APPENDIX K

Indigenous Engagement Supporting Documentation

Letter of Intent and Mutual Support

April 17, 2018

This letter is a declaration of shared goals and a promise of mutual support among members of the Working Group on Smallmouth Bass Eradication in Miramichi Lake. The purpose is to give comfort to members of the working group who may apply to be the proponent for eradication.

We jointly agree to the following:

1. The working group is committed to the success of the project and each member organization will provide in-kind, public, and moral support over the life of the project for any group member that applies to be a proponent.
2. The working group will remain resolute, unified, and openly communicate through all stages of the project.
3. The working group will collaborate to build public and community support for the project and will engage in a transparent and respectful way.
4. The working group agrees that regardless of which organization is the proponent, eradication costs and liability must be borne by the federal and/or provincial government as regulators.

Signatories

Atlantic Salmon Federation
Neville Crabbe

Miramichi Salmon Association
Mark Hambrook

Miramichi Watershed Management Committee
Debbie Norton

New Brunswick Salmon Council
Peter Cronin

New Brunswick Wildlife Federation
Charlie Leblanc

North Shore Micmac District Council
Jim Ward

October 10, 2018

Patricia Saulis, Executive Director
Maliseet Nation Conservation Council
150 Cliffe Street, 2nd floor, Suite 8
Saint Mary's First Nation
Fredericton, NB, E3A 0A1

Dear Patricia:

SUBJECT: Eradication of Smallmouth Bass from Miramichi Lake

On behalf of the Working Group for the eradication of smallmouth bass from Miramichi Lake, we are writing to follow-up on recent discussions and correspondence between you and Jim Ward of the NSMDC. As confirmed by Jim, the Working Group was not aware until recently that the lake was located in shared Maliseet/Mi'kmaq territory. Once this important factor about your lack of inclusion was brought to our attention, Jim took leadership and initiative to engage with you.

The Working Group has also postponed our public outreach plan and any further developments until respectful discussions about the Project, especially with the need to accommodate co-leadership and co-management between the two AAROM bodies.

The support of the Maliseet communities will significantly increase the collective effectiveness of convincing the governments of Canada and New Brunswick to effectively address the major threats posed by smallmouth bass in the Miramichi watershed.

The Working Group would appreciate a meeting with you and the MNCC to discuss the expert report, answer questions and address any concerns that you may have. We understand that you suggested a traditional/ceremonial water ceremony at the lake, then hold the meeting somewhere nearby. The Working Group would be honored to participate in the ceremony at your convenience and have the MNCC become a member of the Working Group.

We look forward to your participation and contribution on this important matter.

Yours in Conservation

PETER J CRONIN
Co-Chair of Working Group
Past President NBSC

MARK HAMBROOK
Co-Chair of Working Group
President MSA

Meeting to Discuss Smallmouth Bass Eradication from Miramichi Lake

10 January 2019, St. Mary's First Nation Conference Room

Meeting attendees: Charlie Leblanc (NB Wildlife Federation), Peter Cronin (NB Salmon Council), Nathan Wilbur & Neville Crabbe (Atlantic Salmon Federation), Blake Daly and Aruna Jayawardane (Maliseet Nation Conservation Council), Victor Gionet (North Shore Micmac District Council) and Colin Curry (Wolastoqey Nation in New Brunswick)

Meeting Notes:

1. **Roundtable introductions**
   - Colin provided overview of WNNB and indicated the organization was set up to deal with resource extraction proposals that may impact aboriginal and treaty rights.

2. **Background -** Peter provided background on history of invasive smallmouth in Miramichi Lake since 2008, as well as efforts to contain and reduce them, and emphasized the need to eradicate to avoid a permanent disaster for wild Atlantic salmon and the native ecosystem of the Miramichi.

   - Colin indicated he had a general understanding of the issue and acknowledges the need to protect the native Miramichi ecosystem.
   - Victor Gionet made the point that Chief Bill Ward and Chief George Ginnish are in strong support of the project and that there is urgency to expedite the process. He emphasized that his communities are ready to lead and see no reason for further delay. He said any consultation should be concurrent with planning and permitting so the process can move along as quickly as possible.
   - Aruna indicated he thinks Maliseet leadership is comfortable with the concept of eradicating smallmouth bass from the lake.

3. **Expert Report -** Nathan delivered a presentation summarizing the expert report and the proposed eradication plan, including rotenone application & deactivation, mitigation, native fish removal/reintroduction, monitoring and cost.

   - Neville provided a paper copy of the full expert report to Colin
   - Questions and discussion around the plan and mitigation measures
   - Colin expressed a level of support for technical aspects of the eradication plan, and the need for it, but that the communities will have to go through their processes to decide on level of support.
   - Colin stated that Maliseet communities have a strong interest in salmon conservation and enhancement and that he doesn't think they will get in the way of a project like this, but that they need the facts and an understanding of the project.
   - Victor stated again that we need to do parallel work to keep things moving. He posed the question: is this plan the best option to minimize the risk? Yes.

4. **Consultation Process**
    - WNNB provided an overview of their consultation processes
    - The territory belongs to the entire Nation so all communities are consulted when consultation is required. Colin indicated some communities may not be interested and may pass altogether on the consultation.
    - Colin indicated he now has enough information to brief the various Maliseet consultation coordinators, and his advice would be that the project would have a temporary impact on indigenous access to the lake, limited in time and space, but for the long term benefit of conserving the native ecosystem and indigenous access to the resources.
    - The communities are busy with many consultations but Colin suggested this particular issue would likely get attention and interest since it involves salmon.
    - Colin indicated, with the caveat that he's not the decision maker, that the project may simply be agreed to by the Chiefs, at which point there may or may not be any need for wider community meetings. He believes because salmon are involved, people will be very receptive.
    - May not need to go down the consultation route, but if so, should begin as soon as possible
    - Agreement amongst all that processes should happen in parallel to keep things moving as quickly as they can (consultations, DFO science review process, permit applications, project planning).
    - It may be necessary or helpful to have the Working Group present to communities on the plan, and answer questions.
    - Colin said it is good that indigenous organizations are already involved in the project and planning (MNCC, NSMDC); this should help move consultations along positively.
    - Peter asked about timelines and if eradication may be possible in September, 2019. Colin indicated yes, their processes likely will move fast enough for eradication to be possible in 2019 (if DFO's processes will move fast enough).
    - Costs – Colin said to hold a community meeting is typically costs less than $1000 (rent a meeting hall, coffee, honorarium for elder)

5. **Next steps**
    a. Colin will get back to Peter early in the week of January 14 – 18 with any suggested edits to the Working Group's drafted meeting request to new provincial Ministers of Environment and Energy and Resource Development. Peter will then submit the request. The meeting objective is to further develop provincial support.
    b. Working Group to finalize the application for use of a deleterious substance and submit to DFO so that DFO's science review processes can take place in parallel with consultation processes.
    c. WNNB to conduct technical briefings to leadership and to the consultation coordinators of the Maliseet communities and report back to the Working Group.
    d. WNNB and MNCC will respond to the Working Group soon on next steps from their perspectives.

Presentations made by Brian Finlayson and Steve Maricle at Natoagenag First Nation

