

APPENDIX L

Cottage Owner Engagement Supporting Documentation



October 31, 2019

[Redacted]
[Redacted]
Florenceville, NB [Redacted]

To: [Redacted]

From: Neville Crabbe on behalf of the *Working Group on Smallmouth Bass Eradication in Miramichi Lake*

As a registered owner of property on Miramichi Lake, I am writing on behalf of a coalition of First Nations organizations and non-government organizations committed to eradicating smallmouth bass from the Miramichi watershed. The purpose of this letter is to introduce ourselves and initiate a conversation.

Collectively we are the Working Group on Smallmouth Bass Eradication in Miramichi Lake. Members include the Atlantic Salmon Federation, Maliseet Nation Conservation Council, Miramichi Salmon Association, Miramichi Watershed Management Committee, New Brunswick Salmon Council, New Brunswick Wildlife Federation, and North Shore Micmac District Council. The Working Group came together in the fall of 2016. In April 2019, the North Shore Micmac District Council submitted an application to eradicate smallmouth bass from Miramichi Lake which remains under review by Fisheries and Oceans Canada.

As you're aware, sometime prior to 2008 there was an illegal introduction of smallmouth bass in Miramichi Lake. Although our groups called for immediate eradication, Fisheries and Oceans Canada chose an expensive and prolonged program of removal and containment. Experts in aquatic invasive species said this would not work, and on August 22nd, 2019, a smallmouth bass was photographed in the Southwest Miramichi below the outflow of Miramichi Lake.

This resulted in coverage from local and national media, including mention of eradicating smallmouth bass from Miramichi Lake. It was always our intention to speak with camp owners about eradication before any public discussion. However, circumstances changed when bass were discovered in the river and media picked up the story.

Smallmouth bass are a voracious fish native to the Ohio River valley. As an invasive species, smallmouth consume and displace trout and salmon, contribute to a reduction in biodiversity, and fundamentally change the character of a watershed. Fisheries and Oceans Canada has concluded that smallmouth bass in the Miramichi River would lead to a reduction in the abundance of native species. As long as smallmouth bass remain in the lake they will continue to escape, fuelling a constant threat.

Neville A. Crabbe, on behalf of the Working Group on Smallmouth Bass Eradication in Miramichi Lake
Cell: (506) 467-6804 email: ncrabbe@asf.ca

Wild Atlantic salmon in particular have been a central to human life in the Miramichi River Valley for thousands of years. Today, salmon support Indigenous food fisheries and a recreational fishery.

However, a combination of factors has led to a significant decline in the number of returning adult Atlantic salmon since the 1990s. The establishment of smallmouth bass would be an additional threat, further hampering conservation and recovery efforts.

It is our intention to eradicate smallmouth bass from the entire Miramichi river system. The first step is to eradicate the only established population in the watershed, at Miramichi Lake. To help achieve that goal, in 2017 our groups shared the cost of hiring experts to assess eradication options, select the best one, and describe a treatment plan for Miramichi Lake.

We have nicknamed this the 'expert report' and will be pleased to share full details with you, but in short, the authors found the only practical way to eradicate bass without harming the environment, or putting humans or animals at risk, is by using rotenone, a naturally derived organic compound found in the roots of bean plants.

Rotenone has traditionally been used by Indigenous groups in South America and the Pacific to capture fish for consumption. It kills gill breathing organisms by inhibiting their ability to draw oxygen from the water. When used properly, it is not harmful to mammals, birds, amphibians, or humans. Rotenone breaks down quickly in the environment, and although recreational water uses can often resume immediately following a treatment, a 72-hour waiting period is recommended.

Because it is highly effective on target organisms, and safe for people, animals, and the environment, the use of rotenone is the most common method of controlling aquatic invasive species worldwide. Successful projects are carried out in Canada, the United States, and Europe each year.

Our plan also involves capturing a portion of native species from the lake and holding them in tanks on shore during the treatment. Once the water returns to safe levels, these fish would be placed back in the lake to re-establish the native fish community that existed prior to 2008. Experience from eradication efforts in other lakes has shown that ecosystem will bounce back quickly.

Over the coming weeks we will be in-touch to invite you to an in-person engagement session with experts on rotenone. Members of our Working Group will also be in attendance. This will be an opportunity to ask questions and have a discussion about the lake and safeguarding the Miramichi River for future generations.

In the meantime, we invite you to visit our website at <https://www.miramichismallmouth.com>. My contact information is below and I invite you to reach out and share your email and phone number for ease of future contact. Our promise is to be open, transparent, and honest as this process unfolds

Sincerely,



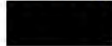
Neville A. Crabbe, on behalf of the Working Group on Smallmouth Bass Eradication in Miramichi Lake
Cell: (506) 467-6804 email: ncrabbe@asf.ca



December 27, 2019



Bristol, N.B.



Re: Woodstock Information Session

As promised in our October 31st letter, members of the Working Group on Smallmouth Bass Eradication in the Miramichi have worked diligently to arrange the details for a face to face meeting with yourselves, the camp owners of Miramichi Lake, early in the New Year.

Where: AYR Motor Centre, 105 Connell Park Road, Woodstock

When: Sunday, January 26th from 1:00 p.m. to 4:00 p.m.

At the meeting, representatives of the working group will speak briefly about the current status of the application to eradicate invasive smallmouth bass, including the roles and respective positions of the provincial government, federal government, and Indigenous communities.

We will then have presentations from **two visiting experts**, Brian Finlayson and Steve Maricle.

Finlayson spent his career with the California Department of Fish and Game and now works as a consultant on rotenone eradication projects around the world. He has authored a manual for the American Fisheries Society entitled *Planning and Executing Successful Rotenone and Antimycin Projects* which has become standard operating procedure. Finlayson visited Miramichi Lake in July 2017 and co-authored the original expert report on eradication commissioned by the Working Group. He is currently working on developing a plan to use rotenone in the stretch of the Southwest Miramichi River where smallmouth bass are present to submit to Fisheries and Oceans Canada in the near future.

Brian will present on rotenone, its properties and use in fisheries management, environmental, health, and safety considerations. He will also describe in detail the existing plan to eradicate bass from Miramichi Lake, Lake Brook, and the Southwest Miramichi River.

Steve Maricle is a fisheries biologist who spent his career with the Government of British Columbia's Department of Forest, Lands, and Natural Resources. He was the driving force behind a multi-year rotenone eradication campaign that successfully removed non-native smallmouth bass and yellow perch from 12 lakes in the Thompson River watershed.

Steve will make a presentation on the B.C. experience, including his extensive work with camp owners, farmers, First Nations, and stakeholders regarding rotenone eradication projects.

Following the presentations, the floor will be opened to questions. We will also be available for small group conversations and one on one discussions.

We are investigating the possibility of having video conference equipment in the room, so camp owners unable to attend may listen and participate remotely. If you have any specific questions you would like answered or information you would like presented, let me know in advance and we will accommodate.

Please RRSVP to ncrabbe@asf.ca. We hope to see you all in Woodstock. To learn more about our group and the use of rotenone in fisheries management, please visit www.miramichismallmouth.com.

On behalf of the Working Group on Smallmouth Bass Eradication in the Miramichi,



Neville Crabbe

ncrabbe@asf.ca

office: (506) 529-1033

cell: (506) 467-6804



January 10, 2020

To: [REDACTED]

From: Neville Crabbe

Re: Questions in your January 3 letter

Thank you for getting in touch with questions about the eradication of smallmouth bass from the Miramichi watershed. It's taken me longer than expected to focus on this reply, but I hope it helps you understand why we are proposing the use of rotenone in the Southwest Miramichi River and Miramichi Lake. This is something that no member of the Working Group on Smallmouth Bass Eradication in the Miramichi wishes to do, but we are compelled to act out of necessity, in order to safeguard the Miramichi River ecosystem for future generations.

If you have any follow-up questions, please feel free to contact me by phone or email.

Sincerely,

A handwritten signature in blue ink that reads "Neville Crabbe".

Neville Crabbe

1. Have smallmouth bass caused a decline in wild Atlantic salmon populations since 2008?

No. Prior to the summer of 2019, there had been no detected occurrence of smallmouth bass in the Miramichi River where wild Atlantic salmon are present. The impact to Atlantic salmon and indeed the broader native ecosystem in the entire Miramichi River watershed is precisely what we are trying to avoid by eradicating smallmouth bass before they spread further and become established.

The presence of smallmouth bass in Miramichi Lake, and the prospect of their escape into the river, has presented a serious threat to wild Atlantic salmon in the entire Miramichi River watershed for the past 12 years, since their discovery in the lake. This was recognized by First Nations and conservation groups and is reflected in reports from DFO at the time.

For example, [see Halfyard 2010](#), a DFO report that recommends the use of rotenone to eradicate bass before they escape the lake and become established in the river. Next to native species like Atlantic salmon and trout, invasive smallmouth bass will compete for habitat and food, and prey directly on other fish. If they become established in the river system, the Miramichi will experience irreversible changes, altering the ecosystem and rippling through the communities that count on Atlantic salmon for sustenance and income.

2. What are the three most important issues facing the survival of the Miramichi salmon population?

In no particular order, the three most important issues facing wild Atlantic salmon in the Miramichi are: habitat loss and degradation, predation, and marine survival.

Habitat loss and degradation: Analysis of satellite imagery has revealed that the Southwest Miramichi is one of the most heavily deforested areas in Canada ([see Linke 2017](#)). The loss of mature forests, especially by clear-cutting leads to erratic flows and warm water conditions. This physical degradation effectively reduces the amount of productive habitat available to fish in the river system.

ASF and other members of the Working Group on the Eradication of Smallmouth Bass from the Miramichi are advocating for forestry reforms and an increase in protected areas.

At the same time, working with the North Shore Micmac District Council, we are about to embark on a \$1,000,000 project to conduct cold water habitat enhancements at 11 sites throughout the Miramichi River system. The work began in 2019 and it will be a 4 year program.

Predation: Beginning around 2010, a dramatic rise in the striped bass population of the Miramichi has resulted in significant predation on Atlantic salmon. ASF and partners like the Miramichi Salmon Association and New Brunswick Salmon Council have worked diligently to document and quantify this phenomenon.

In 2018, ASF researchers, working with Fisheries and Oceans Canada [published a scientific paper based](#) on 14-years of juvenile salmon tracking that found only one in four smolt leaving the Northwest Miramichi River were making it through the estuary in recent years. This is a significant decline from a relatively consistent survival rate of 67-95% in all the years before striped bass exploded.

Guided by our science work, ASF and other conservation groups have advocated for DFO to achieve some level of ecosystem balance between striped bass and other native species, while maintaining a sustainable striped bass population. We also support Eel

Ground First Nation's new commercial striped bass fishery. Unlike smallmouth bass, striped bass are a native species in the Miramichi. We recognize their place in the ecosystem, but believe a directed harvest can be conducted sustainably to the benefit of other native species.

The establishment of smallmouth bass in the Miramichi would add to the threat of predation that is already affecting native fish species in the river.

Marine Survival: Atlantic salmon have an extraordinary life cycle. They migrate from the rivers where they are born all the way to the North Atlantic Ocean, some going to Greenland, and then all the way back to their natal rivers to spawn. In the early 1990s ocean survival rates for wild Atlantic salmon began to decline. Since then populations have suffered a prolonged period of high marine mortality. Leading up to this period it was not uncommon for seven to eight per cent of smolt to return after at least one year in the ocean and spawn as adults. In many North American rivers today that number has dropped to between one and three per cent or lower.

Although the exact reasons for the decrease are unknown, scientists hypothesize that oceanographic changes beginning in the last decade of the 20th century altered dynamics up the food chain. For example, favoured prey species declined in abundance or moved to different areas. Similar declines in survival were noted in other species like Atlantic cod, Bluefin tuna, seabirds, and marine mammals.

ASF's juvenile tracking program in the Gulf of St. Lawrence is providing insights, and along with a new collaborative project launched in 2018 to track adult salmon off the west coast of Greenland, our goal is to pinpoint areas of high mortality and assess whether increased protections or other measures could benefit marine survival rates of Atlantic salmon.

Given that marine survival affects wild Atlantic salmon populations everywhere, and the magnitude of the oceanographic changes behind this phenomenon, ensuring that freshwater environments are as healthy as possible helps mitigate declines. The more smolt that successfully survive their juvenile freshwater stage and head to sea, the more adults we can expect to return.

In addition to the research, ASF has negotiated a 12-year conservation agreement with the Greenlanders to limit their harvest of Atlantic salmon to subsistence only with a 20 ton quota (about 6,000 fish). This means that more adult salmon will return each year to spawn in rivers like the Miramichi.

- 3. Is there any possibility of constructing a permanent dam structure on the lake outlet to contain the bass population to the lake?**

Unfortunately, this is not a viable option because of the damage it would do to migratory native fish populations that use Miramichi Lake to spawn, not to mention having a negative impact on the overall natural ecosystem function of the lake. Thousands of gaspereau, also known as alewife, migrate from the sea into Miramichi Lake during the spring and early summer to spawn. In late summer the juvenile gaspereau migrate back downstream. Similarly, American eel migrate from the sea into Miramichi Lake, and so do Atlantic salmon. Other species like brook trout and white sucker also migrate into and out of the lake. A permanent barrier would block fish passage and have substantial ecosystem effects.

Additionally, a permanent barrier would still have continuous water flow over it because the lake is always draining water from the landscape (otherwise Lake Brook would have no water in it). This means that smallmouth bass would be able to simply swim over the spillway on the barrier anytime to escape the lake.

The treatment plan developed by the Working Group on Smallmouth Bass Eradication in the Miramichi considers the effects of rotenone on migratory fish species. Treating the lake in the fall would ensure that very few gaspereau are present.

4. How do you intend to eradicate smallmouth bass from the entire river system?

In the months following the discovery of a single smallmouth bass in the Southwest Miramichi last August, there were intensive “environmental DNA” surveys conducted to figure out the extent of bass spread in the river. Known as eDNA, this is a relatively new technology that can indicate the presence of species in a waterbody through the detection of DNA emanating from things like feces, mucus, and scale particles. Those surveys showed that the bass are limited to about a 10 km section of river between the mouth of Lake Brook to just below the mouth of McKiel Brook.

Knowing their limited distribution in the river, the Working Group contracted Brian Finlayson to develop a technical plan to use rotenone in that relatively short section of the Southwest Miramichi where smallmouth bass are present. The plan is currently being refined and will be presented to regulators by February 1st, 2020.

Rotenone is used in river systems and its downstream distribution can be controlled by deactivation with a water purifying agent called potassium permanganate.

We look forward to sharing more details about the river treatment plan once it is finalized. From a conservation perspective, smallmouth bass must be eradicated from the river and lake. It would be ineffective to treat one or the other because as long as they are present, the risk remains to the entire Miramichi watershed.

