting a mishap would be done

promptly to the responsible authorities. These documents are the means of gaining approval of the assessment committees and assuring the public that the project will be done properly. On the surface, the mitigative measures seem reasonable and acceptable to most people. Star Lake, however, is in the back country and "out of sight, out of mind". Compliance monitoring by the proponent and DFO was almost entirely absent during construction, and large amounts of silt did enter the streams and lakes. This statement is substantiated by eye witness accounts, photographs and water samples; the evidence was outlined in two prosecution briefs filed with the office of the Attorney General of Canada (Mitchell vs. Abitibi Consolidated and CHI Hydroelectric Inc., March 1998, and Mitchell vs. Abitibi Consolidated, CHI Hydroelectric Inc. and Tarmac Inc., June 1998). Along with other accounts of siltation, the waters of Star Lake, Star Brook and Red Indian Lake were silted more than fifty days during the construction period.

Reports of siltation events were not reported to the Compliance and Enforcement or the Habitat Management Branch of the DFO by the Star Lake Partnership despite their commitment to do so. The first site visit by Habitat Management was conducted on September 11/97 (meeting with DFO in Grand Falls, March 23/98) although the project had begun in May/97. The first site visit by the Compliance and Enforcement Branch in Springdale (named as the contact in the Letter of Advice, May 22/97) was in April of 1998 (pers. comm. Alan Sheaves, DFO, Aug. 3/98). This inspection was made following construction of the dam and the reservoir flooding and after charges had been laid under the Fisheries Act through two private prosecutions earlier in April and the previous October.

The outflow of Star Brook was identified as fish habitat early in the assessment (Fisheries Component Study), and it was pointed out by a number of scientists that there was a need for further spawning studies and that the outflows of such systems are very productive (e.g. letter from the Newfoundland Natural History Society to Provincial Minister of the Environment, 16 February, 1996). During September and October of 1997, DFO permitted the proponent to divert the entire watercourse at the outflow of Star Lake into a newly blasted channel parallel to Star Brook (pictures Oct 4, Prosecution Brief Mitchell vs. Abitibi et al.). This activity caused the streambed to become mostly dewatered and heavily silted. This former river was fish habitat. Thirty seven hundred fish were removed from remaining pools in late November (letter from DFO to Mr. G. Manion, Feb.25/98). When charges were laid against the Star Lake Partnership under a private prosecution for alteration and destruction of fish habitat, DFO requested the Office of the Attorney General to enter a stay of proceedings on the charges. Neither DFO or the office of the Attorney General offered any explanation for their actions or lack thereof.

The reticence of DFO continues to the present day. Three letters have been written on behalf of one of the authors (letters from Shelley Senior to Ray Finn, Director, Habitat Management Division, DFO, June 2/98, and to Hon. D. Anderson, Federal Minister of DFO, Aug. 5/98 and Aug. 31/98) requesting that DFO conduct studies on the bottom of Red Indian Lake to determine the level of siltation from the construction activities. The request has been ignored by the DFO. Two letters were unanswered and the one that was answered did not acknowledge the request.

Authorizations

Hydroelectric dams are constructed to profit the owner. When it is decided that a project is viable, then it is in the best interests of the owner to get the project through the various assessments and the construction underway as quickly as possible. Time is money.

Under the CEAA a project is not released from assessment and cannot start until the relevant permits are issued by the Responsible Authority, in this instance DFO. The requirement for an Authorization for Works Affecting Fish Habitat [Section 35(2) of the Fisheries Act] was the relevant permit for the hydroelectric project to proceed at Star Lake. DFO made an early determination that as long as habitat was not altered, disrupted or destroyed during the construction phase then the project could proceed (letter to Star Lake Partnership from Regional Director, DFO, Aug 27/96). In other words, the dam could be constructed, the penstock and powerhouse installed and all related work proceed, except the flooding of the reservoir. The construction is permitted through "Letters of Advice" to the proponent with outlined mitigation procedures. This is the backdoor approach to assessment. The public gets no say, whatsoever, about the various components of the project since no mechanism is in place for public input. The recent decision by the Nfld. Supreme Court not to allow a road and airstrip under the non-assessed exploration phase of the Voisey's Bay project is an example of how assessment should work.

An earthen berm was built in the summer of 1997 and extended approximately 30 metres into Red Indian Lake in order to facilitate the construction of the tailrace and powerhouse. The berm was constructed by bulldozing several hundred tons of rock and soil into the lake (pictures from Prosecution Brief Mitchell vs. Abitibi et al.). No studies were conducted by the proponent to determine whether this cove was fish habitat and no mention is made of this berm in any of the relevant provincial or federal permits. However, this particular section of water was fished heavily by recreational anglers and is good angling for brook trout, and ouananiche up to fourteen pounds (pers. comm. T. Byrne and T. Marshall). This cove was also possible spawning ground for anadromous Atlantic salmon since it is at the outflow of both Lloyds River and Star Brook (pers. comm. Don Ivany, Atlantic Salmon Federation). The construction of this large earthen berm in the lake has, in all likelihood, destroyed an unknown quantity of fish habitat. This activity contravenes the spirit and intent of CEAA, the Newfoundland Environmental Assessment Act (NEAA) and the Fisheries Act.