January 27, 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

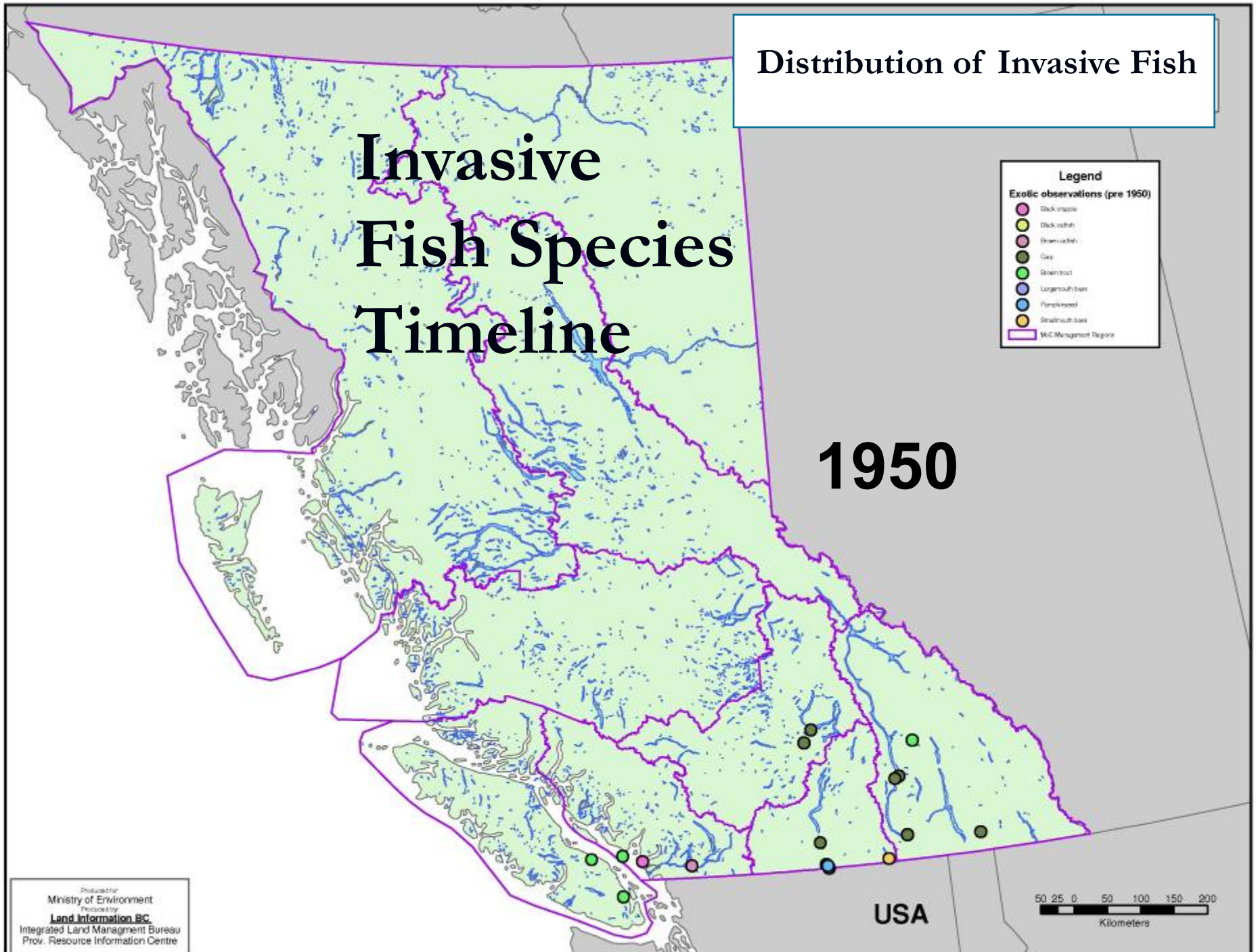
Primary Fisheries target Salmonid stocks

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

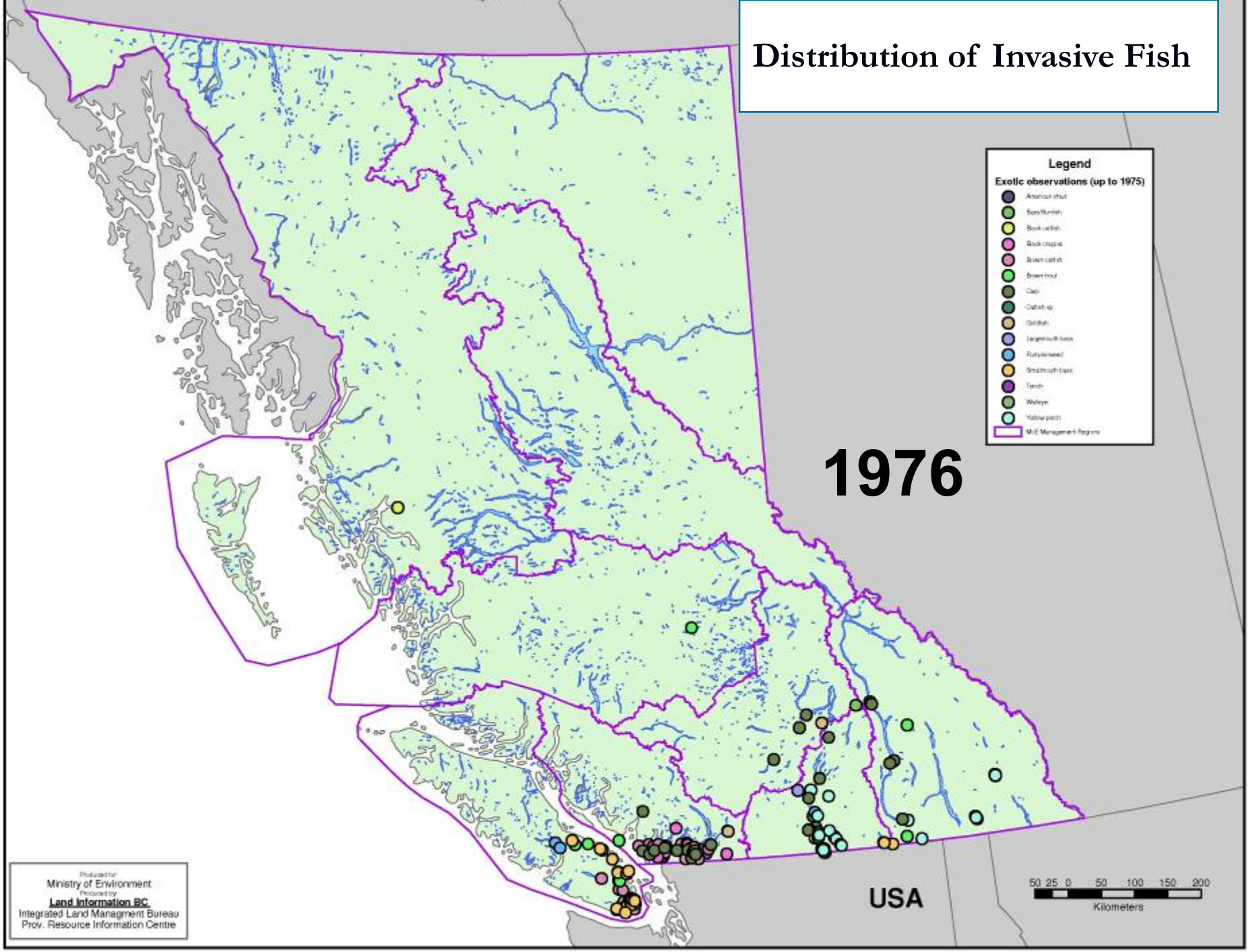
The Rocky Mountains separate BC from most species on the east side of the mountains

Many of these species pose serious threat to Salmonids

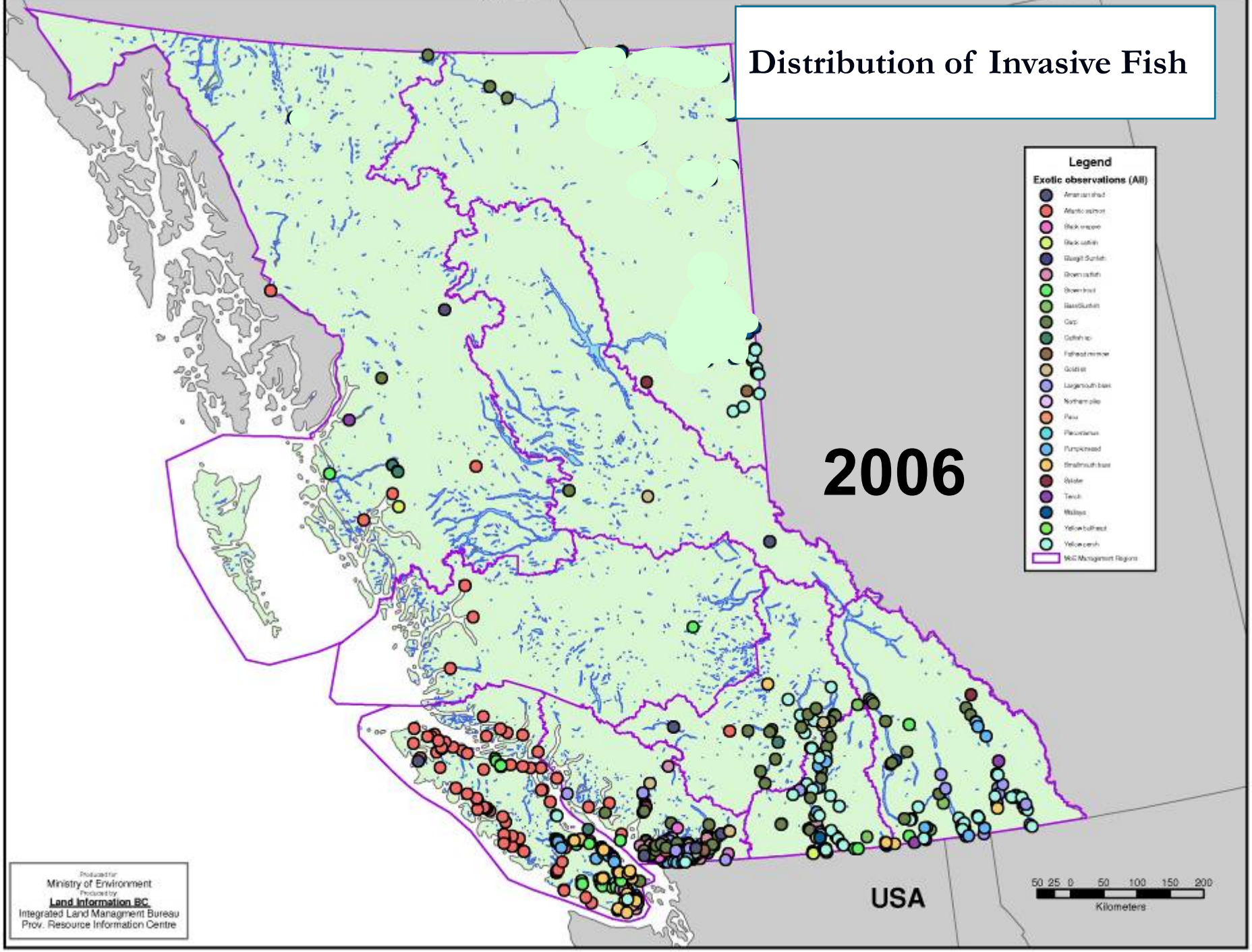
Recreational Fishing in BC generates over $One Billion/Yr