5. Has a smallmouth bass population existed in Miramichi Lake prior to 2008?

Smallmouth bass are not native to any parts of Canada, although they have been widely introduced outside their native range in the Ohio River Valley. There is no evidence from prior biological surveys that smallmouth bass were present in Miramichi Lake prior to their discovery in 2008.

In 1976 the N.B. Department of Natural Resources undertook a physical, chemical and biological survey of Miramichi Lake. Gill nets and minnow traps were used to collect over 100 individual fish from the lake and no smallmouth bass were present. Angler records also confirmed that smallmouth bass were never caught in the lake.

On 26 September 2008, a reliable source informed DNR fisheries staff that a smallmouth bass (~20 cm) was angled in the lake in August 2008.

On 29 September 2008, DNR fisheries staff caught 5 young-of-the-year smallmouth bass in Miramichi Lake. Subsequently, two bass, one male and one female, were gill netted in the lake on 3 October 2008. Since then, thousands of smallmouth, mostly young-of-the-year have been removed. Smallmouth of all age classes continue to be caught each year.

6. Where has rotenone been used successfully to eradicate aquatic invasive species in Canada previously?

Two recent examples of successful eradication are Despres Lake in New Brunswick and throughout the Thompson River Valley in B.C.

Case studies, along with other examples are presented at www.miramichismallmouth.com

Presentations to Cottage owners and
family members by Brian Finlayson and
Steve Maricle
January 26, 2020

Eradication of High-Risk Invasives in the Thompson Drainage



Ministry of Environment

Overview

1. Provincial Perspective on Invasive Fish Species
2. Thompson Region Challenges
 - Decision Making Factors
 - Process to successfully deal with Invasives
 - Challenges along the way
3. Outcomes

British Columbia Fisheries Management



British Columbia's Fisheries

Large Area: 944,700 Square Kms

Divided into 8 distinct Management Regions

Primary Fisheries target Salmonid stocks

Include 5 salmon species, 2 trout species and 3 char species

The Rocky Mountains separate BC from most species on the east side of the mountains

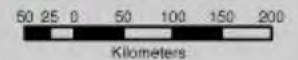
Many of these species pose serious threat to Salmonids

Recreational Fishing in BC generates over \$One Billion/Yr

Distribution of Invasive Fish

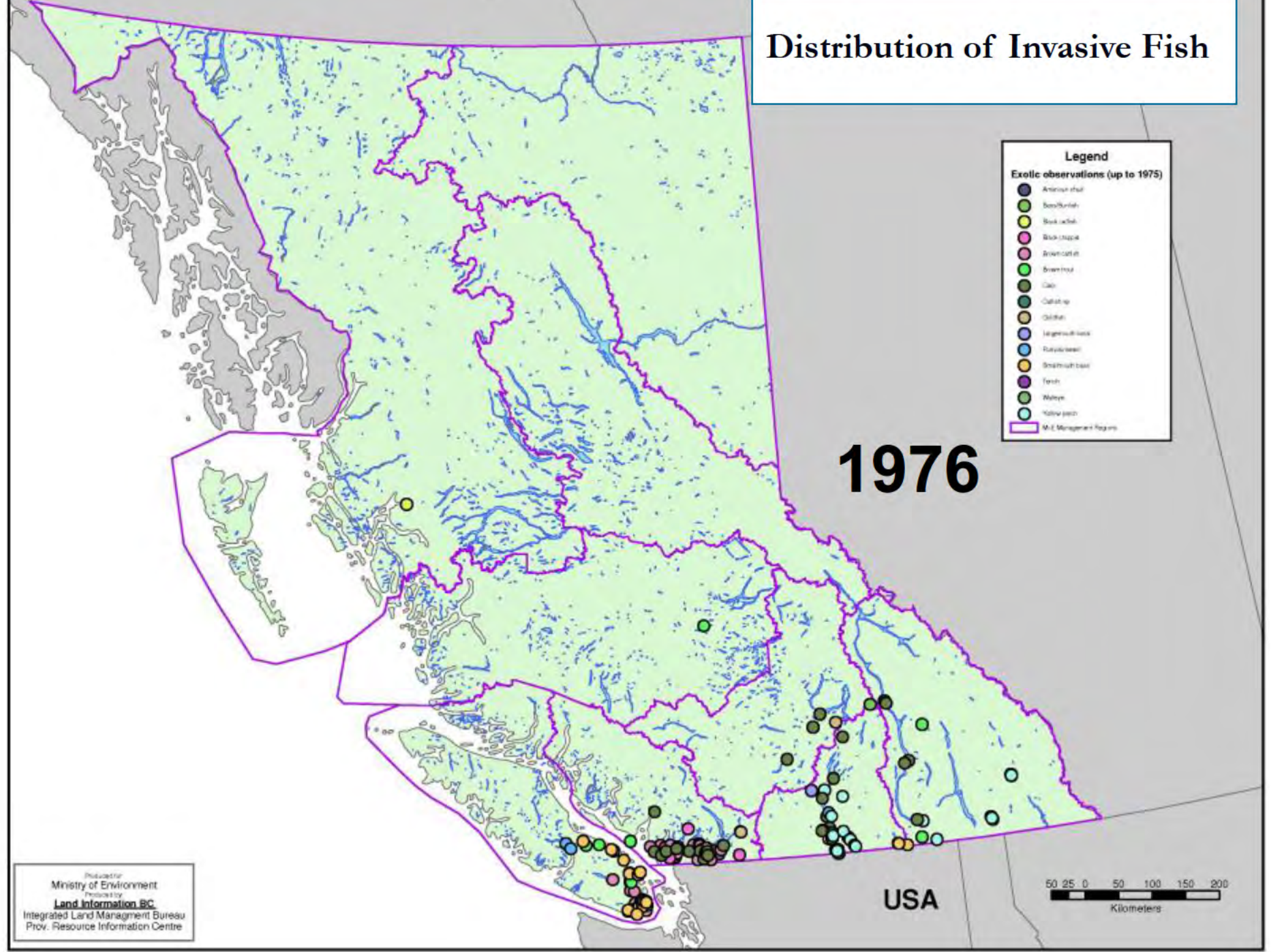
Invasive Fish Species Timeline

1950

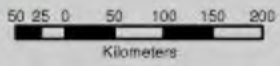


USA

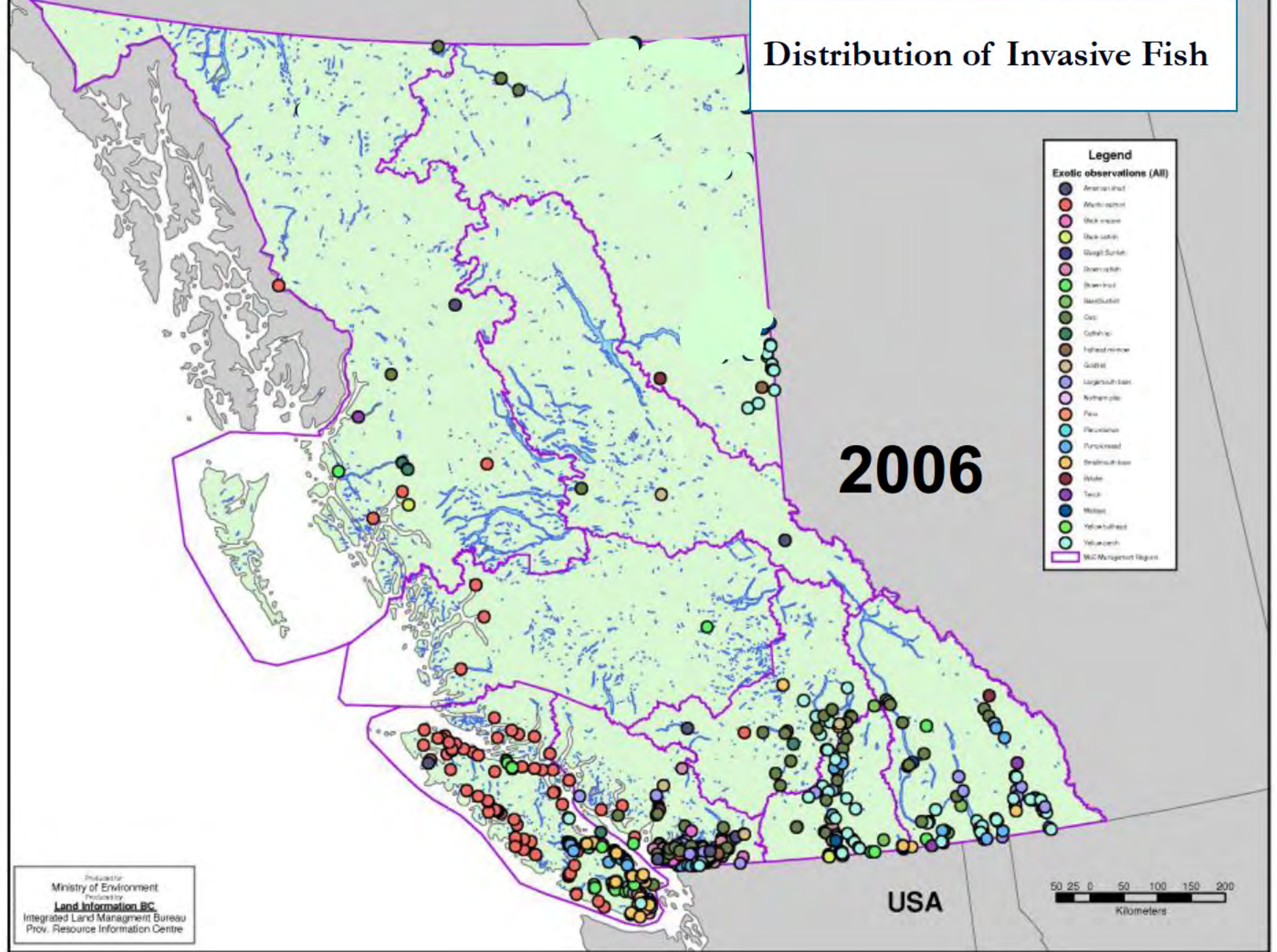
Distribution of Invasive Fish



USA



Distribution of Invasive Fish





“Invasive species have been identified as the second greatest threat to biodiversity worldwide after habitat loss.”

- International Union for Conservation of Nature-

Thompson Region Fisheries Management



Thompson River Watershed

56,000 Km² - $\frac{3}{4}$ the size of New Brunswick

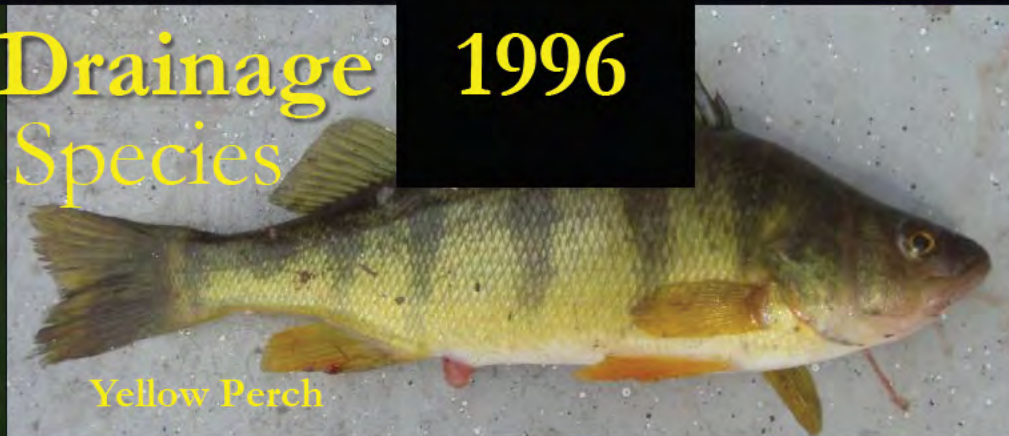
Supports many of the highest valued Salmon & Trout stocks in the Province

Recreational Fisheries Generates over \$150 Million in Revenue

Thompson Drainage 1996 Spiny-ray Species



Smallmouth Bass



Yellow Perch



Largemouth Bass



Pumpkinseed Sunfish

Small Lakes Plan Non-indigenous Species

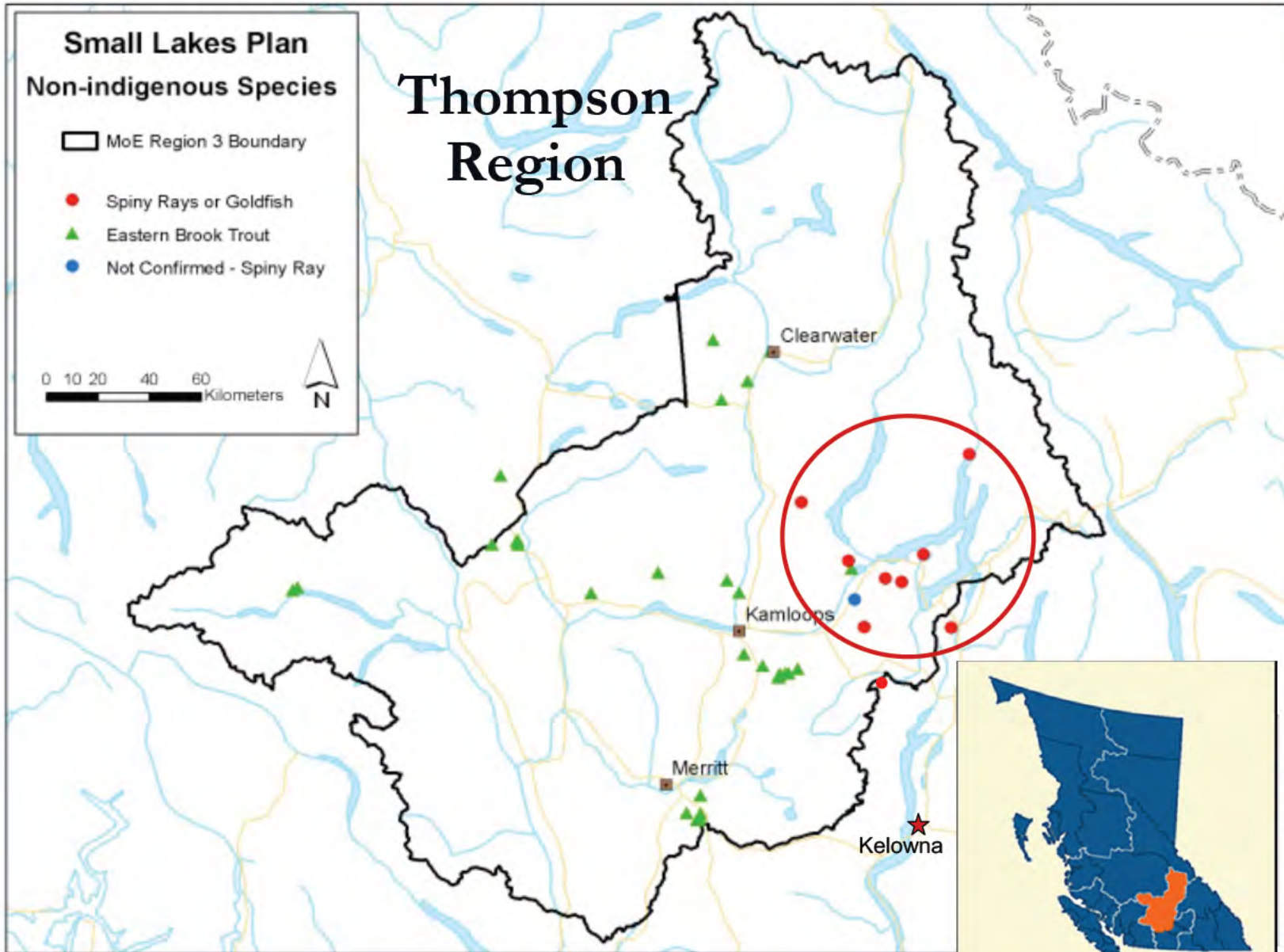
MoE Region 3 Boundary

- Spiny Rays or Goldfish
- Eastern Brook Trout
- Not Confirmed - Spiny Ray

0 10 20 40 60
Kilometers



Thompson Region



Risks and Concerns of Invasive Species

- Predation on native species
- Competition for food resources and key forage habitats
- Introduce disease



