UNIVERSITY of GUELPH
Aquatalk
AQUACULTURE NEWS AT THE UNIVERSITY OF GUELPH

VOL.VI NO. 2 FALL 2002

Awaiting the charr

Aquaculture Centre helps Inuit community reclaim long-lost fishery

BY KRISTY NUDDS

Nestled among freshwater lakes and rivers, the remote Inuit community of Kuujjuaq in Nunavik, northern Québec, doesn't seem like the kind of place that would be lacking for fish. But it is — one of its rivers, the Nephijee, was a strategic corridor between the ocean and freshwater necessary for the migration of Arctic charr, a traditional Inuit food. For years, access to the Nephijee River from the ocean has been blocked by a series of naturally formed waterfalls, and the charr were unable to ascend the river. However, thanks to a little ingenuity and perseverance, Arctic charr should be on their way back to Kuujjuaq.

This re-introduction has taken nearly two decades and involved many elements: community participation, engineering, hatchery construction, co-operation from the neighbouring town of Tasiujaq and expertise from the Aquaculture Centre's Alma Aquaculture Research Station (AARS) at the University of Guelph.

Still, despite the teamwork, obstacles were encountered at every turn. First, the landscape had to be altered to make a fishway between the freshwater surrounding Kuujjuaq and the ocean. Then, to speed up production, a hatchery had to be developed. Unfamiliar with the rearing of juvenile Arctic charr, the community of Kuujjuaq finally found the help it needed from the Aquaculture Centre.

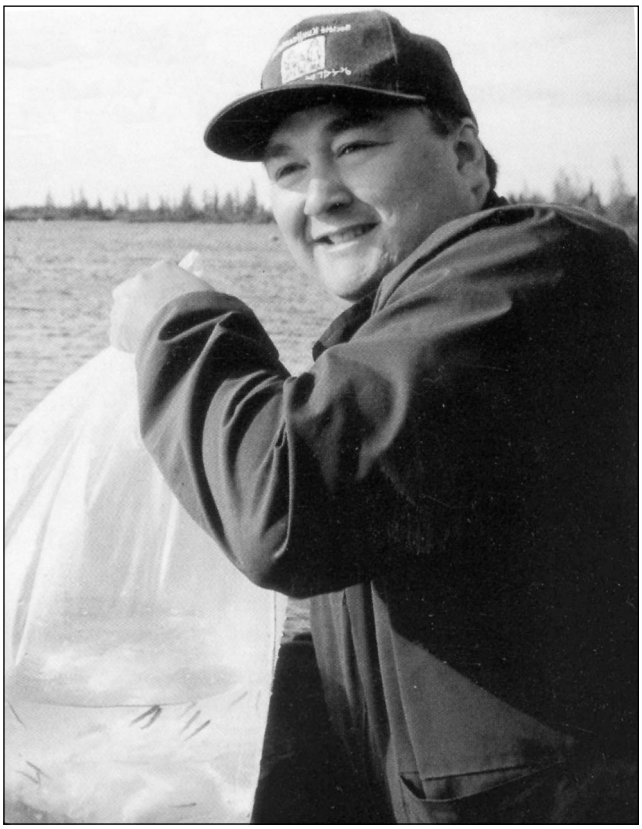
Researchers and townspeople believe the lengthy process will pay off in an estimated six to eight years time, when the Inuit of Kuujjuaq will be able to fish charr in local waters. By then, some of the 100,000-plus charr fry that biologists have released into surrounding lakes will be mature enough to begin reproducing on their own.

"The successful hatching and rearing of these fry was largely due to the training we received from the Alma Research Station," says Geoff Klein, a fisheries biologist with the Nunavik Research Centre. "They offered us incredible support…we would have been sunk without them."

Arctic charr, known as iqaluppik to the Inuit, is not only a traditional food, it is also highly preferred, second only to caribou meat. So townspeople were understandably anxious about their fishery.

The difficult journey actually began almost 20 years ago, when a study conducted by University of Waterloo Prof. Geoffrey Power revealed that the

CHARR continued on page 2



PHEBE BENTLEY

Allen Gordon releasing Arctic charr fry into Stewart Lake near Kuujjuaq.

Inside...