Distribution of Invasive Fish
Invasive Fish Species Timeline
1950
Legend
Exotic observations (pre 1950)
Black crappie
Black catfish
Brown catfish
Carp
Brown trout
Longer mouth bass
Pumpkinseed
Smallmouth bass
MoE Management Regions
USA
50 25 0 50 100 150 200
Kilometers
Produced for
Ministry of Environment
Produced by
Land Information BC
Integrated Land Managment Bureau
Prov. Resource Information Centre

Distribution of Invasive Fish



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

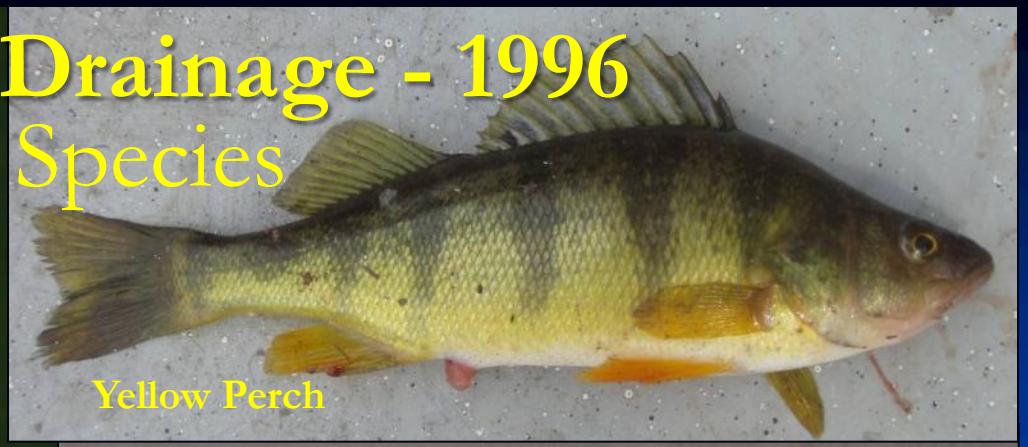
56,000 Km^2 - ¾ the size of New Brunswick

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

Recreational Fisheries Generates over $150 Million in Revenue

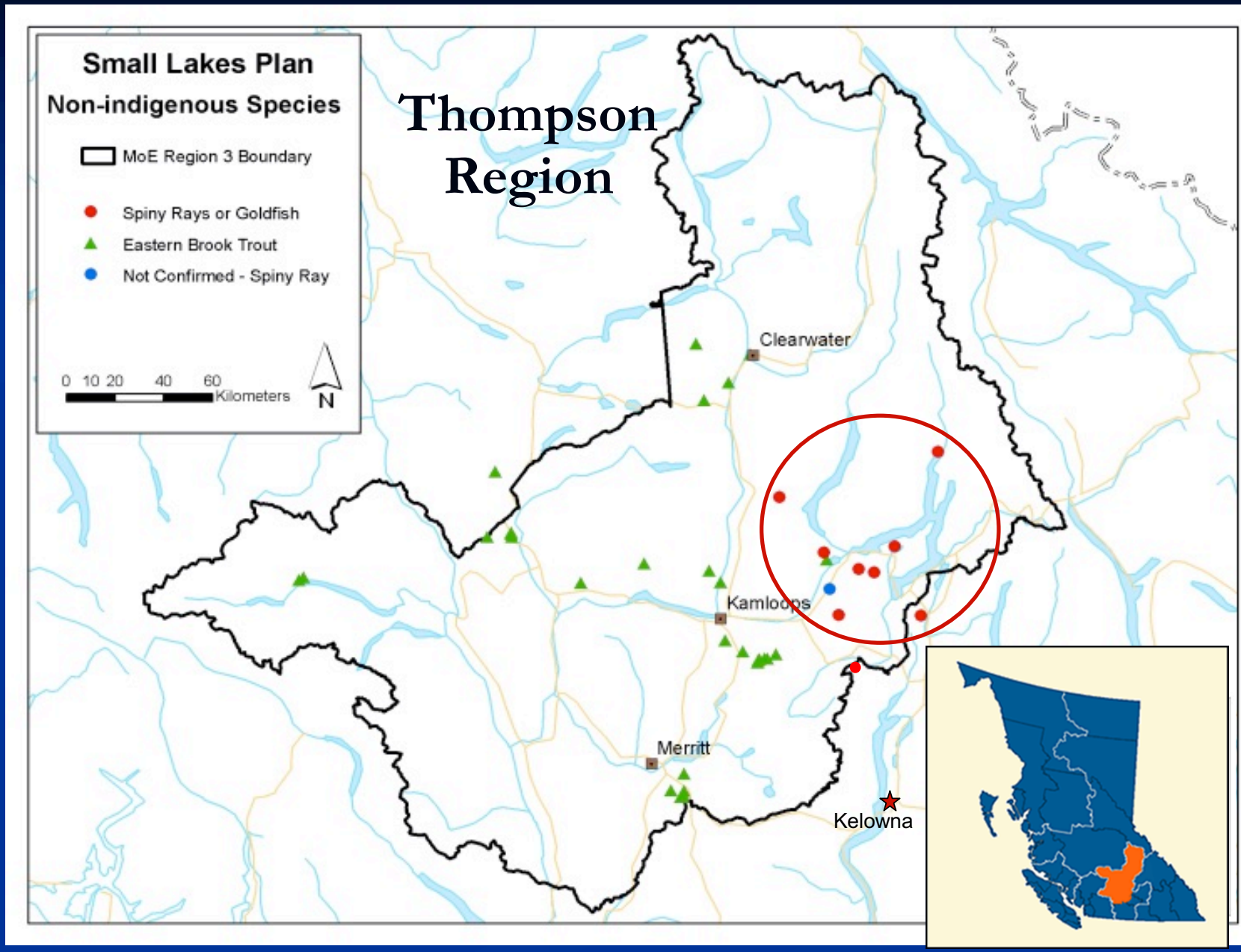
Thompson Drainage - 1996
Spiny-ray Species