Impacts to Lakes from Spiny Ray Fish

- Very quickly the pre-existing trout were outcompeted and replaced by perch and bass.
- Impacts to ecosystem were evident with population levels of amphibians and invertebrates crashing.
- Major downstream threat to Thompson drainage which is home to the endangered Interior Fraser Coho, Thompson Steelhead and world famous Adams River Sockeye



Impact to Whole Ecosystem

Evidence



Gardom Lake - Impact of Invasives

Largest lake we treated - 35 Residents and one Camp

Residents formed "The Friends of Gardom Lake"

Document the Ecological Richness (ER) of the lake

Following bass introductions, ER declined by 60%

Included Insects, amphibians, mammals & birds

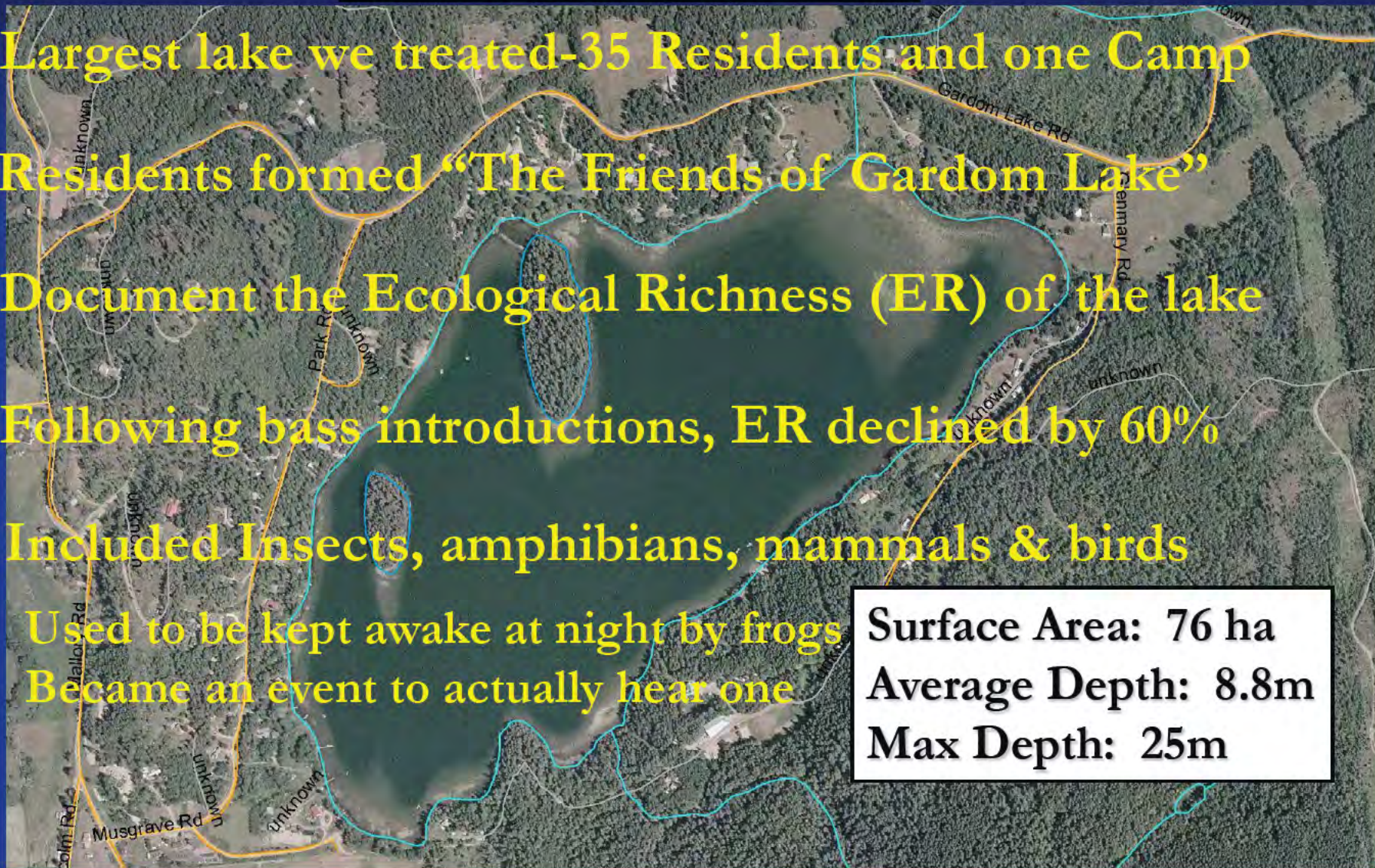
Used to be kept awake at night by frogs

Became an event to actually hear one

Surface Area: 76 ha

Average Depth: 8.8m

Max Depth: 25m



Summarizing The Problem

- British Columbia has had spiny-ray species for many decades but the Thompson remained the **last major southern drainage in the province** without established populations.
- The first cases of spiny-ray fish in the Thompson drainage were reported and confirmed in 1996.
- By 2005 there were 9 lakes with established populations. (yellow perch, small and largemouth bass, and sunfish)
- Five of the 9 lakes have direct connection to the Thompson Drainage.
- The situation had become critical if efforts were going to be made to stop the spread.

Time to draw a line

Couldn't put our head in the sand any longer.

Needed to develop a Plan

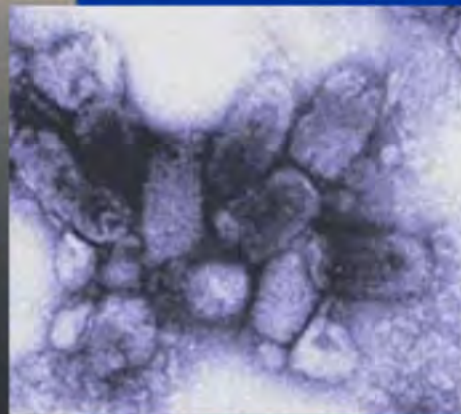


Do Nothing?



Options For Invasive Species Management

Physical



Biological

Chemical

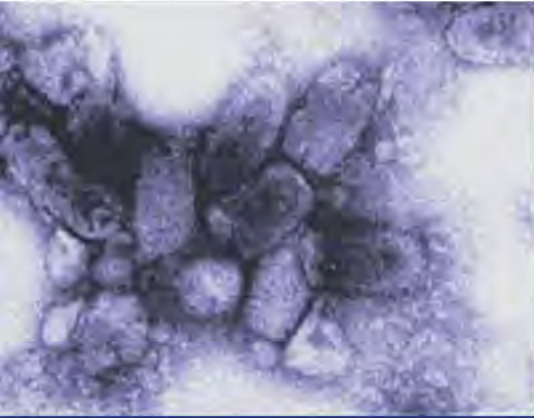




Control Measures

1. Physical

- Water level manipulation
 - Barriers
 - Netting and trapping
 - Electro-fishing
 - Concussion blasting
 - Increased fishing pressure – no bag limit
- None of these would eradicate
Invasive fish species



Control Measures

2. Biological

- Stocking:

- Introduction of predators
- Ineffective and would not Eradicate
- Blackwater Trout
 - Sterile Pike
- ### Invasive Fish Species

- Species specific pathogens

- None developed for our species



Control Measures

3. Chemical

- Only proven option for complete eradication of Spiny-ray species (other than de-watering)
- Piscicides are used extensively to rehabilitate lakes throughout North America

The Plan

■ Issues:

1) Deal with future illegal introductions

Public Education and Awareness

Incentives and Disincentives

2) Deal with existing populations

Full lake chemical treatments

Stop Further Movement!

- Reward up to **\$20,000**
- Public **E**ducation and Awareness
 - Public information meetings
 - Media & Signage
- Increase **E**nforcement presence
- Closed all 12 Lakes with Spiny-Ray Species
- **E**radicate

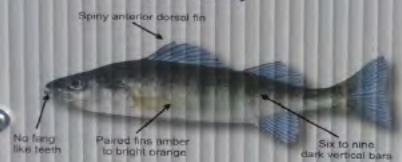
Invasive Species ALERT

REWARD up to \$20,000.00

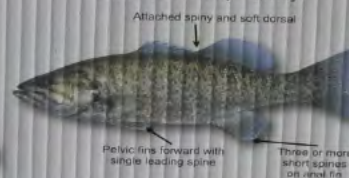
Sponsored by: Ministry of Environment, Fisheries and Oceans Canada, and The BC Wildlife Federation

Bass, Pumpkinseed Sunfish and Yellow Perch have been **ILLEGALLY STOCKED** into several small lakes in the Thompson Basin

Perch Family



Bass (Sunfish) Family



A reward of up to \$20,000 is available to anyone providing information leading to the successful prosecution of the individual(s) responsible for the illegal transport or stocking of invasive fish species in B.C. waters. Report any suspicious activity relating to the illegal transfer of live fish to the Conservation Officer Service (1-877-952-7277).

B.C.'s Interior freshwater fisheries are prized by fishermen from around the world.

- Invasive species jeopardize B.C.'s unique native fish stocks and ecosystems.
- These invasive species are voracious predators that both feed on native fish, and can out-compete native species for limited resources.
- Invasive species reproduce quickly, resulting in a population explosion that can quickly upset the delicate balance in an ecosystem.
- Introducing Bass, Pumpkinseed, Sunfish and Yellow Perch can cause irreversible damage that can endanger native fish stocks, possibly resulting in a collapse of our world famous sport fishery.

REPORT A POACHER, POLLUTER OR ANYONE TRANSPORTING LIVE FISH
CALL THE RAPP LINE: 1-877-952-7277
OR CRIME STOPPERS AT 1-800-222-8477



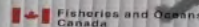
BRITISH COLUMBIA
CONSERVATION
FOUNDATION



BCWF
B.C. Wildlife Federation



BRITISH
COLUMBIA



Fisheries and Oceans
Canada

Engagement

Convincing the Public

- Hosted meetings with various groups including:
 - First Nations (F/N)
 - Local Residents
 - Fish and Game Clubs
 - Naturalist Clubs
 - Community Groups



Imperative that F/N and the Public Supported our efforts

Rotenone Treatment Priority Schedule

9+3 Lakes Treated (6 Connected)

- Skmana Lake - 2007
- Little Skmana Lake - 2007
- Forest Lake - 2008
- Nellies Lake - 2008
- Gardom Lake - 2009
- Phillips Lake - 2010
- Fleming Lake - 2010
- Skimikin Lake - 2010
- Miller Lake - 2010
- Larch Lake - 2013
- L. Larch Lake – 2013
- Windy Lake – 2017



Treatments

Huge Learning Curve



With little to no experience completing rotenone treatments we had to learn quickly.

We spent lots of time consulting with experts in the field.

- Months of on-site prep work was completed on each lake to ensure success of the treatments.
- Required an “Environmental Impact Assessment” on each lake



Environmental Impact Assessment



Surveys Completed

- Amphibians and Reptiles
- Red and Blue Listed Species
- Benthic Invertebrates
- Zooplankton
- Water Quality

Water Quality

■ Water Testing

- * Tested lake before treatment to establish background levels.
- * Monitor immediately after treatment.
- * Continue to monitor until levels return to background.

■ Public & Environmental safety was a priority and we worked in partnership with:

Interior Health

*Health Canada

*BC Health Authority

Lake Treatment Day

Application techniques



Boat Dispersal

■ Pontoon Boat

Pumps are used to mix rotenone into the water.
Used for 90% of the lake treatment.



■ Venturi System

Similar pumping system.
Best for shoreline treatment of the lake.



Backpack Sprayers

- Backpack sprayers are used to treat areas along the shoreline that are not accessible by boat.

- Marshy areas

Shallow ponds

- Vegetated shoreline



Aerial Application



Post Treatment Water Testing

- Testing continued following the treatment.
- Water chemistry levels were monitored until pre-treatment levels were achieved.