CHARR continued from page 1

nearby Nephijee River held the most potential for offering extensive overwintering habitat for the fish, allowing the charr to enter the watershed surrounding Kuujjuaq from the ocean. Unlike many northern fish, charr lack an antifreeze protein in their blood, and need warmer freshwater environments to survive through the winter.

But there was a problem — the waterfall, where one of the bays emptied into the sea, was too high for the charr to ascend. It prevented them from entering the waterways.

Power suggested that the waterfall be excavated to provide the fish better access to the Nephijee River. Ultimately, that project was pursued when Allen Gordon — a student at the time of the original study— became president of the Nayumivik Landholding Corporation. He decided to make the project part of his mandate. An engineering firm was contracted to modify the waterfalls, creating 'fish-ladders' low enough for the fish to ascend. That reestablished the vital corridor between the sea and freshwater environments.

The fish-ladder initiative, completed in 1999, proved to be successful; a counting weir indicated that more than 100 fish used the ladders in their first year of operation. However, biologists knew this was not going to be enough to permit even a subsistence fishery. So, they decided to speed up the introduction of charr into the lakes.

With guidance from a commercial fish producer in Gaspé and Québec provincial biologists, the team converted the old Kuujjuaq Water Plant into a fish hatchery. The water plant proved ideal; the plumbing and water source were already in place. Egg incubators were purchased and the building was retrofitted for rearing the young fish.

With a donation of 35,000 eggs from Tasiujaq in the fall of 2000, it appeared the project was finally underway. But even though 92 per cent of the eggs in the hatchery developed into fry - more than four times the amount that normally occurs in the wild - water from the intake pipe in the hatchery proved to be too warm. The eggs developed too quickly, already having absorbed their yolk sacks by late March.

This was a serious problem - thick ice was still covering the lakes, preventing the sunlight necessary to produce the zooplankton that would support the fish once they were moved into the lakes.

Now faced with the reality that the fry would starve before being moved into the lake system, the project team turned to provincial biologists for guidance on how to feed and care for the fish until spring. This proved to be disappointing — they were told there was no hope of feeding the fish, and were advised to abandon the project altogether, says Gordon.

Unwilling to give up, the project biologists searched the internet…and found the Aquaculture Centre's website. At short notice, Prof. Rich Moccia, AARS Station Manager Michael Burke, and research assistant David Bevan hosted Gordon, Klein and Sandy Suppa from the Nunavik Research Centre at the AARS for three days — providing the biologists a workshop and information on how to feed and care for the fry until the lakes were ready to support them. This included instruction on fish rearing, water management, fish health, feeding techniques and feed storage.

On their return, Gordon quickly arranged for early rearing tanks to be constructed by local Inuit boat builders. By early June, the charr fry were ready for release. In all, some 25,000 fry were released into four nearby lakes. Another 8,000 fry were retained in the hatchery for later release as larger fingerlings. Thanks to the basic training and support from the AARS, a whopping 97 percent of the fry survived to stocking, says Gordon. "The project has been a great success."

The training provided by the Aquaculture Centre has also allowed the project team to triple its egg collection from 35,000 to 110,000 last year. Survival rates were again impressive — 98 per cent of the resulting fry survived to stocking age, and were recently released into six lakes in the Nephijee water system. This success has heightened enthusiasm for the project among the Inuit of Kuujjuaq, and ensures egg donations until the town is able to establish its own broodstock, says Gordon.

The Aquaculture Centre, with support from the Ontario Ministry of Agriculture and Food, continues to assist the Kuujjuaq charr project on an as-needed basis.

This project was sponsored by the Kativik Regional Government.

FISH BITS

GMO Fish

Professor David Castle, Department of Philosophy, is leading a Genome Canada funded research project looking at the legal, ethical, social and environmental impacts that genomics and biotechnology will have on the aquaculture industry. Collaborators include research faculty from Memorial University of Newfoundland and the University of New Brunswick.

Smart fish?!

Stephanie Yue, a PhD student in the Aquaculture Centre, is testing memory retention and learning ability in domesticated rainbow trout. A better understanding of the cognitive capacity of farmed fish will aid in developing improved husbandry techniques. Look for a full story in our next *Aquatalk*.