Smallmouth Bass


Yellow Perch

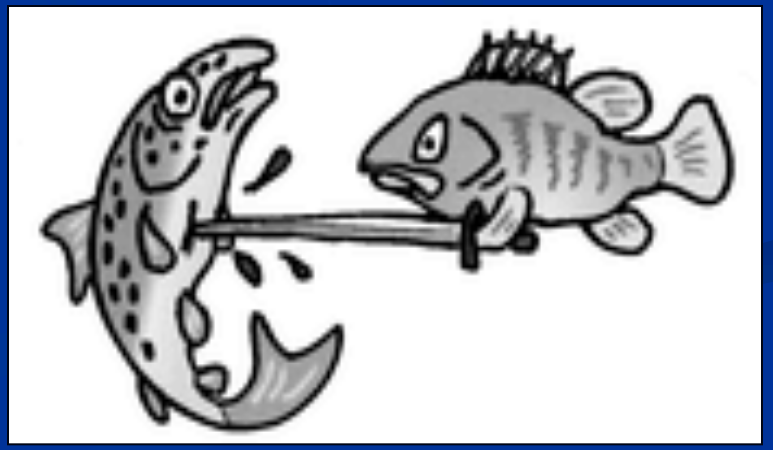

Largemouth Bass


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
N
Thompson Region
Clearwater
Kamloops
Merritt
Kelowna

Risks and Concerns of Invasive Species

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



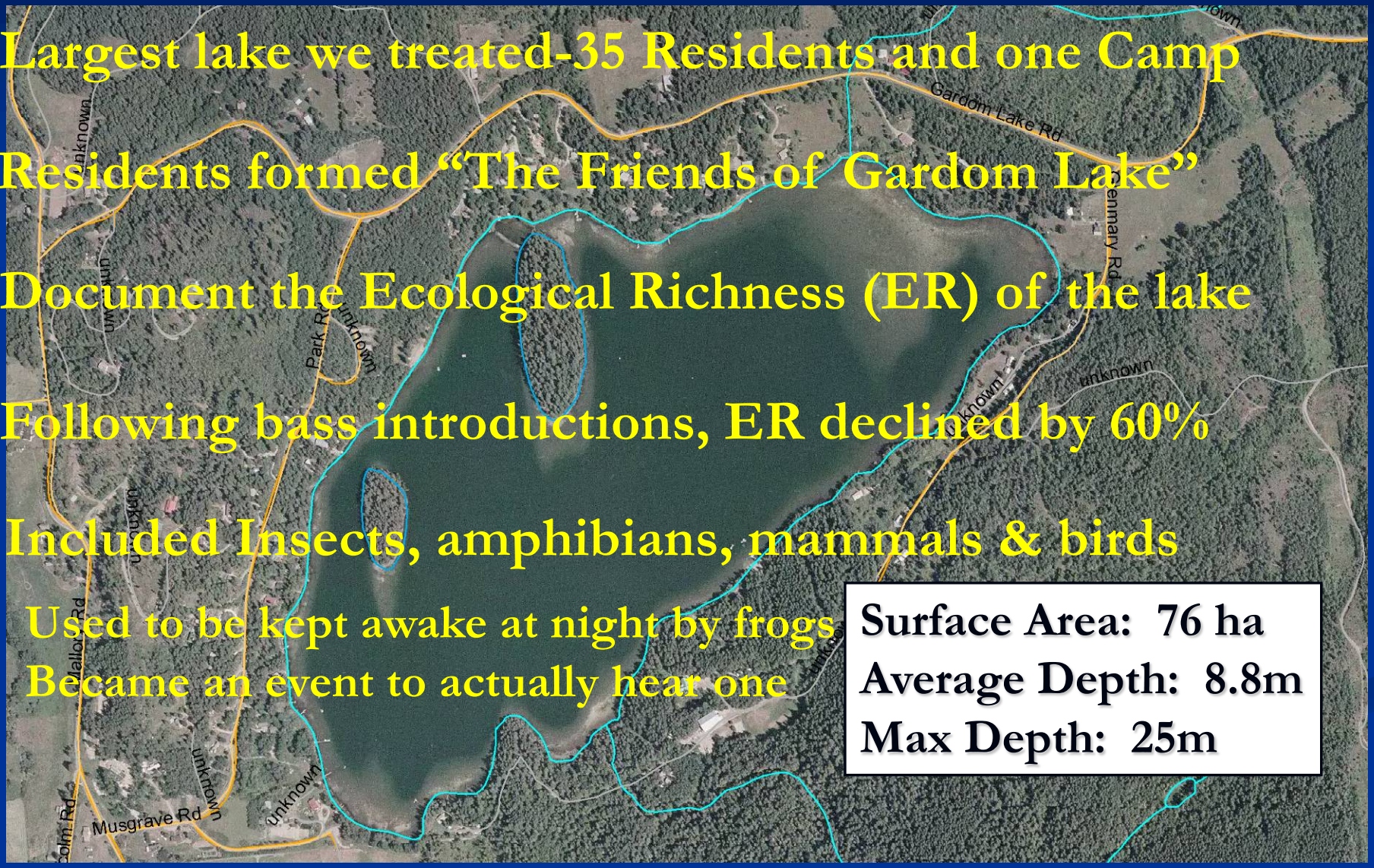
Impacts to Lakes from Spiny-Ray Fish

- 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 the 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.

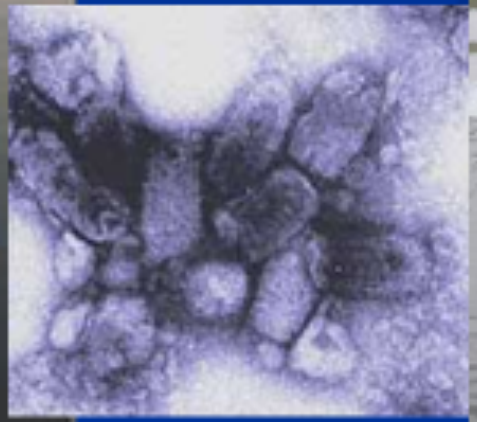
Time to draw a line

Do Nothing?

Options For Invasive Species Management

Physical

Chemical

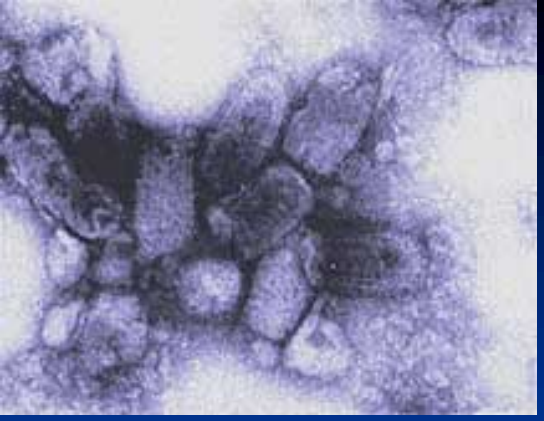


Biological

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
      Invasive Fish Species
    - Sterile Pike

- 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)

- Piscides 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!

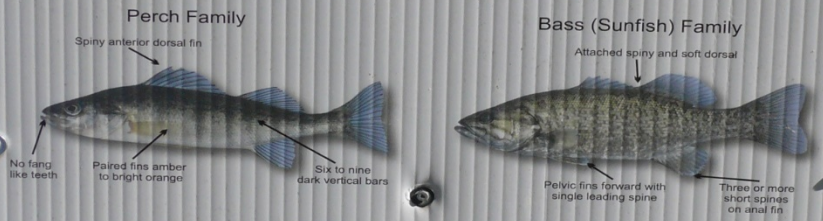
- Reward up to **$20,000**
- Public Education and Awareness
  - Public information meetings
  - Media & Signage
- Increase Enforcement presence
- Closed all 12 Lakes with Spiny-Ray Species
- Eradicate

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



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'd on Pre-sample

Results Post-Treatment

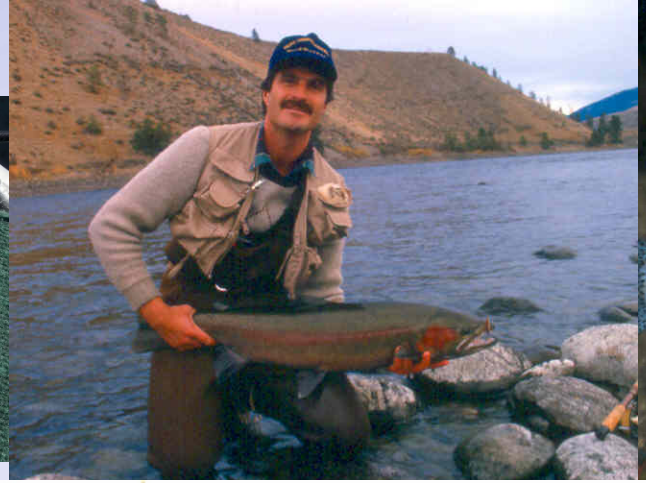
Eliminated the threat of Spiny-ray establishment in the Thompson mainstem