Environmental Impact Assessment Post-treatment Sampling



Assessment Results

- All species remained present
- Densities of these species was often higher after treatment
- A few species identified that were not id'ed on Pre-sample

Results Post-Treatment

Eliminated the threat of Spiny-ray establishment in the Thompson mainstem

Created some of the best lake fisheries in the Province



Final Important Points

A Biological Pollutant is Forever

**Don't let someone Decide your
Ecological Future**

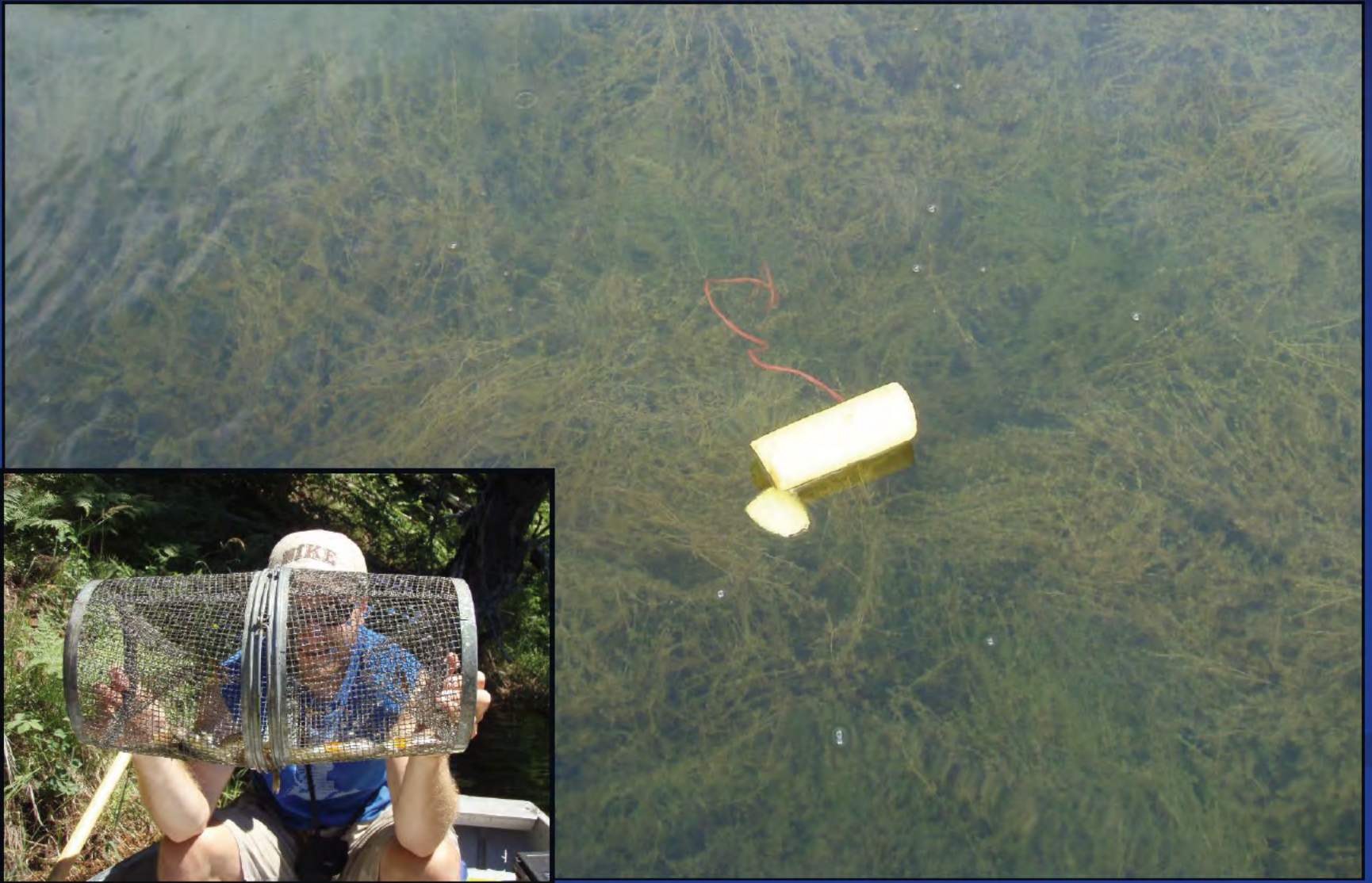


Ministry of
Forests, Lands and
Natural Resource Operations



The End

Sentinel Cages



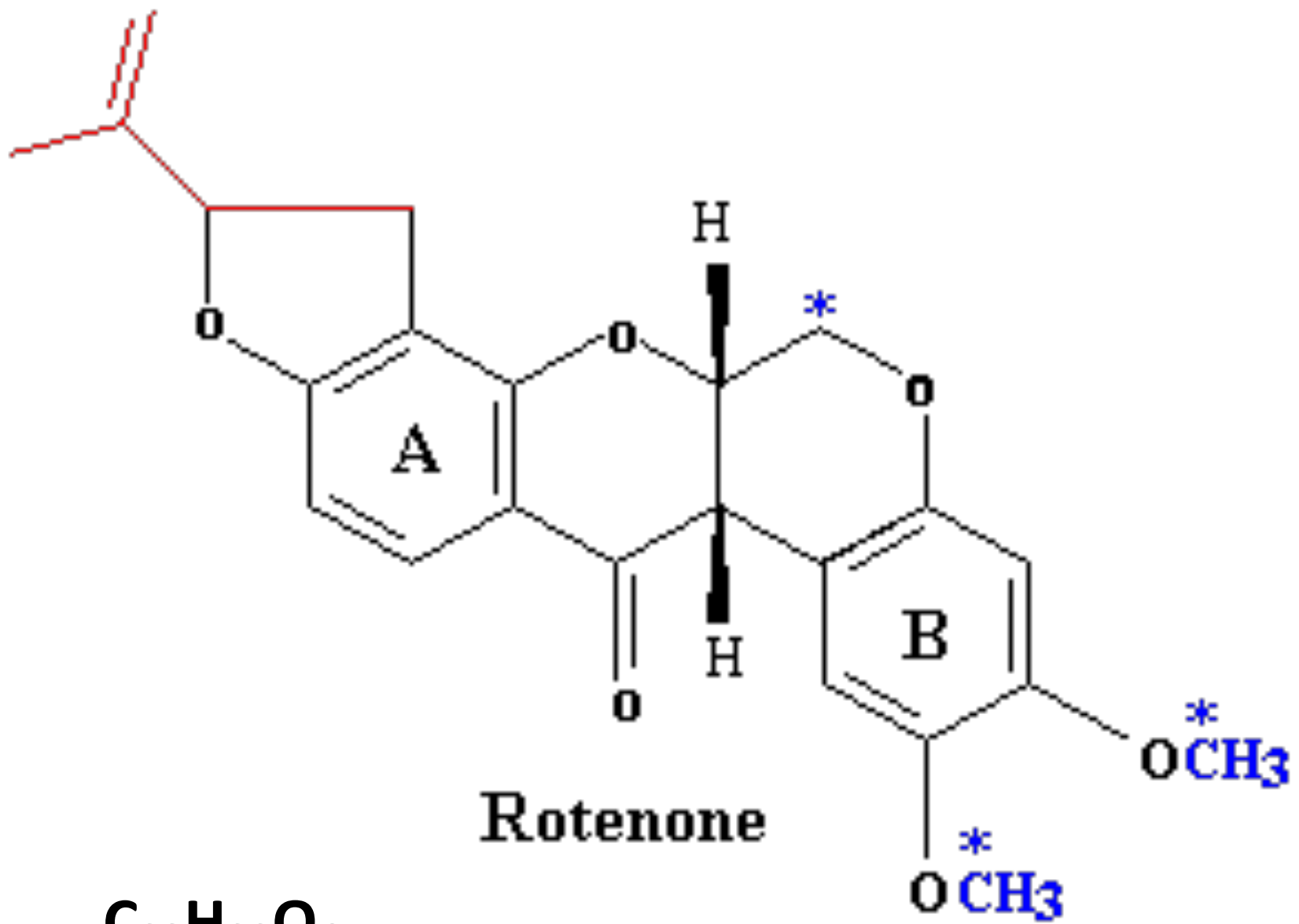
Rotenone

What's the Story?



- Is derived from plant roots
- Was discovered by indigenous South Americans and used for fishing
- Is completely biodegradable
- Used in organic industry
- Has over 60 years of major use in the U.S. and Canada





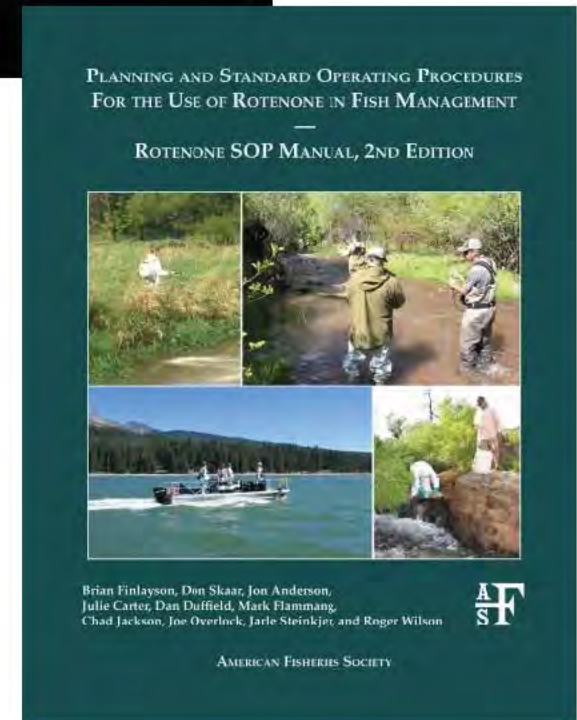
$C_{23}H_{22}O_6$

Miramichi LK & SW Miramichi RIV SMB Eradication

Proposed Rotenone Treatment
Environmental & Public Health

Brian Finlayson & Don Skaar
Fish Control Solutions, LLC

Why Rotenone? What Is Rotenone? Environmental & Public Health? How Is It Used Safely?



Rotenone Stewardship Program Website

URL: <https://units.fisheries.org/rotenone-stewardship>

Why Rotenone in Miramichi Lake & SW Miramichi River?

www.miramichismallmouth.com

Exploring Options for Eradication of Smallmouth Bass in Miramichi Lake

A report prepared for the Working Group on Smallmouth Bass Eradication in Miramichi Lake:

Atlantic Salmon Federation
Miramichi Salmon Association
Miramichi Watershed Management Committee
New Brunswick Salmon Council Inc.
New Brunswick Wildlife Federation Inc.
North Shore Micmac District Council Inc.

September 2017

Michael R. van den Heuvel

Christina Pator

Canadian Rivers Institute

University of Prince Edward Island



and

Brian Finlayson

Don Skaar

Fish Control Solutions



Why Rotenone?

Eradication Options Considered

Options	Comments
Physical Removal – nets & electrofishing	Limited success in achieving eradication; most promising in very simple environments. May lead to decreased intraspecific competition and accelerated maturation of SMB and thus, greater recruitment. SMB control in Miramichi Lake between 2010-2017 decreased SMB biomass, but several age classes of fish still present.
Biological Control – predator & pathogen	Rarely been used for eradication due to lack of potential, selective control agents. Predators will likely attack Atlantic Salmon too. Pathogens carry risks to other non-target species and other environmental concerns. Two SMB parasites (tapeworm and protozoan) are known but would need to be tested.
Genetic Manipulation – sterile or triploid individuals	Generally not 100% sterile. More sophisticated methods such as genetic control would take years and much study.
Dewatering	Likely impractical due to lack of water barrier to keep Miramichi Lake from backfilling, relatively level topography and ensuring no SMB are discharged downstream.
Explosives – detonating cord	Not effective in water depths > 3 m
Chemicals	Rotenone is the most prevalent chemical used for eradication. Exposure times and concentrations of rotenone necessary to kill fish are well known and technologies for treatment of lakes and streams are well developed.

What is Rotenone?

An Overview

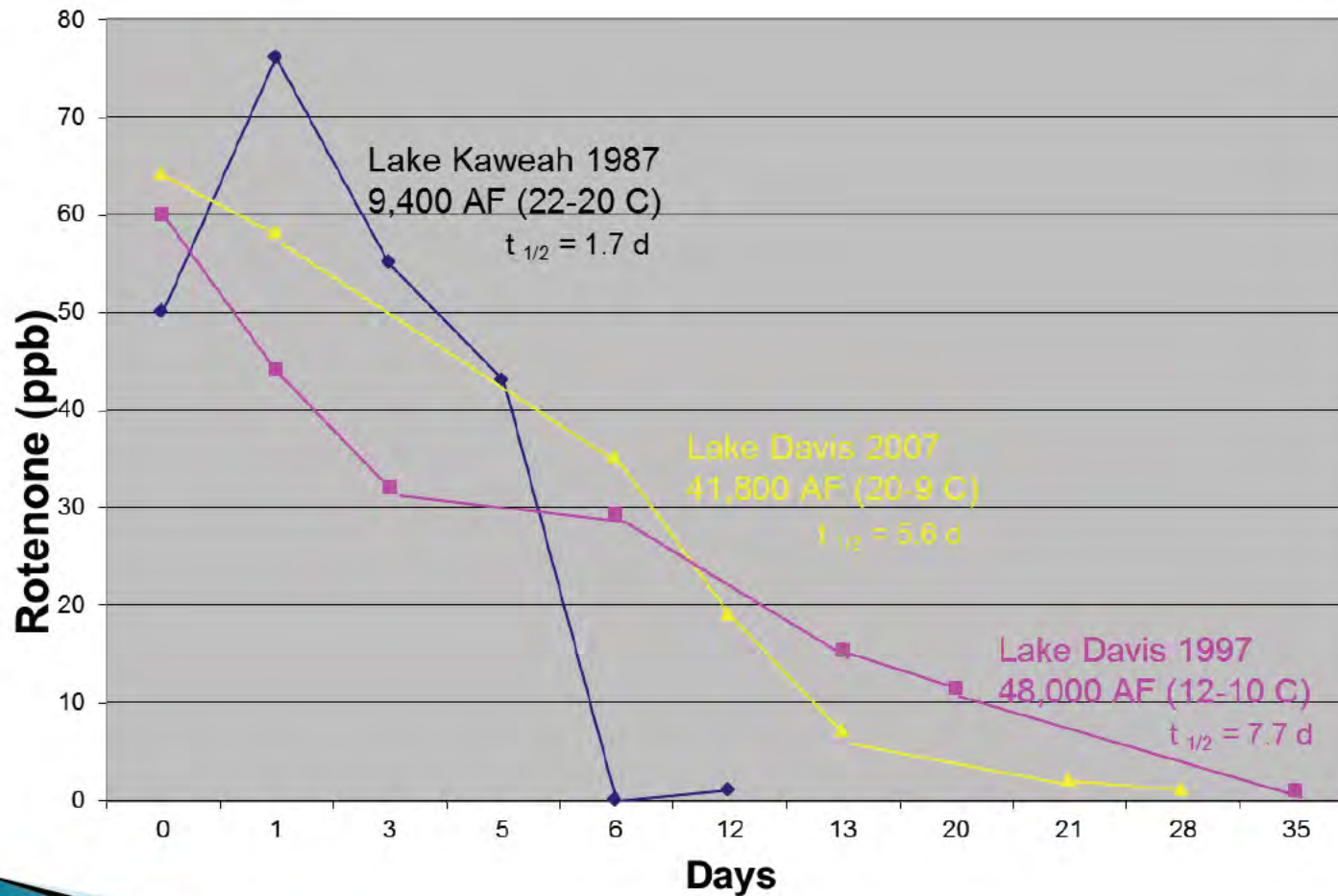
- ▶ Botanical – present in roots of bean family
- ▶ Centuries of use by indigenous peoples
 - Asia, Australia & Americas (Pacific Rim of Fire)
 - Collecting fish for food
- ▶ Insecticide on crops & livestock – certified organic
- ▶ Interferes w/ mitochondria respiration (phosphorylation inhibitor)
- ▶ Professional fisheries management use ~ 1930s
 - US States & Canadian Provinces (NB 1939)
 - Europe, South Africa, New Zealand & Australia
- ▶ Powdered & emulsifiable formulations
- ▶ Use Profile
 - 9,300 kg A.I./year
 - >97% standing water
 - AIS eradication & native fish restoration major uses
- ▶ Noxfish II registered by Canada PMRA (2018)
- ▶ 2nd Edition AFS Rotenone SOP Manual (2018)
- ▶ Registrants – Central Life Sciences & TIFA