Recommendations to Improve Public Participation and Enforcement of the Fisheries Act

It is recommended, in order to avoid future problems, that the following measures be taken:
(1) that projects and/or portions of projects cannot proceed until compensation for habitat losses are finalized and appropriate permits are issued.
(2) that regulatory mechanisms are put in place for meaningful public involvement and to include:
    (a) sufficient time for the public to prepare presentation;
    (b) a mechanism whereby public meetings are attended by representatives of all government agencies;

(c) a requirement that proponents and government agencies answer questions in a public meeting format rather than a trade show format;

(d) that all public concerns are addressed in writing, and not just at the beginning of the assessment, but throughout;

(3) that work stop orders are put in place to act as penalties for proponents who do not submit environmental compliance reports to the appropriate authorities.

(4) that in cases where there is a potential to harm fish habitat from deleterious substances such as silt, a monitoring device is put in place on the stream and regularly checked by DFO personnel.

(5) that all components of a project are assessed.

Legislative Mechanisms for Conservation

The CEAA was triggered by the Fisheries Act, which under Section 35 states that no person shall carry on work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat, but allows latitude for development to take place, under Subsection 35(2), if compensation can be made. In the case of Star Lake the ecosystem is being destroyed and adequate compensation has not been made.

In the present case a multinational company of economic importance to Newfoundland appears to have influenced proper government procedures. This is not unique to Newfoundland, and the environmental impact assessment process is frequently looked upon as a bureaucratic formality (McCully 1996). Reforms are required that would improve the signals that are received by resource users. Harte (1996) assesses the two generally held views of future development, one of which is that nature is the ward of humanity, and the other that it is the steward. He believes that the commonsense values underlying the nature-is-steward vision are not being communicated adequately to the public. He claims that we are losing the educational battle because the science underlying the nature-is-steward vision does not appear to be as convincing, let alone as dazzling, as is the science underlying the people-are-stewards vision of continuing growth and of conversion of wild habitat to manacled rivers and manicured forests. Until recently no hydroelectric proposal had been refused in Newfoundland, although most were damaging to river ecosystems, but in August of 1998 Premier Brian Tobin announced a moratorium on small river hydro development, as a result of public awareness and advocacy, illustrating the value of public education. However globalization promoted by certain agencies, with competition for investment encourages a "Race for the Bottom" in environmental standards, an effect that is already seen in the standstill and rollback provisions of the draft Multilateral Agreement on Investment, and in "free" trade agreements. We should insist that our governments require binding environmental standards in investment and trade agreements (McAllister 1998).

The Walter and Duncan Gordon Foundation (1996) suggest that there should be one strong independent agency that sets the rules, monitors the results and applies the law fairly to all. Also it is suggested that harmonization should mean one good federal law administered by 10 provinces and two territories, guaranteeing one prudent assessment per significant project in the public interest. At present the proponent hires the consultant to prepare the EIS. This tends to result in the proponent

not necessarily hiring the best expertise, but hiring the company submitting the lowest bid, and biassed in favour of the proponent's project proceeding, with as little cost as possible to the proponent. We suggest that the federal government, or some independent Board, select the consultant group, and devise the appropriate study, which would be funded by the proponent. In addition we suggest that an EIS should be reviewed anonymously by competent research scientists in the field, as are scientific proposals and published papers in the primary literature. Comments should be made public, and assessed by an independent Board or Commission, under federal government chairmanship, but including provincial government members and scientists. Also some liability should remain with the proponent if compensation were unsuccessful. If the proponent were responsible for restoring any damage incurred by activities in a watershed, including unforseen consequences a decade or more later, and had to pay for both initial and follow up scientific studies, which would be supervised and ensured to be competent by some watershed regulatory committee, representing all user groups, the EIS would at least be honest, and all users would be aware of the consequences of the project. Public participation and participation by all user groups, and to include scientific involvement, would ensure better enforcement of regulations than presently exist. The user of a natural system might be legally required to buy insurance that would cover the costs of environmental restoration in the case that the user's activities led to environmental degradation (Costanza and Perrings 1990; Costanza and Cornwall 1992).

Conclusions

Despite personal meetings with the Provincial Minister of the Environment, and written presentations to both levels of government and the proponent throughout the process, by competent scientists, pointing out that a valuable and unique ecosystem would be destroyed by the hydroelectric project, the decision has been made to convert Star Lake into a hydroelectric reservoir. The voluminous literature on the effects of other hydroelectric projects, and the unanimity of scientists qualified to assess the present project, leave no uncertainty as to the future of the present brook trout populations and the consequences to Star Lake, with the impending loss of scientific and recreational amenities, their associated economic benefits, and the further diminution of salmonid biodiversity. The acceptance of a flawed EIS, despite the shortcomings having been emphasised by competent research scientists, and a "compensation" plan that cannot restore fish habitat productivity or conserve genetic stocks, and in reality is a public relations strategy, suggests to us that a political decision was made at an early stage to proceed with the project, and that scientific advice was ignored. The fact that the project proceeded before final federal government approval was made, and that public participation was ignored or minimized, contributes to our conclusion. The EIS was an expensive desk product, the time taken to comment by professional scientists and many environmentalists was wasted. The Star Lake case was a theatrical play, a comedy to some, a tragedy to most others. The CEAA, the Fisheries Act and Canada's official international commitment to conserve biological diversity have all been contravened, and failed to prevent another ecological disaster. Changes are needed to apply the CEAA and Fisheries Act honestly and to prevent such mistakes in the future.

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