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

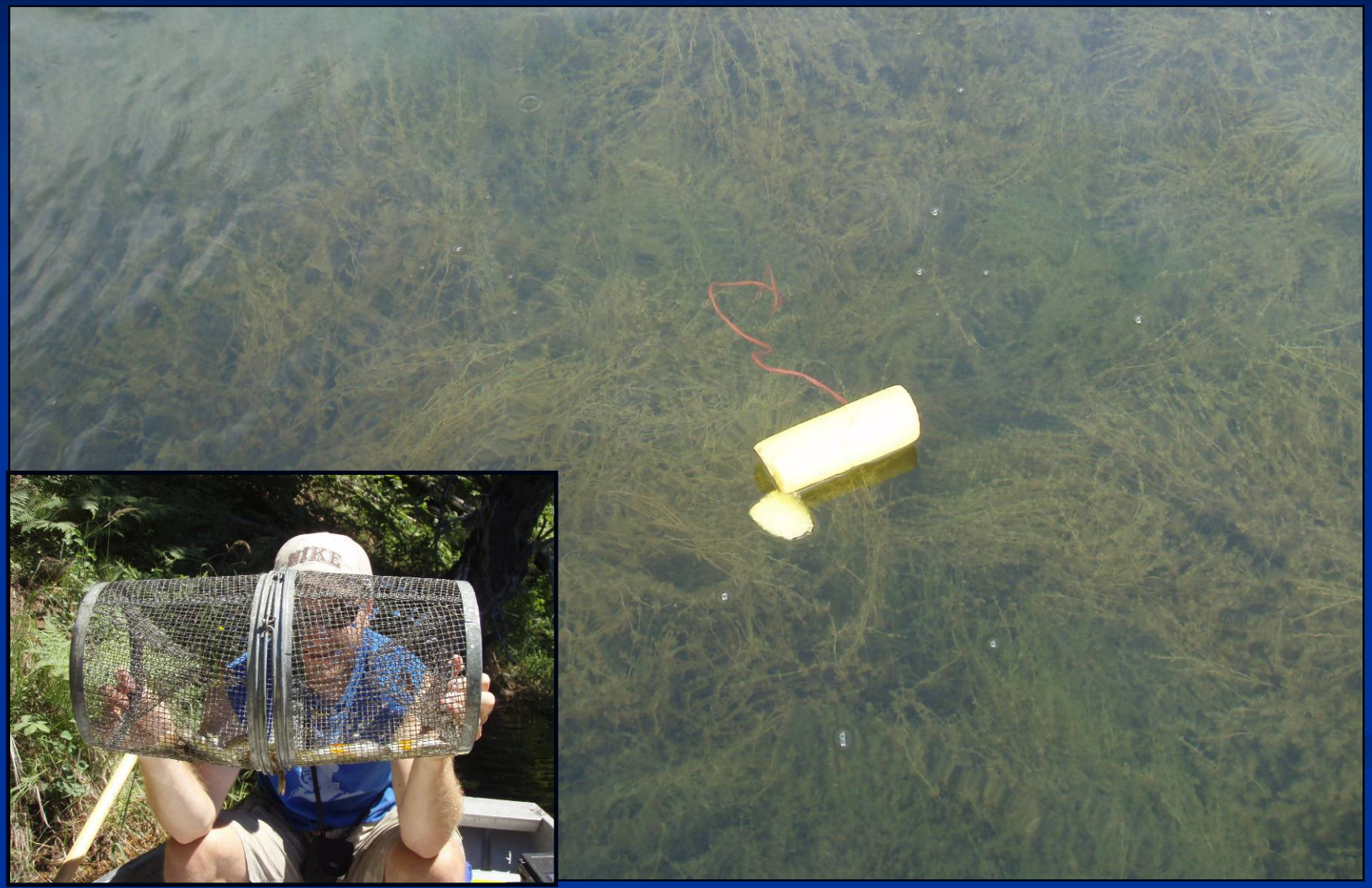


BRITISH COLUMBIA

Ministry of
Forests, Lands and
Natural Resource Operations

The End

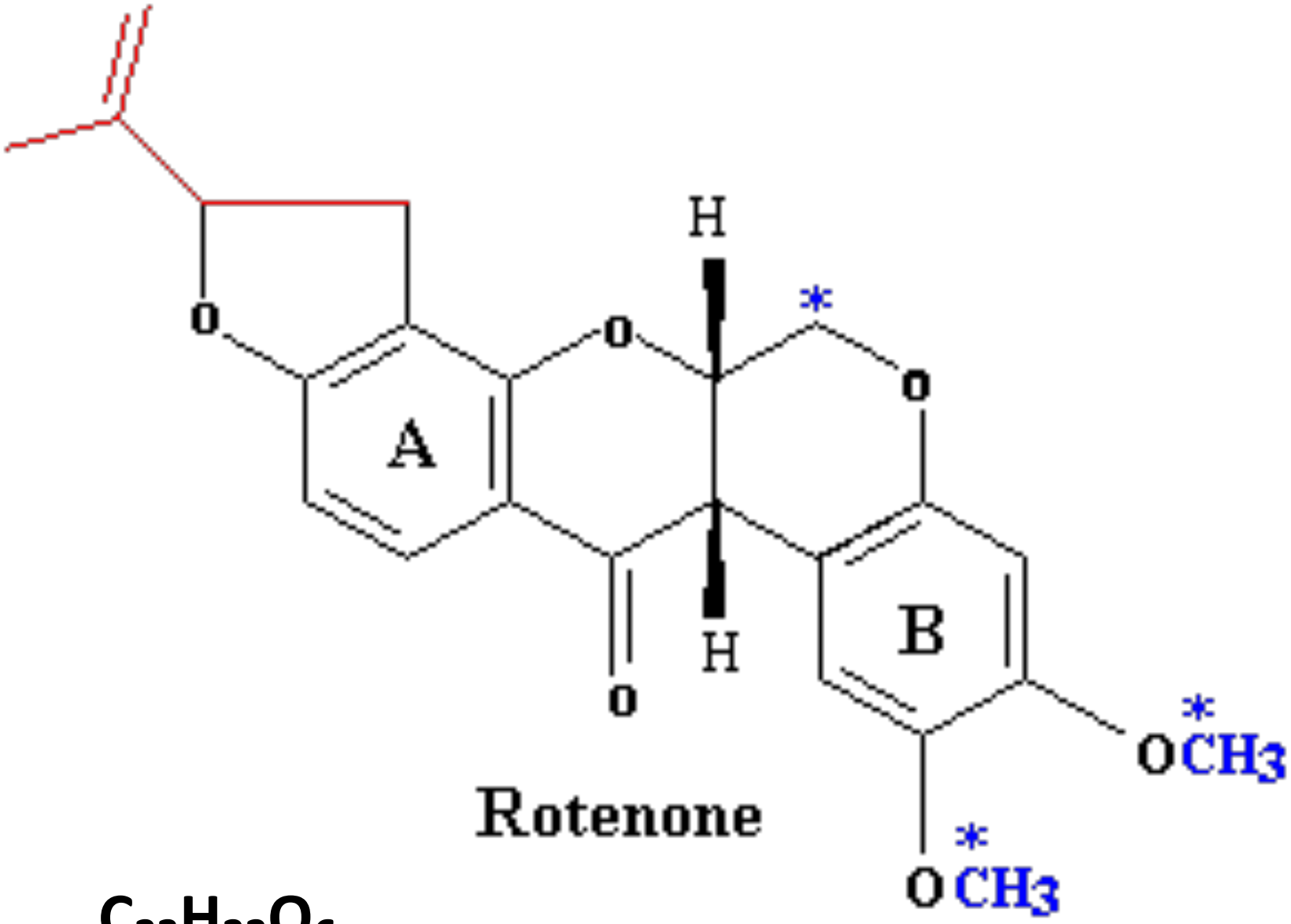
Sentinel Cages



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



Rotenone

$C_{23}H_{22}O_6$

Miramichi LK & SW Miramichi RIV SMB Eradication

Proposed Rotenone Treatment Environmental & Public Health

Brian Finlayson & Don Skaar
Fish Control Solutions, LLC

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

Summary
Environmental Persistence

- Dissipation by photolysis, hydrolysis & metabolic pathways
  - Temperate lakes gone within 30 days
  - Increased pH, sunlight & temperature speed breakdown
- Persistence in Miramichi Lake
  - 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