Physical & Chemical Properties

Limit Mobility in Environment

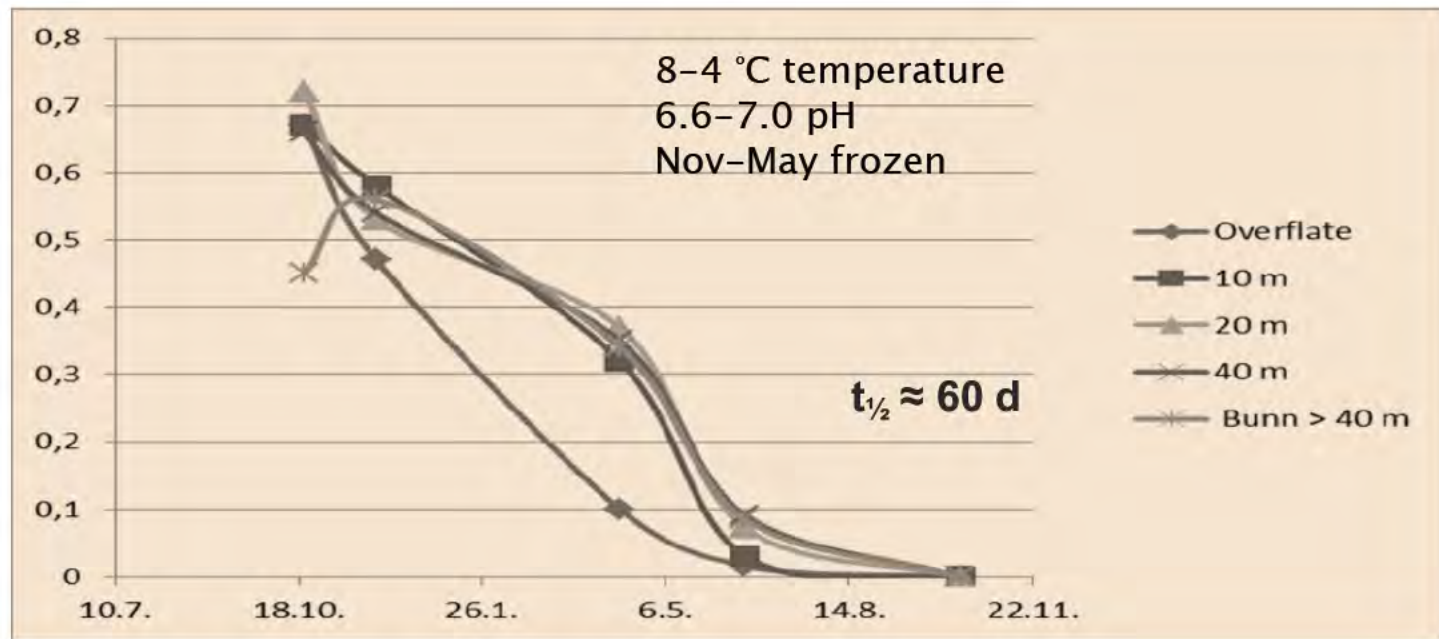
- ▶ Preferentially moves from water to fish due to limited solubility in H_2O & high solubility in organic materials
- ▶ Very susceptible to hydrolysis & photolysis that speeds breakdown in the environment
- ▶ Metabolized (broken down) by all organisms
- ▶ Does not volatilize & move off target due to a very low vapor pressure
- ▶ Does not bioconcentrate in the food chain due to rapid breakdown & metabolic pathways
- ▶ Binds to organics & clay in soil & sediment preventing it from being a groundwater contaminant

Persistence in California Lakes



Persistence in Lake Fustvatnet Norway

CFT Legumine (ppm)



2012-2013 (day.month)

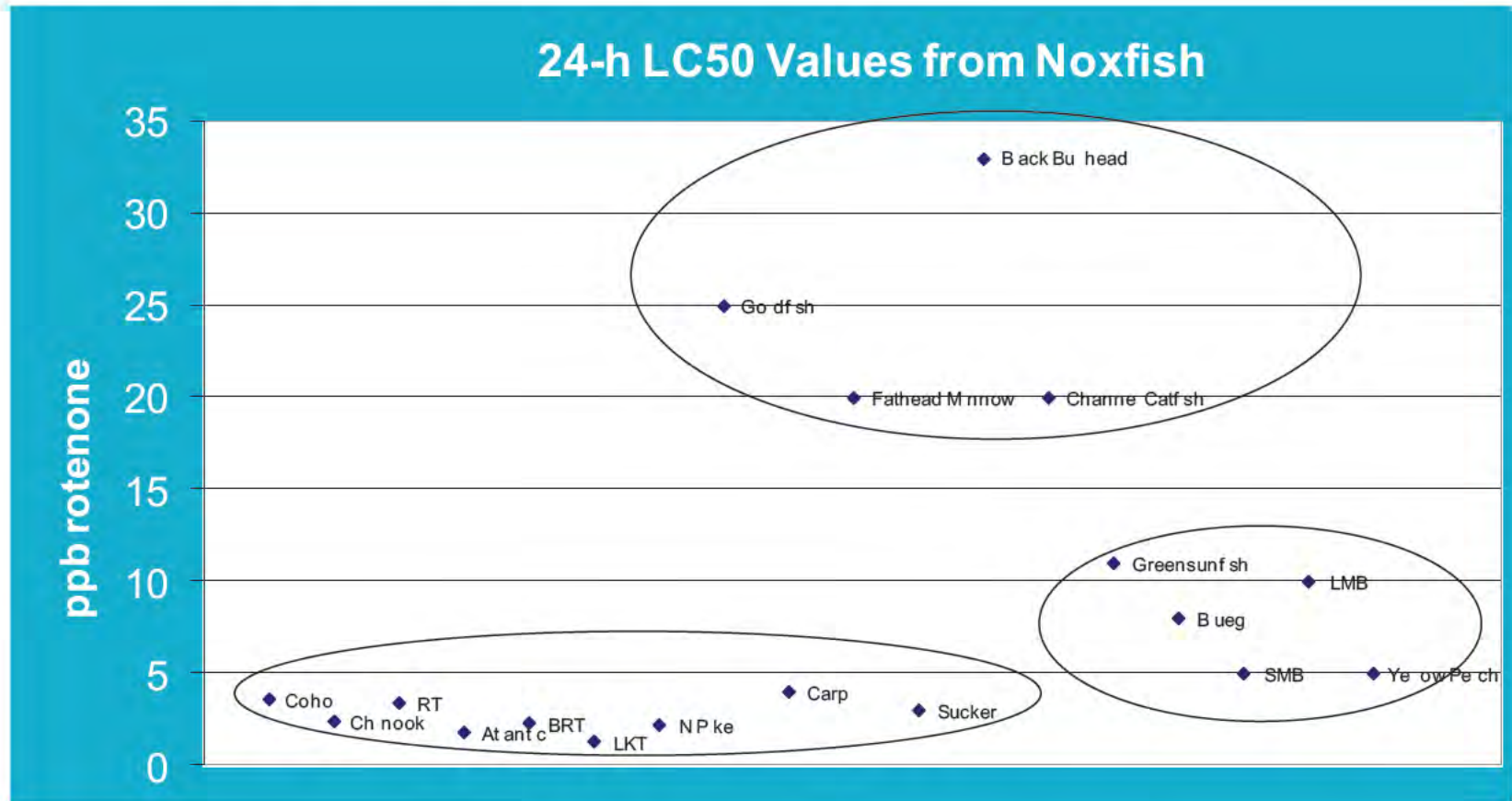
Summary

Environmental Persistence

- ▶ Dissipation by photolysis, hydrolysis & metabolic pathways
 - Temperate lakes $t_{1/2} = 0.6 - 7.7$ d
 - Increased pH, sunlight & temperature speed breakdown
- ▶ Persistence in Miramichi Lake
 - H₂O temperature of 18 °C expect $t_{1/2} = 2 - 3$ d
 - Degradation 75 ppb • < 2 ppb requires 6 $t_{1/2}$
 - Expect rotenone residues gone w/i 2-3 weeks
 - No groundwater contamination expected
- ▶ Short-term residues in dead fish
 - 0.2 to 1.0 ppm rotenone
 - Fish will be collected & disposed in landfill

Toxicity to Fish

Application rate 75 ppb



Toxicity (ppb) to Amphibians At Application rate 75 ppb

Species	Stage	Formulation	24-hr LC ₅₀	96-hr LC ₅₀
Spotted Frog	Adult	Prenfish	41,500	9,650
Leopard Frog	Adult	Noxfish	24,000	5,800
Tailed Frog	Tadpole	Prenfish	40	9
Leopard Frog	Tadpole	5% powdered	100	

Toxicity to Invertebrates At Application Rate 75 ppb

Species	Lifestage	Formulation	8-hr LC ₅₀	24-hr LC ₅₀	96-hr LC ₅₀
Cladoceran (<i>Daphnia</i>)	n/a	Noxfish		1.4	
Snail (<i>Helisome</i>)	n/a	Noxfish		1500	398
Freshwater Clam (<i>Corbicula</i>)	n/a	Noxfish			380
Stonefly (<i>Oroperla</i>)	Nymph	CFT Legumine	102		
Mayfly (<i>Rithrogena</i>)	Nymph	CFT Legumine	40		
Caddisfly (<i>Arctophysche</i>)	Larval	CFT Legumine	34		

Toxicity to Terrestrial Wildlife

Application Rate 75 ppb

- ▶ Low toxicity to birds
 - $LD_{50} = 1,680,000 \mu\text{g}/\text{kg}$ (ppb) pheasant
 - $LD_{50} = 2,200,000 \mu\text{g}/\text{kg}$ (ppb) mallard
- ▶ Low toxicity to mammals
 - $LD_{50} = 39,500 \mu\text{g}/\text{kg}$ (ppb) rat (F)
 - $LD_{50} = 102,000 \mu\text{g}/\text{kg}$ (ppb) rat (M)
- ▶ Low toxicity to bees ($LD_{50} > 60 \mu\text{g}/\text{bee}$)
- ▶ USEPA has no concern with terrestrial wildlife drinking or eating fish treated with rotenone

Summary Impacts to Fish & Wildlife

Application Rate 75 ppb

- ▶ SMB & salmonids eliminated
- ▶ Few BB & GS survive
- ▶ Variable impacts on invertebrates & amphibians
 - Depends on habitat, species & life-history stage
 - Little impact on mussels & crayfish
 - Minor impact on stream insects
 - Severe impact on lake zooplankton
 - Impacts are short-term (<1 to 3 years)
 - Eggs & recolonization (zooplankton, amphibians & insects) important
 - No long-term impacts expected at 75 ppb
- ▶ No impacts expected to birds & mammals

Safety of 75 ppb Rotenone

- ▶ USEPA recommends < 90 ppb prior to human contact (safe recreational H₂O level)
- ▶ USEPA recommends < 40 ppb prior to drinking (safe drinking H₂O level)
- ▶ Canadian PMRA Noxfish II label requires:
 - No contact w/ H₂O during 2-d application
 - No contact w/ H₂O for 3 days following application
 - Total 5-d restriction for Miramichi Lake
 - Expect 19–36 ppb @ 5 days, < USEPA safe levels

Parkinson's Disease (1)

- ▶ Description
 - Progressive, degenerative neurological disease
 - Loss of dopamine secreting brain cells
 - Symptoms – limb tremors, rigidity & slow movement
- ▶ Familial PD – young & genetic component
- ▶ Sporadic PD – elderly & age component
- ▶ Laboratory PD model
 - Developed to test effectiveness of drugs on symptoms
 - Emory University – 2000
 - Rotenone produces some PD symptoms
 - Requires extreme intravenous & direct brain exposures
 - These routes of exposure not germane to human exposure
 - Never intended as research on the cause/cure of PD

Parkinson's Disease (2)

- ▶ **Laboratory studies:**
 - Conflicting information
 - Exposure route not germane to human use
 - Ingestion, inhalation & dermal normal routes
 - Direct injection into body cavity avoids body's natural defenses
 - Penicillin injected into chicken embryos causes deformities
 - Salt injected into the brains of cats causes seizures
 - Many disorders have the same symptoms
 - Runny nose (cold, flu, allergy, eating & cold weather)
 - Sore back (disc, strained muscle, pinched nerve & bone cancer)
- ▶ **Rotenone exposure is controlled**
 - Applicator – PPE significantly reduces exposure
 - Public – restricted site access until deemed safe
 - Human–rotenone exposure effectively eliminated
- ▶ **EPA concludes no causal link between rotenone & PD**

Mammalian Toxicity – Noxfish II

Rotenone & Inert Ingredients

Chemical	(%)	Max H ₂ O (ppb)	Acute Toxicity (ppb)
Rotenone	5	75	> 39,000
Benzyl alcohol	20	300	10,000
Propylene glycol	10	150	20,000
Solvent naphtha	53	772	>6,000
Naphthalene	0.5	7.5	10,000

Application of Rotenone

How Is It Used Safely?