Cole notes: BOD is bad

Collaborative effort helps to reduce environmental impact of fish feed

By Kristy Nudds

DAVID BEVAN

Brian Beattie prepares a sample of fish manure for analysis of biochemical oxygen demand (BOD).

Gord Cole was frustrated. Authorities kept telling the operator of Aqua-Cage Fisheries Ltd., an enterprise rearing trout in net cages in Parry Sound, Ontario, that excess phosphorus discharged from freshwater aquaculture is a significant environmental concern. But Cole knew from 20 years experience that a bigger issue in freshwater is biochemical oxygen demand (BOD) of manure wastes (the reduction of dissolved oxygen in water, caused primarily by bacterial breakdown of solid organic material).

So, Cole took action. He contacted Martin Mills Ltd. and Prof. Dominique Bureau, a fish nutritionist at the University of Guelph, with the idea of trying to minimize solid organic waste output by creating a low-BOD feed.

"When fish are fed at optimal levels, phosphorus is not normally an environmental issue. Some algae growth can result, but it's more of an aesthetic concern, and easy to mitigate," says Cole. "The problem lies with solid waste in fecal material and the small amount of uneaten feed falling directly below the cages, which can affect the ecosystem of the lake."

Solid organic waste in freshwater ecosystems increases the activity of bacteria that feed on fecal matter, and steps-up competition with natural fauna for oxygen. It's predominantly in the lowest and deepest levels of the water (the hypolimnion), where fecal matter and uneaten feed end up.

The main culprit in fish feces is carbohydrates. In fish feed, carbohydrates are used primarily to 'bind' other ingredients into pellets. But carbohydrates are not well digested by fish and are excreted, increasing fecal organic matter, says Bureau.

So, to formulate a low-BOD feed that could change the fecal characteristics, the obvious choice was to reduce the non-digestible carbohydrate content. However, the trick with this approach is developing a diet that can be easily manufactured, says Cole.

That's where Bureau came in. He helped Cole formulate several test feeds with reduced carbohydrate contents. Then, Martin Mills Ltd. had the challenge of manufacturing these feeds. Without a large amount of carbohydrate to bind the protein and fat components, the process became "an exercise in trial and error," says Mark Wagner, manager of Martin Mills Ltd.

After numerous attempts, Martin Mills Ltd. was able to manufacture two of the experimental feeds. Growth trials comparing these feeds with two standard feeds were conducted by Prof. Rich Moccia at the University of Guelph's Alma Aquaculture Research Station, with a domestic Ontario strain of rainbow trout. The digestibility of the feeds — an essential parameter to predict fecal waste output — was then measured by Bureau at the university's Fish Nutrition Research Laboratory.

The results were dramatic: compared to regular feed, the most effective low-BOD feed improved digestibility (and reduced fecal solid waste output) by 10 per cent, and improved feed conversion by eight per cent. That's because of the much higher nutrient density of the low-BOD diets, says Bureau.

"Reducing carbohydrates makes the feed higher in what the fish can use — essentially fat and protein," he says. "Carbohydrates contribute little or nothing to fish growth."

BOD analysis on the manure waste was conducted by graduate student Deena Berlingeri, as part of her major project for the M. Sc. (Aquaculture) degree at the University of Guelph. Berlingeri integrated estimates of BOD with growth performance and waste output estimates into a computer model she developed with Moccia, named the Hypolimnion Environmental Load Prediction (HELP) model. With this, she was able to develop quantitative predictions of the impact of each feed on water BOD. This information will help with environmental cost-benefit comparisons of the various test-feed formulas.

This collaborative effort between industry and researchers will pay off. Not only do the reformulated feeds reduce BOD, they also result in increased feed conversion and lower production costs. On a per-kilogram basis, a more nutrient dense diet requires less feed to grow the same amount of fish than that of a regular feed, says Martin Mills Ltd.'s Wagner. "This is sure to have a positive impact on the industry," he says. The company hopes to market a commercial low-BOD feed within the next year, after further formulation analysis and final product testing is completed.

This research was sponsored by Martin Mills Ltd., the Ontario Sustainable Aquaculture Working Group, Environment Canada, Fisheries and Oceans Canada, Aqua-Cage Fisheries Ltd., the Ontario Ministry of Natural Resources and the Ontario Ministry of Agriculture and Food.