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

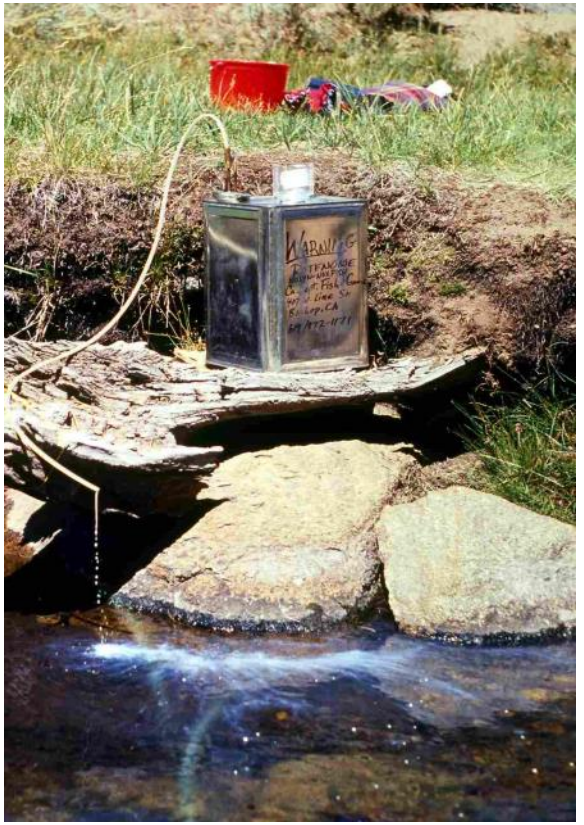
- USEPA recommends < 90 ppb prior to human contact (safe recreational H_2O level)
- USEPA recommends < 40 ppb prior to drinking (safe drinking H_2O level)
- Canadian PMRA Noxfish II label requires:
  - No contact w/ H_2O during 2-d application
  - No contact w/ H_2O for 3 days following application
  - Total 5-d restriction for Miramichi Lake
  - Expect 19-36 ppb @ 5 days, < USEPA safe levels