- ▶ Boats w/ pumps inject rotenone underwater in lakes
- ▶ Drip stations & peristaltic pumps emit rotenone into streams
- ▶ Rotenone is sprayed into hard to reach backwater & stagnant areas
- ▶ Safety:
 - Applicators wear PPE (gloves, respirators, boots, coveralls & safety glasses)
 - Public is excluded from project area for 3 days post application

Application to Streams – Drip Cans



Calibrating drip can, South Africa



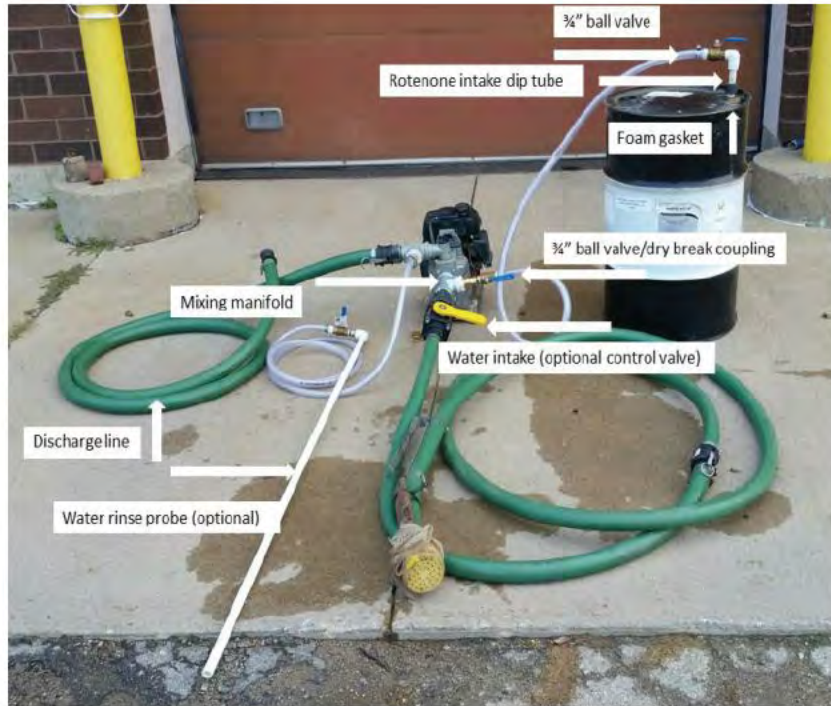
Drip can emitting rotenone, California

Application to Streams – Pumps



Peristaltic pump application, Norway

Application to Lakes



Semi-closed probe system, Iowa



2 systems on pontoon boat, Oregon

Spraying Backwater Areas



Pump spraying on airboat, Washington



Manual spraying, Iowa

Any Questions?



Miramichi LK & SW Miramichi RIV SMB Eradication

Proposed Rotenone Treatment Preliminary Treatment Plan

Brian Finlayson & Don Skaar
Fish Control Solutions, LLC

Considerations for Treatment in Early September

- ▶ SMB spawning & fry emergence completed
- ▶ Post-spawned gaspereau & most juveniles gone
- ▶ Minimum discharge in SW Miramichi RIV:
 - Minimize rotenone use
 - Minimize KMnO_4 use
- ▶ High H_2O temperature:
 - Optimum SMB response to rotenone in LK & RIV
 - Rapid dissipation of rotenone in LK
 - Optimum KMnO_4 deactivation in RIV

Comparison of Miramichi Lake to Successful Lotic Eradications

Parameter	Miramichi Lake – NB (SMB)	Gordom Lake – BC (SMB)	Phillips Lake – BC (SMB)	Diamond Lake – OR (TC)	Lake Davis – CA (NP)
Surface (ha)	225	76	52	1226	1188
Maximum depth (m)	7.3	25	10	14.8	30
Mean depth (m)	3.7			6.9	4.8
Volume (m ³ x 10 ⁶)	5.36			53.0	51.6
Temperature range (°C)	18-23			8-17	8-17
pH	7.3			9.7	7.5
Rotenone (ppb)	75	200	150	110	63
Rotenone DT _½ (d)	2.5 (est.)	≈2.0	≈2.3	4.5	5.6
Rotenone Longevity (d)	15 (est.)	≈14	≈14	39	34

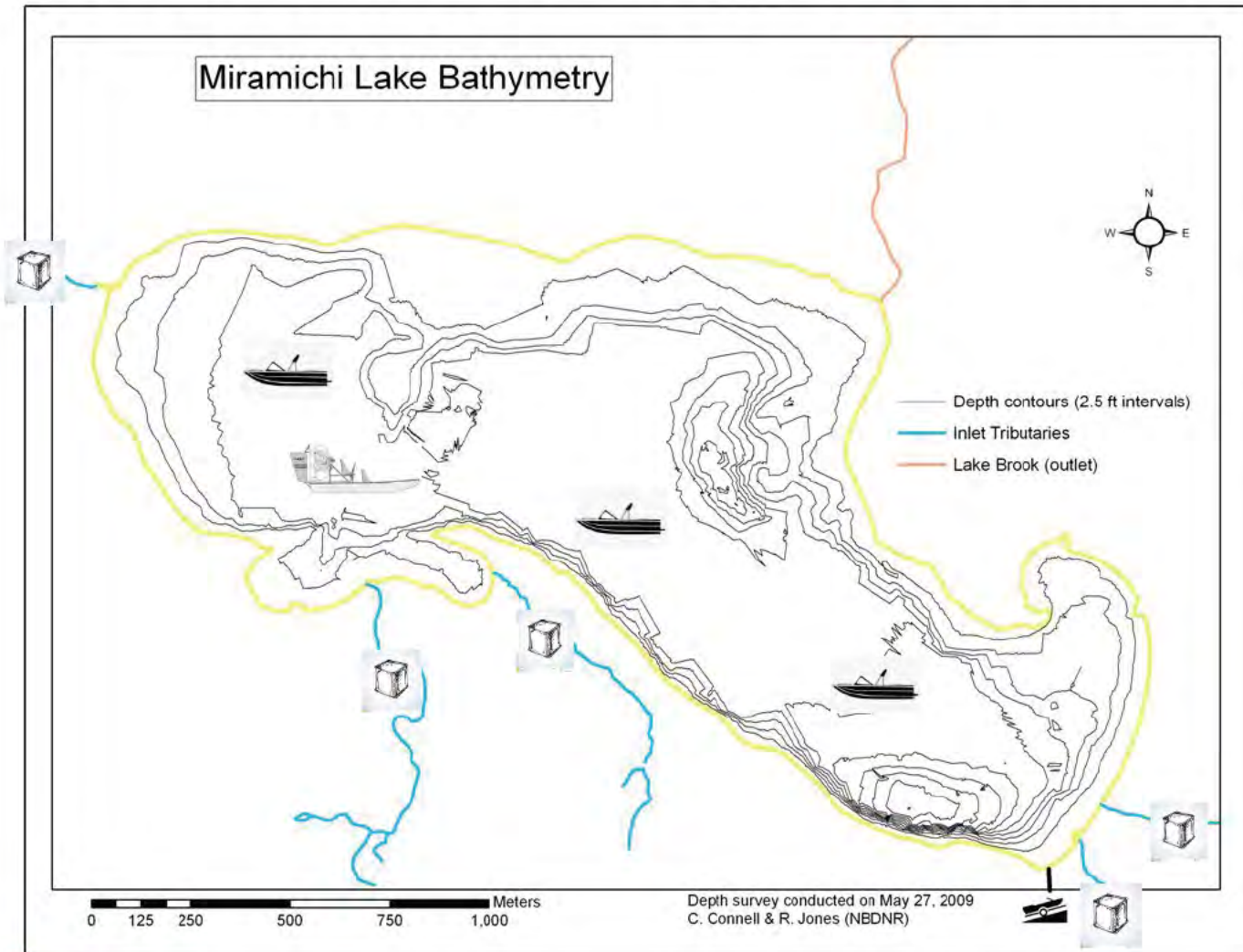
Estimated Treatment Parameters for Miramichi Lake

Parameter
Miramichi LK Surface Area	225 ha (558 acres)
Miramichi LK Volume	$5.36 \times 10^6 \text{ m}^3$ (4345 AF)
Miramichi LK Temperature	• 18–23 °C
Miramichi LK pH	> 7.0
SMB Spawning	• 15 °C (May)
SMB Egg Incubation	• 9 d
Treatment Date	Early September
SMB Rotenone LC ₅₀ Value	4.7 ppb
SMB Rotenone Lethal Level	• 9.3 ppb
Rotenone Treatment Level	75 ppb
LK Duration of Rotenone	6 x 2–3 d • 12–18 d


Verification of Miramichi Lake Information @ Treatment Date

- ▶ LK Volume & discharge to Lake Brook
- ▶ Travel time from barrier to SW Miramichi River
- ▶ Discharges of all inlets to LK
- ▶ SMB distribution in all tributaries
- ▶ SMB distribution in Lake Brook
- ▶ Reverification of rotenone toxicity tests:
 - Yellow Perch or Brook Trout
 - On site Miramichi Lake water
 - Noxfish II rotenone formulation

Miramichi Lake 2-Day Rotenone Application



Legend

-  Drip Stations
-  Boats
-  Airboat

Cost Estimate (CAD) for Treating Miramichi Lake

Parameter	Description
ROTENONE (preliminary estimate) 30-gallon Noxfish II Drums Including transportation to Miramichi Lk	75 @ \$2937 = \$220,275 total
EQUIPMENT - LAKE Semi-closed Application Systems Honda WX15 High Pressure Pump	3 @ \$914 each = \$2,742
EQUIPMENT - LAND Land Dripcans/Sprayer	5 @ \$326 each = \$1,630
EQUIPMENT - SAFETY Respirator, goggles, coveralls & gloves,	2 sets/application staff @ \$52/set 11 staff x 2 sets x \$52 = 1,144
OPERATIONS STAFF A. Boat Staff @ 2/boat & 3 boats = 68 staff 2 Application + 1 Travel Day	A. 6 staff x 8 h/d x 3 d = 144 h 144h x \$78/h = \$11,232
B. Land Staff @ 5 staff (dripcan/sprayer) 2 Application + 1 Travel Day	B. 5 staff x 8h/d x 3d = 120 h 120h x \$785/h = \$9,360
SUPPORT/LOGISTICS STAFF 2 Application + 1 Travel Day	2 staff x 8/h/d x 3d = 48 h 48h x \$78/h = \$3,744
SUPERVISOR/SAFETY STAFF 2 Application + 1 Travel Day	1 staff x 8/h/d/ x 3d = 24 h 24h x \$156/h = \$3,744
TRAVEL (lodging & per diem) Lodging @ \$91 d Per diem @ \$51/Travel Day	14 staff x 3 d x \$179/d = \$7,510
Monitoring Rotenone Residues	20 samples @ \$261 sample = \$5,221

Rotenone 220,275
Equipment 5,516
Staff & expenses 35,559
Rotenone monitoring 5,221

\$266,602

Comparison of SW Miramichi RIV to Successful Lentic Eradications

Parameter	Silver King Creek – CA (RT)	SW Miramichi River – NB (SMB)	Skibotn River – NO (AS)
Discharge (m ³ /s)	0.42	5.3 (1.9–9.2)*	19.8
Stream Length (km)	19	10	24
Temperature (°C)	15	18	<7
Rotenone (ppb)	50	75	40
Stream Width (m)	6	≈30	≈30
KMnO ₄ Deactivation	Yes	Yes	No

*Prorated average (min-max) discharge using stream gauge data from Nashwaak RIV & Miramichi RIV @ Blackville; storm flows & flows over 10.0 m³/s deleted.

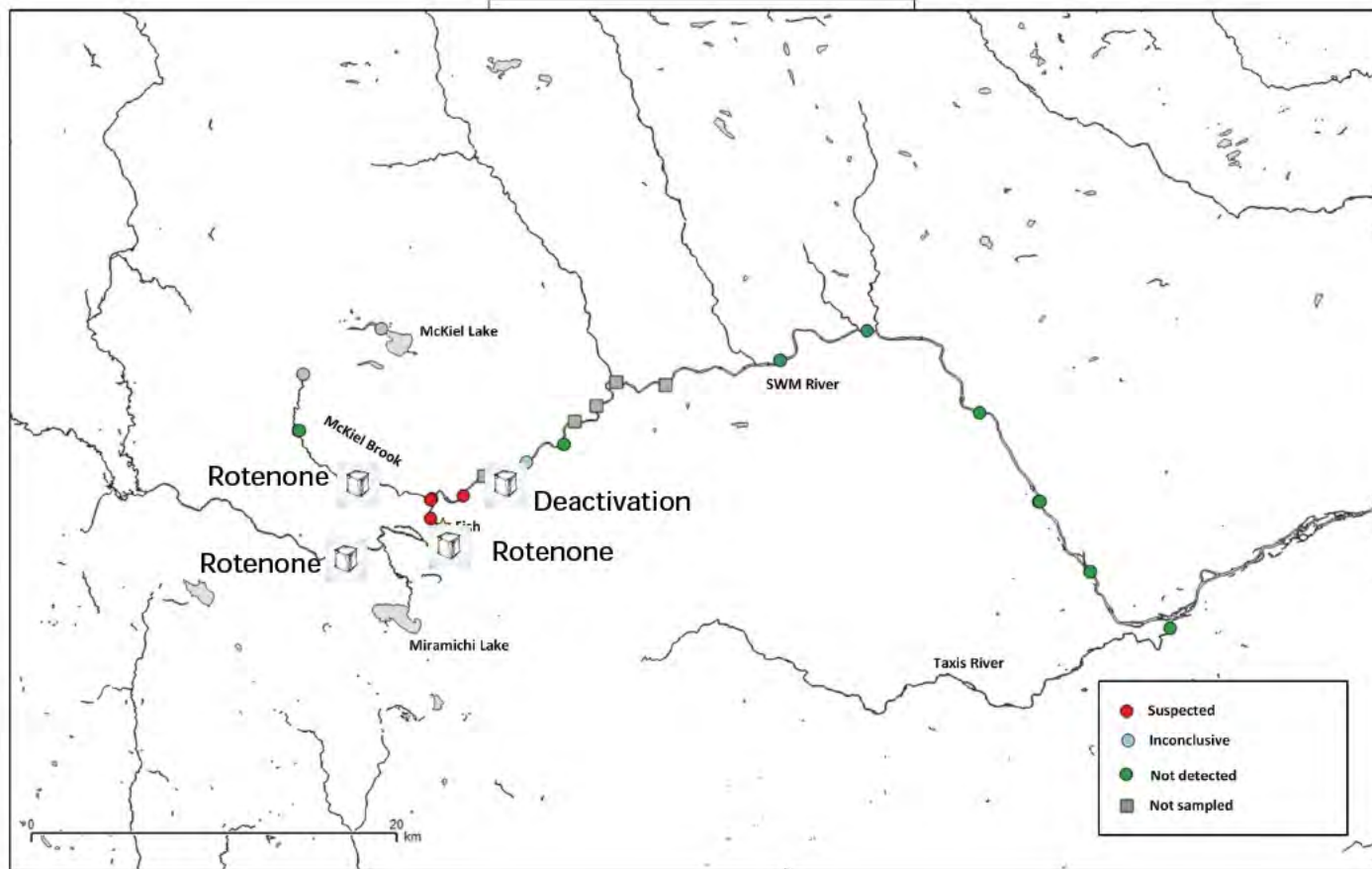
Estimated Treatment Parameters for SW Miramichi River

Parameter
Miramichi RIV Discharge	5.3 (1.9–9.2) m ³ /s
Miramichi RIV from Lake to McKiel Brooks	10 km
Miramichi RIV Temperature	• 18–23 °C
Miramichi RIV pH	> 7.0
Application Sites	3-6
KMnO ₄ Deactivation	d/s McKiel Brook
Treatment Date	Early September
SMB Rotenone LC ₅₀ Value	4.7 ppb
SMB Rotenone Lethal Level	• 9.3 ppb
Rotenone Treatment Level	75 ppb
Rotenone Treatment Duration	6-h