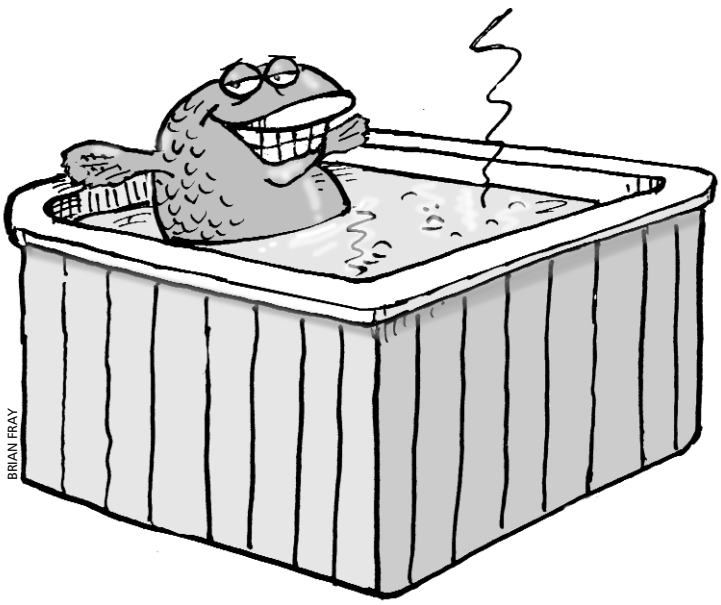
Warming-up at Alma

Infrastructure support will enhance recirculation aquaculture research

By Clare Illingworth

The evolving business of aquaculture in Ontario will soon be heating up. Thanks to a federal infrastructure grant from the Canada Foundation for Innovation (CFI), warm-water fish species are joining the ranks of those being studied at the University of Guelph's Alma Aquaculture Research Station (AARS).

Currently, rainbow trout and Arctic charr, both cold-water species, dominate Ontario's aquaculture industry. But AARS director Prof. Rich Moccia foresees a change — he believes that warm-water species, such as tilapia, yellow perch, and possibly walleye, may soon be an emerging sector of the industry.



BRIAN FRAY

"Warm-water species are currently being imported to Canadian consumers," says Moccia. "This market could be supplied by Ontario producers, and if cost effective, even exported to other markets."

The CFI grant — one of five awarded for aquaculture research in Canada — will allow the AARS to construct a recirculation facility to support the growth of research on warm-water aquaculture in Ontario, helping the industry further develop the technology to provide consumers with locally produced fish.

Warm-water fish are not currently farmed in Canada to any significant extent because the technology and research facilities to study their biological management is lacking. So, the CFI support will outfit an existing building at Alma with three separate water recirculation modules. Each module is designed to provide 5,000 litres of rearing volume with water temperatures between 10°C and 30°C. Each system can operate at more than 90 per cent recirculation, meaning that less than 10 per cent of the total volume is replaced daily.

The AARS warm-water facility has been primarily designed to support production-based research projects. These projects, both publicly and privately funded, will include nutrition, energetics, reproduction, and other aspects of warm-water fish rearing and performance. Additionally, the facility will provide an opportunity to evaluate recirculation technology and its impact on water conservation and improved biosecurity measures, two key factors for sustainable aquaculture in Ontario.

This expansion in the research capability of the AARS will help increase market opportunities for producers and keep them abreast of new technologies, says Moccia. "Warm-water species may provide fish producers with a niche market, and diversification of Ontario aquaculture will help stabilize it against the volatility in the seafood markets which now exists," says Moccia. "The enhanced research facility will allow us to provide research and recommendations we haven't been able to offer before. It will also permit greater education and training opportunities for both farmers and students alike."

The AARS services the research and education needs of Ontario's aquaculture industry and is funded by the Ontario Ministry of Agriculture and Food. Further information about the AARS and it activities can be found at: http://www.aps.uoguelph.ca/~aquacentre/aars/index.html

Aquatalk reports on news from the University of Guelph/OMAF Aquaculture Program. It is published by the Office of Research, University of Guelph, in collaboration with the University of Guelph/OMAF Aquaculture Centre

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