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

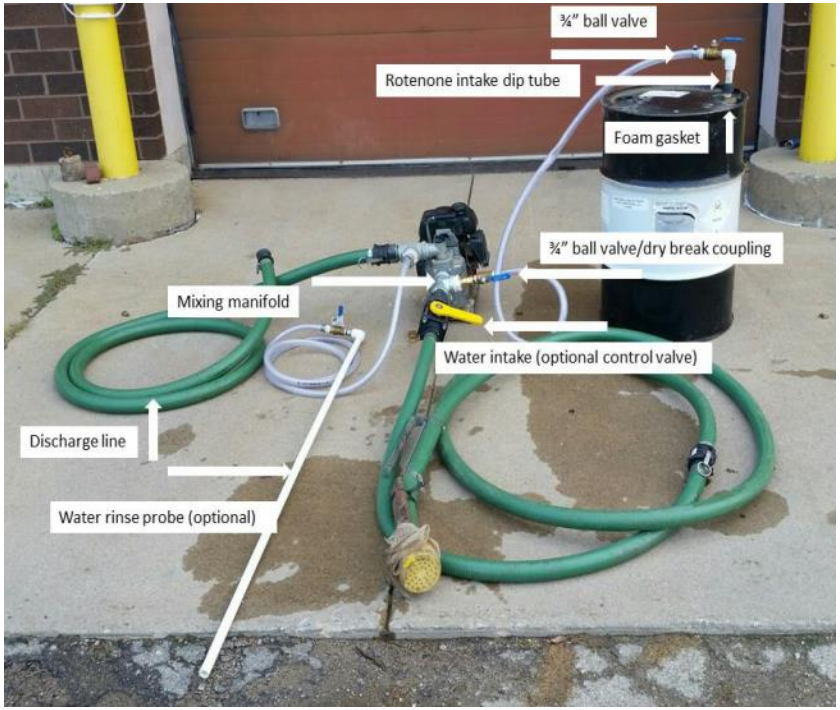


Drip can emitting rotenone, California

Application to Streams – Pumps

Peristaltic pump application, Norway

Application to Lakes



Semi-closed probe system, Iowa

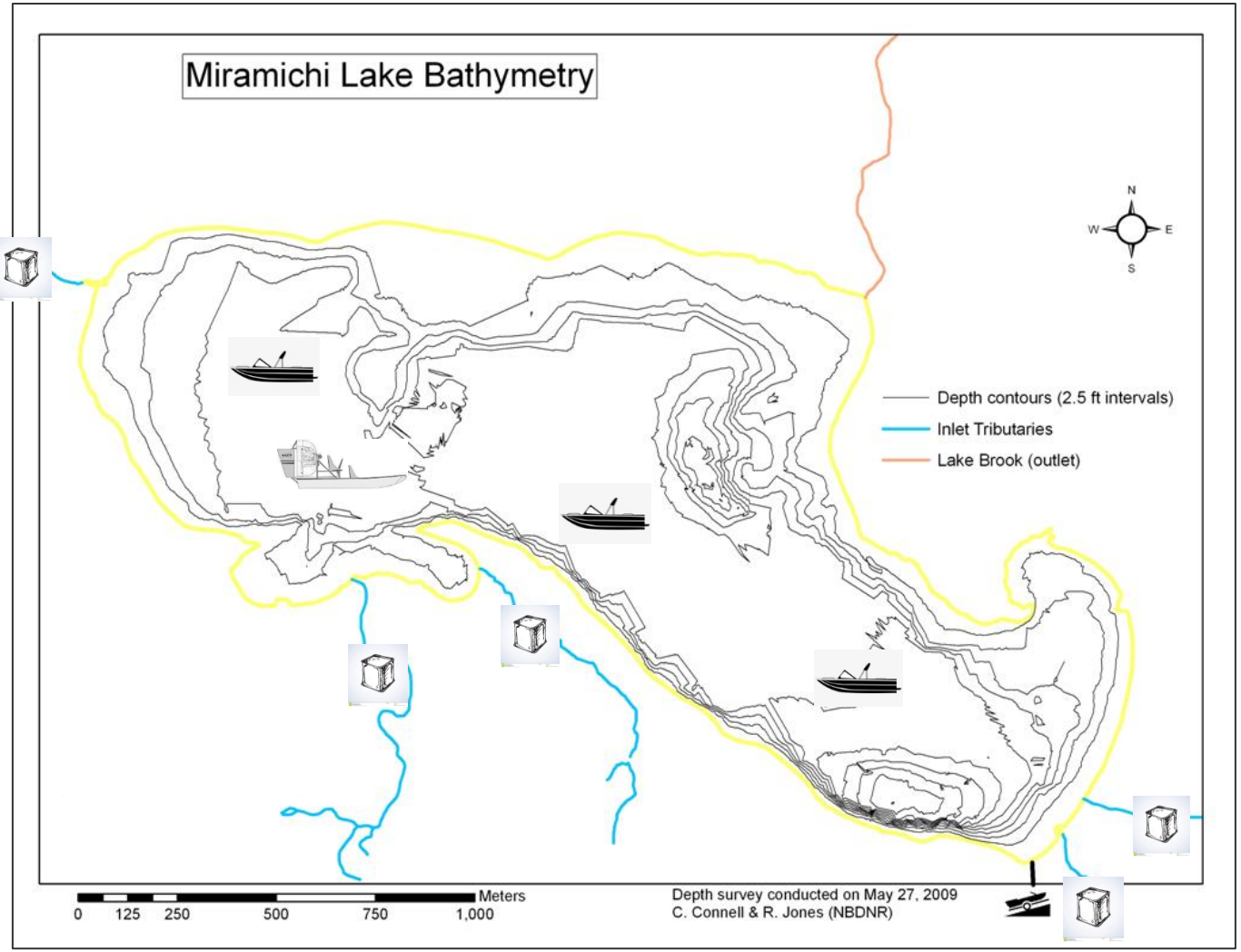
2 systems on pontoon boat, Oregon

Spraying Backwater Areas

Pump spraying on airboat, Washington

Manual spraying, Iowa

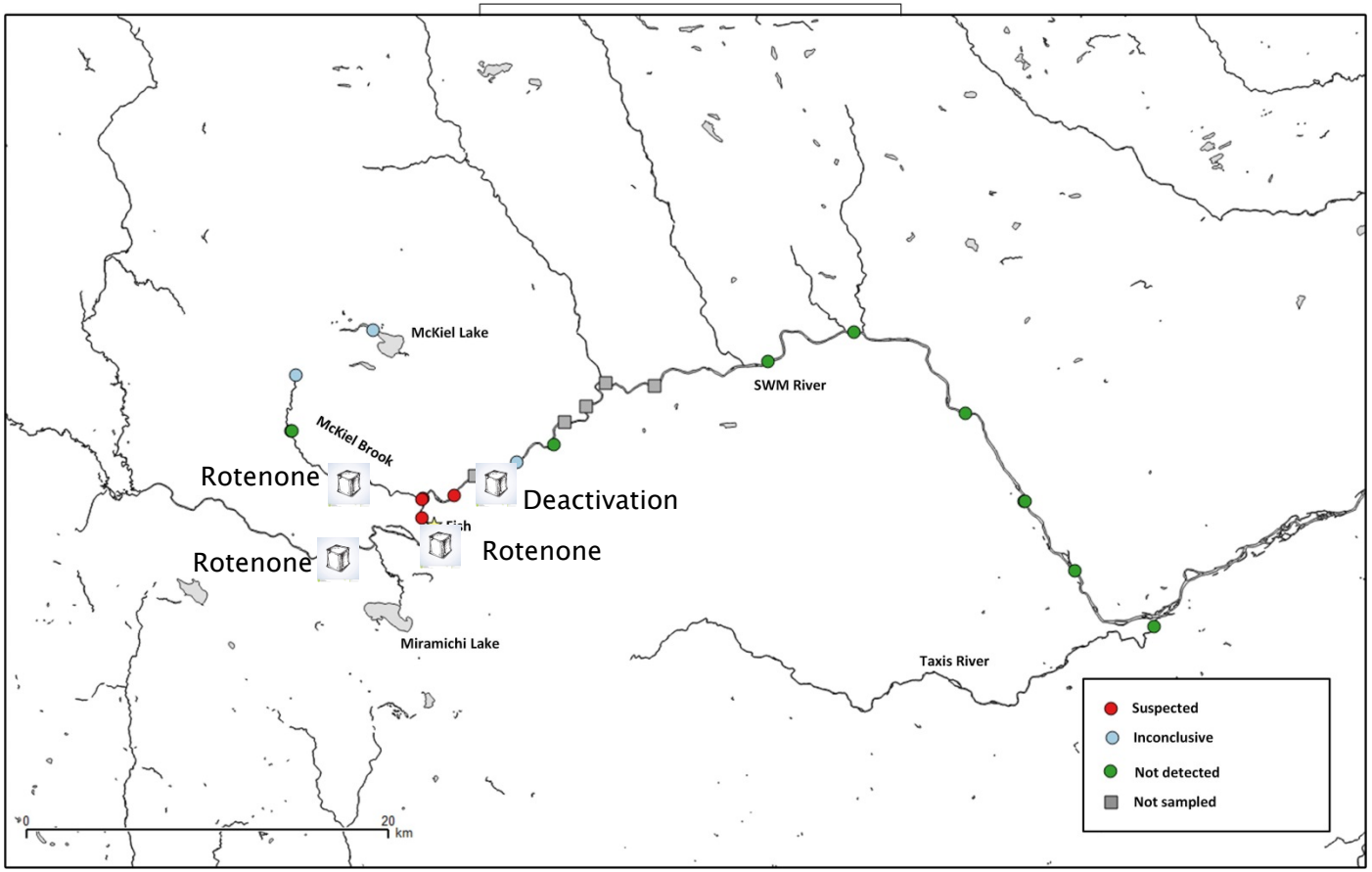
Miramichi Lake 2-Day Rotenone Application



Legend

- Drip Stations
- Boats
- Airboat

SW Miramichi Rv Treatment Stretch



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

Any Questions?

Invasive Smallmouth Bass Eradication from the Miramichi Watershed

Presented by: Nathan Wilbur

On Behalf of the Working Group

30 June 2020

Agenda

1. Background and project overview
2. Rotenone and its use worldwide
3. Proposed eradication plan for the Miramichi
4. Questions and discussion