Verification of SW Miramichi RIV from Lake to McKiel Brooks

- ▶ Discharge & travel time
- ▶ Open canopy, stream width, depth & slope
- ▶ IDs of all inlets & discharges to RIV
 - Bifurcations & connected wetlands
 - Connected seeps, springs & tributaries
- ▶ SMB distribution within the treatment area using electrofishing & eDNA
- ▶ Water quality (pH, organics, turbidity & conductivity)

SW Miramichi RIV Treatment Stretch



Cost Estimate (CAD) for Treating SW Miramichi River

Parameter	Description
SW Miramichi Discharge m ³ /s	5.3 m ³ /s d/s McKiel Brook
Rotenone (preliminary estimate) 30-gallon Noxfish II Including transportation to Miramichi Lk	45.4 gallons/dripstation 136-272 gallons total for 3-6 stations 4.5-9 30-gallon drums \$13,216-26,433
KMnO ₄ 4 ppm for 24 h = 1.27 kg/min	1,832 kg for 24 h @ \$17.23 \$31,565
Equipment	
Peristaltic pump system & generator (1 per site)	\$2,481/unit
Dripcan system (3 per site)	\$310/unit
Sprayers	\$100/unit
Auger & generator	\$4,309/unit
Hach DPD test kit	\$776
Operations Staff	
TRAVEL (lodging & per diem)	
Lodging @ \$91/d	
Per diem @ \$51/Travel Day	

CAD
 Rotenone \$ 13-26 K
 KMnO₄ 31,565
 Equipment ?
 Staff & expenses ?
Total • \$100,000

Overview of Rotenone Treatment

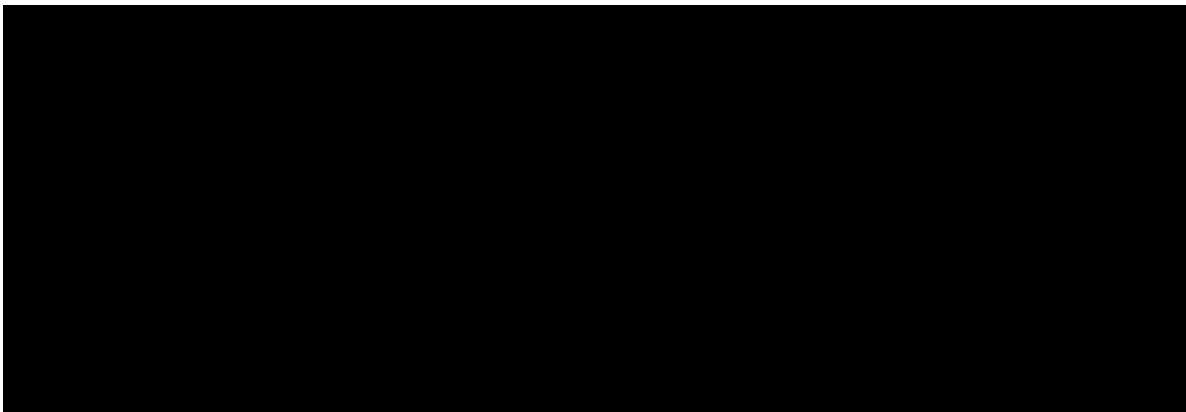
- ▶ **Day 1**
 - Set-up staging area on Miramichi Lake
 - Inventory rotenone, KMnO_4 , boats, drip stations, augers, safety equipment
- ▶ **Day 2**
 - Safety training
 - Staff locate treatment markers and set-up & test equipment
- ▶ **Day 3**
 - Begin treatment of tributaries & Miramichi Lake
 - Begin treatment of SW Miramichi River & possibly Lake & McKiel Brooks
 - Begin deactivation of SW Miramichi River d/s McKiel Brook
 - Debriefing on treatment
- ▶ **Day 4**
 - Continue treatment of tributaries and Miramich Lake
 - Continue deactivation until caged fish survive in SW Miramichi River
 - Debriefing on treatment
- ▶ **Day 5**
 - Disassemble staging area & load-up equipment

FROM: [REDACTED]
SENT: Friday, January 31, 2020 9:19 AM
TO: 'Neville Crabbe' <ncrabbe@asf.ca>
SUBJECT: Question from [REDACTED]
IMPORTANCE: High

Hi Neville:

I have a question:

Do you have the yearly breakdown on the bass caught in Miramichi Lake since 2008?
Also, do you have the number caught by Electrofishing? Yearly amounts
Please forward the info to me if you do and thank you



FROM: [REDACTED]
SENT: Wednesday, February 5, 2020 at 8:13 AM
TO: Neville Crabbe <ncrabbe@asf.ca>
SUBJECT: Question from [REDACTED] - forwarded again with another question

Hi Neville

Please see below, I have not rec'd an answer

Also

I need the number of bass caught at the barrier – do you have this information?

Regards,
[REDACTED]

Hi [REDACTED]

Thanks for the reminder. I'll share the information I have. I've reached out to DFO to DFO to fill in the blanks and will share when I have it. Most of what I'm stating below comes from <https://wavesvagues.dfo-mpo.gc.ca/Library/360082.pdf>. It's important to consider that although the removal efforts knocked back the bass, even after the most intense three year period (2010-2012), in 2013 smallmouth of all age classes were found in the lake. Although the report above mentions that bass were caught in close proximity to the barrier, I wasn't able to tease out a specific answer to your question.

2009: After the presence of smallmouth bass was reported to DNR in the fall of 2008, the following spring/summer volunteers and government staff used backpack electrofishers, nets, and traps and removed 90 smallmouth bass

2010: DFO, the Miramichi Watershed Management Committee, Miramichi Salmon Association, and DNR kicked off a three year campaign to eradicate the bass through physical capture and removal. 2,584 bass were removed, including four young of the year and one juvenile from Lake Brook.

2011: The physical eradication campaign continued, 523 bass were removed from the lake, including one young of the year from Lake Brook.

2012: In the final year of the three-year campaign, 46 bass were removed with none being found in Lake Brook.

2013:

2014:

2015: 183 smallmouth were removed from the lake (via: <https://www.dfo-mpo.gc.ca/aeve/evaluations/16-17/6B139-eng.html>)

2016:

2017: While visiting the lake, DFO contractors showed ASF staff a baggie full of young of the year bass and said the 6,000th bass removed since 2008 was among the collection.

2018:

2019: Smallmouth bass were found in the Southwest Miramichi for the first time. 36 bass were removed from the river and Lake Brook. None were young of the year.

Let me know if you have any questions,
Neville

FROM: [REDACTED]
SENT: Friday, February 7, 2020 at 10:58 AM
TO: Neville Crabbe <ncrabbe@asf.ca>
SUBJECT: [REDACTED] – questions

Hi Neville

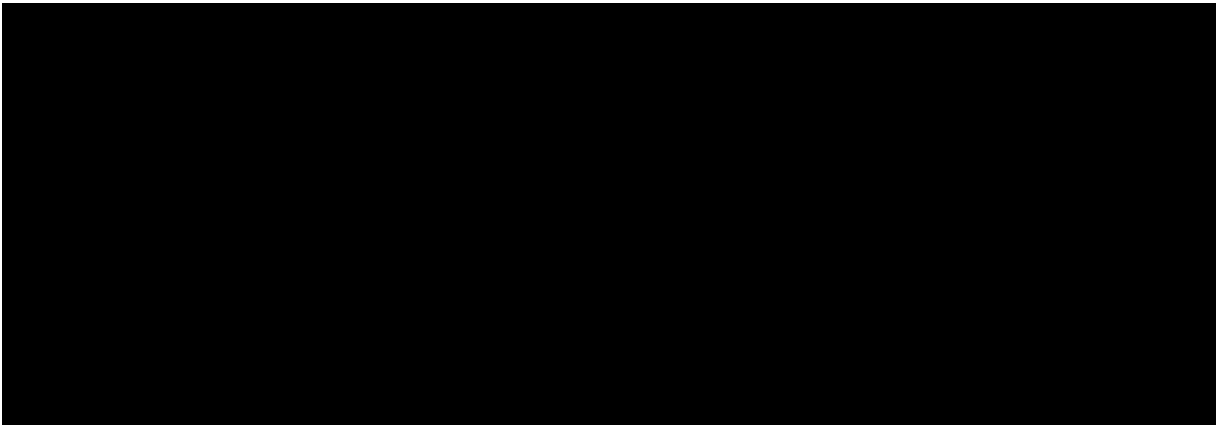
Thank you for the information. I would have thought this being such a serious issue, the committee would have had these numbers readily available.

The years 2010, 2011, 2012 were very effective at eradicating the bass – 2584 to 46!! Why was the campaign stopped?

The information for the years 2013, 2014 will be of interest to find if the number of bass captured has increased or decreased.

Has there ever been an monitoring of the Southwest Miramichi for small mouth bass?

Awaiting your reply and thanks again.



Hi [REDACTED]

DFO got back to me with information that fills in the gaps up to and including 2017. This information comes from the report available at: <https://waves-vagues.dfo-mpo.gc.ca/Library/40736118.pdf>. To make it easy, I've pulled out and compiled the information below. The numbers you see refer to total smallmouth bass, including young-of-the-year, juveniles, and adults.

To your question 'Why was the campaign stopped?', it was not and continues to this day. We do know that the electrofishing boat was pulled prior to the 2017 season, but DFO informs us this was because it was resulting in the capture of very few bass compared to the effort. All other methods of removal continued.

To your question of whether the SW Miramichi has been monitored for smallmouth, according to the original report I shared with you (<https://waves-vagues.dfo-mpo.gc.ca/Library/360082.pdf>), surveys of the river following the discovery of bass in Miramichi Lake found none. I am aware of subsequent efforts that occurred sporadically and at different places in the watershed. No smallmouth bass were found until the summer of 2019.

Here are the numbers of smallmouth bass captured up to and including 2017 from the latest report that DFO has shared with me:

2009: 64
2010: 2,584
2011: 523
2012: 46
2013: 515
2014: 565
2015: 184
2016: 1388
2017: 1549
Total: 7,418

Please let me know if you have any follow-up questions. I have asked DFO for the 2018 and 2019 numbers, but they won't release them until they're finalized and reviewed. I will keep on them and share the results with you when they're available.

Sincerely,
Neville

Meeting Notes
461 St. Mary's Street, Fredericton
Thursday, March 5th, 2020 at 3:00 p.m.

Parties: Working Group on Smallmouth Bass Eradication in the Miramichi and the committee representing camp owners of Miramichi Lake.

Present: Andrew Harvey (MLA Carleton-Victoria), Peter Cronin (N.B. Salmon Council), Mark Hambrook (Miramichi Salmon Association), [REDACTED] (camp owner), [REDACTED] (camp owner), [REDACTED] (camp owner), [REDACTED] (camp owner), Jim Ward (North Shore Micmac District Council), Nathan Wilbur (ASF), Kevin Case (NBNRED) Kristian Moore (NBNRED), Neville Crabbe (ASF)

Purpose of meeting: The North Shore Micmac District Council has applied to DFO for permits to eradicate smallmouth bass from Miramichi Lake and, supported by partners on the Working Group, is amending the application to include the use of rotenone in a section of the Southwest Miramichi where smallmouth bass are present. In anticipation of the amended application, and in light of concern from camp owners, Working Group members and camp owner representatives agreed to meet.

Agenda:

1. Introductions
2. Update on activity since Jan. 26th
3. Review of aspects of eradication for camp owner input
 - a. Lake mitigation
 - b. Lake Monitoring
 - c. Lake restoration
4. Additional concerns and discussion
5. Plan for submission of amended application

Minutes:

Neville thanks people for attending and people introduce themselves around the room. Neville indicates that the working group has been gathering information to support the submission of an amended application and is looking forward to getting camp owner input on aspects of the application.

Nathan updates everyone on activities since Jan. 26 meeting with all camp owners in Woodstock. This includes meeting with DFO, DNRED, DELG, DFO staff, Eel Ground First Nation community meeting, and meeting with provincial ministers and staff.

██████ indicates that camp owners do not wish to discuss specific aspects of the application. He indicates, and others echo, that they remain opposed to eradication and wish to focus on Agenda item 5.

██████████████████ indicate that their concerns extend beyond Miramichi Lake to the river. ████████ asks if the amended application will include a plan to eradicate smallmouth bass from the Southwest Miramichi. Nathan W. explains that the amended application will include a detailed plan for lake treatment, and as much details as possible for the river, with a clear plan to fill knowledge gaps through fieldwork once conditions allow.

MLA Andrew Harvey arrives. Several camp owners state that the application to treat the river must be approved before the lake should be considered for eradication. Peter Cronin explains that ideally both would be treated simultaneously, but the lake could be a first step.

██████ asks what the outcome of eDNA samples were last summer and Nathan W. explains that positive signals stopped downstream of McKiel Brook and sampling continued all the way down to Boiestown. He explained that the fish appear to have aggregated in the preferable smallmouth bass habitat that exists between the mouth of Lake Brook and McKiel Brook. John H. asks if gathering eDNA samples at 2 km intervals is appropriate. Nathan explains the eDNA program was led by specially trained scientists within DFO. They determined that 2 km is an appropriate detection interval.

Neville C. brings up the need to discuss aspects of the lake treatment plan for the application, stating it is difficult to get everyone together and this is an opportunity to give and receive input. ████████ says it is not worth discussing aspects of the lake and they are not interested in supplying information for the application. ████████ following discussion of points from DFO's CSAS on the original application, says there's a lack of due diligence, cites fluctuating lake volumes. Nathan W. explains there were two published sources and the right information is now in place.

Jim W. explains that First Nations will not stand by as smallmouth bass spread throughout the river, threatening the native ecosystem, Mi'kmaq culture and fisheries. He states there is an urgent need for eradication using rotenone products. He suggested the possibility of volunteers from Mi'kmaq and Maliseet communities attempting to physically remove the bass through nets, traps, and angling should the rotenone avenue not be pursued.

██████ states that the river is a dynamic environment and assuring success would be difficult. Raises notion that eradication is not possible. Peter C. mentions Norway and U.S., where dozens of rivers have been treated with rotenone products successfully. Neville C. says DFO is asking similar questions in order to ensure a detailed plan with high likelihood of success.

Nathan W. asks if the camp owners have any specific human health concerns to discuss. ████████ says concerns persist about the chemical formulation of the rotenone product, Noxfish Fish Toxicant II. Nathan cites the fact that it is approved for use by PMRA under Health Canada, and

a detailed study from California looked at human health and monitored well water following rotenone eradications, finding no traces of rotenone or any other formulation ingredients.

He also cited a review study by the Washington Dept. of Fish and Wildlife which found no risk to human health from rotenone eradication examples when used in accordance with the manufacturer label. Nathan mentions that the treatment concentration proposed for Miramichi Lake is 0.075 mg/l, below the U.S. EPA threshold for safe human contact, and that rotenone formulation ingredients break down over days in the environment.

█ expresses concern about potential link between rotenone and Parkinson's. Nathan explains the link has been investigated and found to not exist by regulators, toxicologists, and review studies. Disagreement from █ on the basis that we as humans don't know everything and we sometimes learn of issues down the road after it's too late.

Andrew H. asks why the N.B. Department of ELG decided to forgo a full environmental assessment of the proposal to eradicate. He asks whether it was the result of a species at risk analysis. Kristian M. explains that while species at risk is a trigger for an assessment, when DELG staff evaluated the project proposal, they determined that the danger to species at risk was greater through inaction, and released the project. Kristian also explained that species at risk is not the only trigger, but that the other categories of triggers for an EIA are not relevant nor triggered in this circumstance. Kristian refers to a letter from DELG official, Paul Vanderlaan, which explains why the project was released from an EIA.

Andrew H. asks if DELG staff have studied the breakdown of the rotenone product post treatment. Peter C. cites the final report from Despres Lake in the Cains River watershed, that was treated in 2001. Data from the NB government, which led the eradication of chain pickerel in Despres Lake, shows a predictable and swift breakdown of formulation ingredients.

Jim W. says rotenone has been used traditionally by Indigenous people to harvest fish for food, and the plan NSMDC is bringing forward is the result of consultation with experts which have declared eradication by rotenone to be safe, effective, and necessary in the Miramichi. He cites the importance of salmon to First Nation communities, how Maliseet people have watched the St. John River be destroyed, and his determination not to let a similar fate befall the Miramichi.

█ asks how far is the Working Group prepared to go in the river? What is the length of river that is acceptable to treat? Mark H. says that we simply don't know. Detailed eDNA tests and surveys will be carried out to learn the distribution of the smallmouth bass in summer 2020.

█ asks whether members of the Working Group would be willing to allow 1-2 camp owners to take the appropriate training and be part of the eradication process. Nathan W. says certainly, that would be welcome and has been done in other areas like B.C.

■■■■■ brings up email correspondence with Neville C. where camp owners requested that the proponent and Working Group endorse a full environmental assessment. In the email, Neville C. explained that the N.B. Minister of Environment must first decide to register a project for a screening level review before a public comment period is opened. Nathan explains that it is not appropriate for the proponent to take a position on whether an EIA should be required or not, that this is the role of DELG as part of the regulatory process. ■■■■■ expressed the need for greater camp owner input to the process. He said they are still opposed to eradication and feel that they were brought in late and their concerns have largely been bypassed.

■■■■■ says it makes no sense to treat the lake and not the river, and worries by doing so it will create a cycle of re-infestation and need for further treatment. Mark H. explains that although the lake and river should be treated together, the lake remains the source of the bass in the river, and the only known established population. As long as it remains, smallmouth bass will continue to enter the river. Cutting off the source as a first step does have merit.

Neville C. reiterates that the Working Group is preparing to submit the amended application and continues to work with the goal of treating the lake and the river in 2020 in mind.

Andrew H. suggests the need for a larger meeting where representatives of DELG, DFO, and Health Canada are in the room. The suggestion is met with general agreement. Andrew H. says it's clear that there is a lack of mutual trust and varying interpretations of the literature.

Jim W. speaks and says that trust issues extend to First Nations – there is no trust in the province, in DFO, or with some user groups of the river. He indicates that DFO's record of mismanagement has led to NSMDC's resolve to take the lead on smallmouth bass eradication. First Nations will not stand by and have traditional fisheries permanently altered. Jim W. says they will fight the invasive species and not simply let smallmouth bass go. He indicates that treaty rights are at stake and First Nation communities have let DFO know this fact. Jim says he supports a broad meeting with regulators present to help ensure this is done right.

Strong interest amongst camp owners to have their concerns addressed by the regulators (DELG, DFO, PMRA, etc.). Peter C. asks camp owners to write down their detailed concerns and questions so that the Working Group and regulators have something concrete to work with and address. ■■■■■ indicates that they will prepare their written concerns, and has general agreement from the other camp owners. Agreement in the room is that this is the best way to move forward.

■■■■■ remarks that the future of Miramichi Lake and the river matter to everyone in the room. He understands people are passionate and thanks Working Group members for organizing the meeting.

Andrew H. reiterates the need for a broad meeting, imploring camp owners to make their specific concerns known ahead of time so appropriate individuals can be present to answer. Camp owners agree.

Outcome: The Working Group will organize a larger meeting with stakeholder and rightsholder groups present, along with individuals from DFO, DELG, DNRED, Health Canada.

Notes prepared by Neville Crabbe
March 9, 2020

Sent May 21, 2020

From: ncrabbe@asf.ca

To: All Miramichi Lake cottage owners and interested family members

Good Afternoon,

On behalf of the Working Group on Smallmouth Bass Eradication in the Miramichi, I want to provide all the camp owners on Miramichi Lake with an update and invite you to respond with any questions or concerns you have about the information below.

Following our meeting in Woodstock, N.B. on January 26th, a committee was formed to represent camp owners and act as liaisons between our organizations and yourselves. Members of the Working Group and your committee maintained email contact and met in person on March 5th in Fredericton.

Since then our contact has been limited though we shared the amended application referred to below. I wanted to take this opportunity to update the entire group of camp owners on our project.

- On April 8th, the project proponent and partners submitted a revised application to eradicate to DFO. This application includes everything from the original package, plus additional information requested by DFO in recent months and an initial description of our plan to use rotenone in a section of the Southwest Miramichi River where smallmouth are present. Here is a link to the full application package: <https://drive.google.com/open?id=1ajmhBT5BDP9FYHiqzYw25hPUHXXoAUTE>
- DFO has committed to a 60-day review of the application, returning a decision in the second week of June.
- The amended application to eradicate has also been submitted to the N.B. Department of Environment and Local Government. Here's a link to a guide on New Brunswick's environmental impact assessment process: <https://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/EIA-EIE/GuideEnvironmentallImpactAssessment.pdf>. Currently, the process is at the registration decision stage.
- While the outcome of the latest Environment and Local Government process is to be determined, the original application to eradicate smallmouth bass from Miramichi Lake and Lake Brook was released from further environmental assessment. I have attached a letter with the province's reasoning explained.

- Our groups are prepared to begin collecting data in the field in the next 7-10 days, focused on the Southwest Miramichi River. We require information on flows and river characteristics to support the use and deactivation of rotenone in the moving water. Each of our organizations have developed safe-work protocols and procedures to facilitate this.
- We continue to work diligently through the regulatory process with the intent to eradicate smallmouth from the watershed in the fall of 2020.

If you have any questions please get in touch. I understand the application document is large and technical in areas, but it contains the suite of information about health and safety, monitoring and restoration post treatment.

As developments arise, and certainly upon hearing from DFO on the application, I will send another update. In the meantime, I can be reached by phone or email. We also have a project website at www.miramichismallmouth.com.

Sincerely,
Neville

July 15, 2020

From: ncrabbe@asf.ca

To: All Miramichi Lake cottage owners and interested family members

Good morning,

On Monday, July 15th, our working group received notification from N.B.'s Department of Environment and Local Government that we are required to register our smallmouth bass eradication project for a determination review. We were subsequently informed that the decision was triggered by the expanded scope of our amended application and potential impacts to species like salmon and eel.

We welcome this decision and are confident that all the work we have done and knowledge gathered will help us prepare a registration document in the coming weeks and submit it for a determination review. Once that document is submitted we will notify your group as there is opportunity for public input.

There are three possible outcomes from the determination review: a certificate of determination is issued and the project is released from further assessment, a comprehensive EIA is ordered, or the project is rejected. The province has prepared a guide on the entire EIA process that is quite

helpful: <https://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/EIA-EIE/GuideEnvironmentalImpactAssessment.pdf>.

At this point, as we continue to work through DFO's regulatory process, Indigenous consultation, and now the provincial environmental assessment program, the likelihood of executing the eradication in 2020 is small. Our goal is to continue working vigorously through this phase of the project and make a final evaluation once all permitting and review is complete. The more likely scenario at this point is the continuation of physical controls and information gathering through to ice-up this year, and the application of the rotenone product to lake, brook, and river in 2021.

Please let me know if you have any questions and I will be in touch again once we have submitted our registration document to the Department of Environment and Local Government.

Sincerely,

Neville Crabbe on behalf of the Working Group on Smallmouth Bass Eradication in the Miramichi

JULY 15, 2020 EMAIL TO COTTAGERS USING SHALLOW WELL AT MIRAMICHI LAKE

The majority of cottages, except two, obtain water from a communal drinking water supply fed by a small inlet tributary to the lake located uphill from the cottages (upstream from the lake) and upstream/outside of the proposed treatment area. Two cottage owners indicated that they share a 20-foot shallow well which they believe is fed by groundwater and surface water adjacent to the lake. As potential mitigation measures for the two cottages with the shallow well, we have officially offered those cottage owners three options in writing:

Email to cottage owner, [REDACTED] on July 15, 2020:

"We have discussed amongst the group the matter you brought forward about your shallow well that is shared between 2 cottages and is potentially fed in part by surface water from the lake. We have consulted with Brian Finlayson and Steve Maricle to get guidance on what the standard protocol is for lakeside wells. Both of them have had experience with similar situations.

The literature and their experience monitoring deep and shallow wells before/after rotenone treatments show that no traces of rotenone or any other formulation ingredients have been found in the well monitoring. Also, rotenone does not travel further than a few centimetres into the soil and is not known to be a groundwater contaminant. This indicates that there should be no impact to your well water; however, we understand your genuine concerns and recognize that drinking water is one of the most basic and important aspects of life anywhere, and that one needs to be comfortable with their drinking water source.

As such, we have put together 3 options for you to consider. All 3 options include a request that you not use the well for the duration of the project as a precaution. Should the project go ahead, we offer to:

- 1. Provide drinking water to your two cottages on the well for the duration of rotenone presence in the lake (2-3 weeks), and test the well water before and after the treatment; or*
- 2. If logistically possible, connect your two cottages to the existing spring water source used by the other cottages that is upstream of the treatment area; or*
- 3. Drill you a new proper deep well with no surface water input*

Alternatively, if some combination of these options is favourable to you or you have another option in mind, we are certainly open for discussion on the approach that makes you feel most comfortable."

Nathan

Nathan Wilbur, PEng, MScE
Director, New Brunswick Programs
Atlantic Salmon Federation (ASF)
nwilbur@asf.ca / [506 442-2185](tel:5064422185)

July 20, 2020

From: ncrabbe@asf.ca

To: All Miramichi Lake cottage owners and interested family members

Good Morning,

Nathan Wilbur and I are going to be on Miramichi Lake today. We are gathering flow measurements from the inflows to the lake, checking on the containment and removal efforts, and attempting to angle for smallmouth in a few areas.

After visiting in 2017 with Brian Finlayson, we heard that people wanted a heads up on lake activities.

We should be wrapped up by early to mid-afternoon.

Sincerely,
Neville

Neville Crabbe
Executive Director of Communications
Atlantic Salmon Federation
M: 506-467-6804

August 17, 2020

From: ncrabbe@asf.ca

To: All Miramichi Lake cottage owners and interested family members

Good Afternoon,

Here's an update on the smallmouth bass eradication project. Please get in touch if you have any questions, but note that I am out of the office from tomorrow until mid next-week.

- On July 20th Nathan and I were at Miramichi Lake. The main purpose was to survey the inlets identified by New Brunswick's wet areas map, an important part of treatment planning. We made observations and took measurements. In addition we spent some time angling. We tried areas of the lake where the [REDACTED] don't fish and caught no smallmouth bass.
- The following day, arrangements were made to view the proposed treatment area from the air, surveying the Lake, brook, and river stretch by helicopter. Video and still images were captured that will feed into project planning. It was a valuable exercise that provided a unique vantage point of the terrain.
- Throughout the summer there have been control efforts taking place in the river and another round of eDNA testing is expected to be done soon.
- On the regulatory side, we are coming to the end of the federal Aquatic Invasive Species application process and are preparing our registration document for submission to the province of NB. As mentioned previously, we will be sure to alert this group once that document is submitted.
- **To plan for a safe and effective treatment we are trying to get detailed information about the sources of water for the camps. We have details from people connected to the well, but for those drawing from the stream, could someone help us locate the exact intake point and describe the method of transferring water?**
- Finally, I wanted to share a link to a story about Parks Canada in Alberta. They are using rotenone to create a sanctuary for threatened trout in some remote alpine lakes and streams within Banff. It's encouraging for us to see a federal agency taking this type of conservation action and their conclusion that the treatment will not have negative effects on the wider ecosystem matches the analysis we've done and literature reviewed. Here's the link: <https://www.cbc.ca/news/canada/calgary/fish-preservation-removal-alberta-parks-canada-lake-helen-lake-katherine-westslope-cutthroat-trout-1.5681867>

Thanks for your time. Sincerely,
Neville

September 21, 2020

From: ncrabbe@asf.ca

To: **To: All Miramichi Lake cottage owners and interested family members**

Good Morning,

I wanted to let everyone know that Nathan Wilbur and a representative of the Department of Natural Resources will be at the lake later today to gather coordinates for the water intake. We asked in August if someone could help identify the exact location. The information is needed for our EIA registration. We are anticipating submission on Friday this week. Once provincial staff conduct a privacy review of the document it will be publicly posted. I will share a link once it's available.

Meanwhile, removal efforts continue. DFO has caught more than 3,300 young of the year smallmouth in the lake, plus 4 adults and 2 juveniles. The Province of New Brunswick, with support from Working Group members have caught more than 60 smallmouth in McKiel Pond Pool, almost all of them with a boat mounted electrofisher.

DFO is starting to get results back from their eDNA samples. They shared the early results on a coordination call we had late last week. From 36 collection sites they have processed 7 by my count. Early indication is that no smallmouth have been detected outside the proposed treatment area. However, we were informed last week that a single smallmouth bass was caught in the DFO operated trapnet at Millerton, in the estuary of the Southwest.

This is ~120 km from their known locale in the river. We have no other reports of catches anywhere in between, and no positives on eDNA. Our understanding is that the fish will be subjected to stable isotope analysis to determine if it has been in the Miramichi system, and genetic sampling to attempt and understand if it is related to the Miramichi Lake population. We believe that there will also be an eDNA blitz in the area. Until we have more information it is hard to determine the significance of this single capture.

Please contact me if you have any questions,
Neville