Working Group

North Shore Micmac District Council

Atlantic Salmon Federation

Maliseet Nation Conservation Council

Miramichi Salmon Association

Miramichi Watershed Management Committee

New Brunswick Salmon Council

New Brunswick Wildlife Federation

www.miramichismallmouth.com

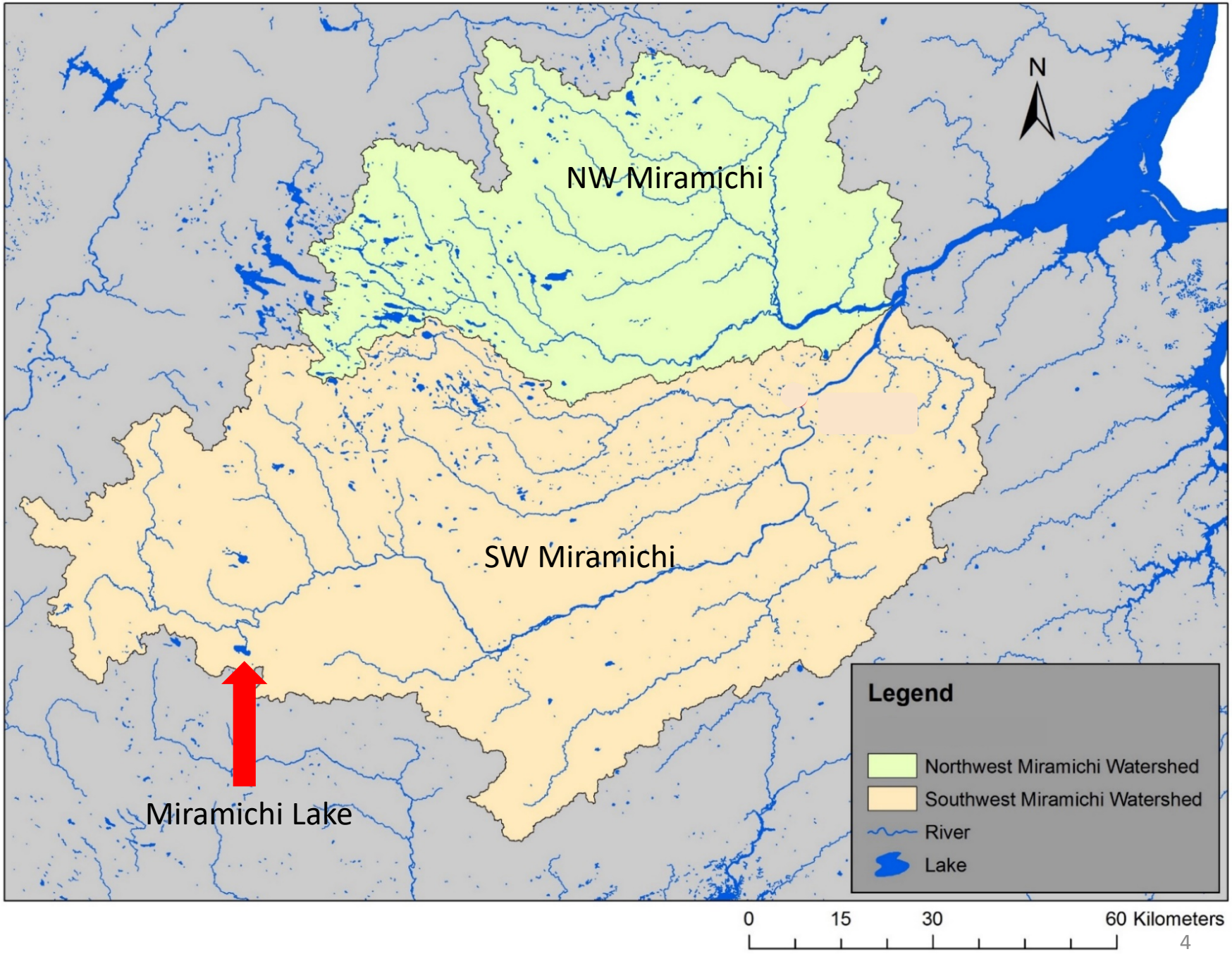
Overarching Statements

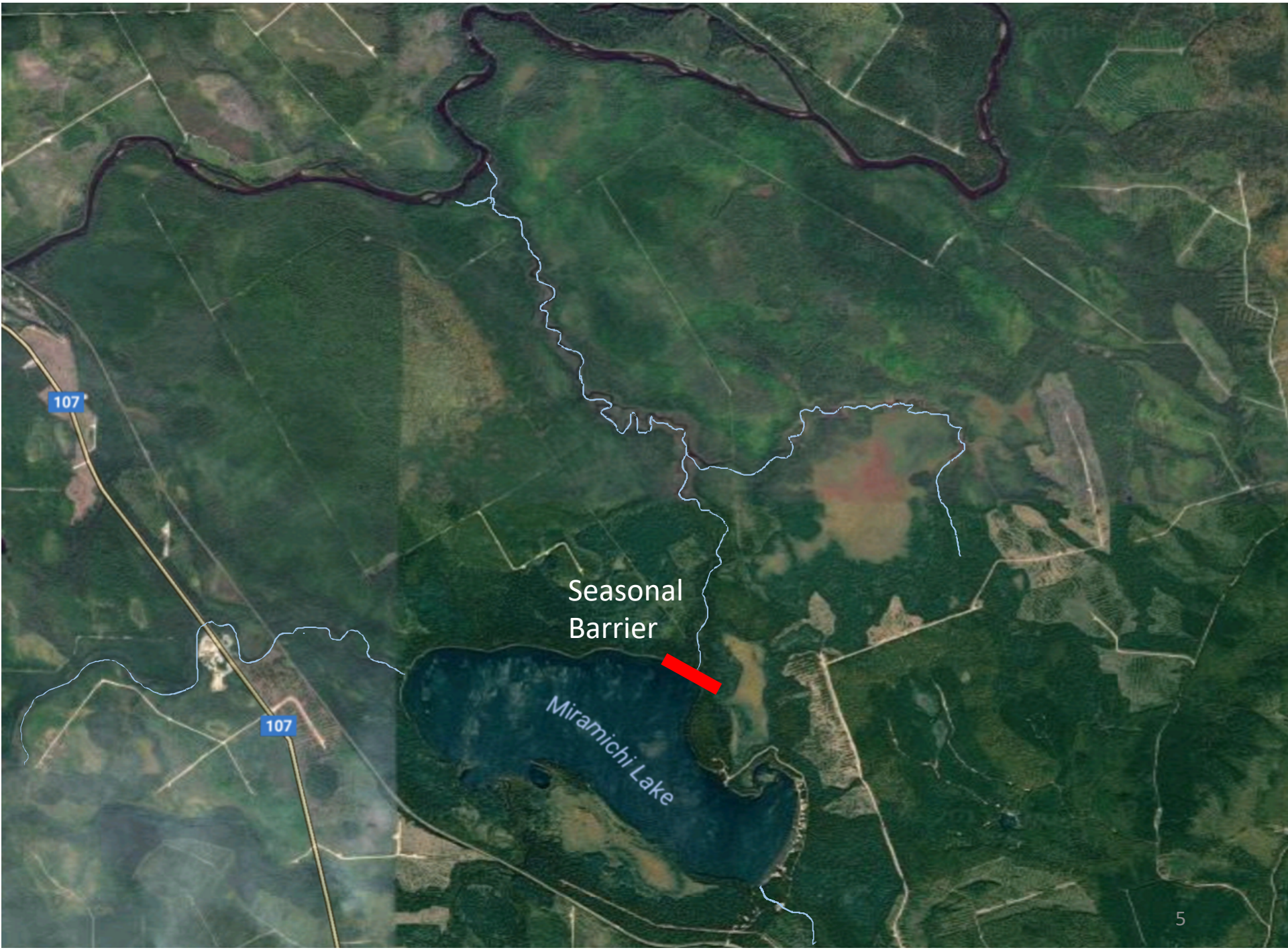
Our Goal

Eradicate Smallmouth bass from the Miramichi watershed

Why?

To protect the integrity of the native ecosystem and everything that it supports – Indigenous food fisheries, recreational fisheries, culture


NW Miramichi
SW Miramichi
Miramichi Lake
N
Legend
Northwest Miramichi Watershed
Southwest Miramichi Watershed
River
Lake
0
15
30
60 Kilometers


107
107
Seasonal
Barrier
Miramichi Lake


Seasonal
Barrier
Miramichi Lake
107

Background

- **2008** – SMB discovered in Miramichi Lake, illegally introduced
- DFO chooses “contain and reduce” method
- **2015** – Federal Government establishes “Aquatic Invasive Species Regulations”
- **2016** – DFO inaction sparks formation of the Working Group
- Goal: eradicate SMB from the Miramichi watershed
- **2017** – Expert report
  - Key outcomes: feasible, practical, legal
- **2019** – Application submitted to DFO
- SMB discovered in Southwest Miramichi River
- Short-term action plan for the river
- Experts hired to develop eradication plan for the river

Background

2020

- Winter - Experts & Working Group meet with camp owners, First Nations, politicians, government officials
- April - Application amended, re-submitted
- Summer - Fieldwork, logistics planning, eDNA

Expert Report: Eradication Options Considered

Options	Comments
Physical Removal – nets & electrofishing	Eradication is never achieved
Biological Control – predator & pathogen	Too risky
Genetic Manipulation – sterile or triploid individuals	Not developed
Dewatering	Not practical/possible
Explosives – detonating cord	Doesn't work at depths >3m
Piscicide	Rotenone is the most prevalent substance 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.

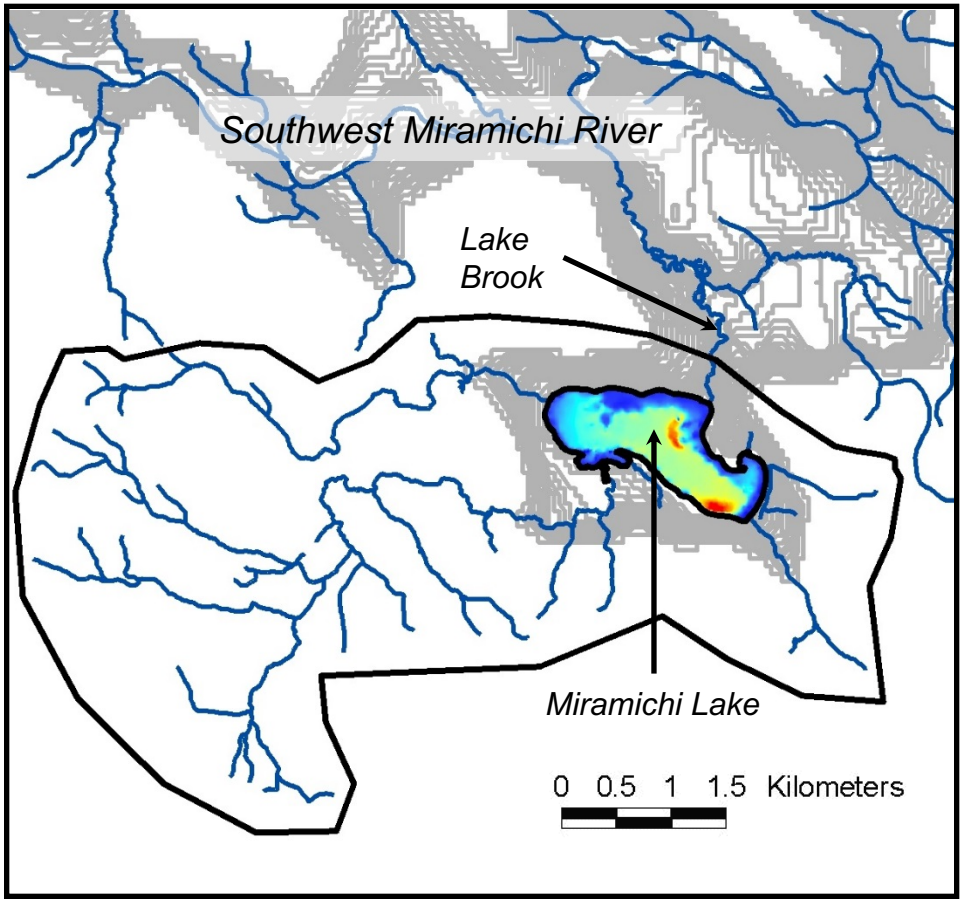
Expert Report Conclusions

Containment and control does not achieve eradication

Use of a piscicide (rotenone) is the only option currently available that has a high probability of achieving SMB eradication in Miramichi Lake

DFO is the responsible agency for invasive species in New Brunswick and eradication using rotenone is now legal under the Aquatic Invasive Species Regulations (AIS)

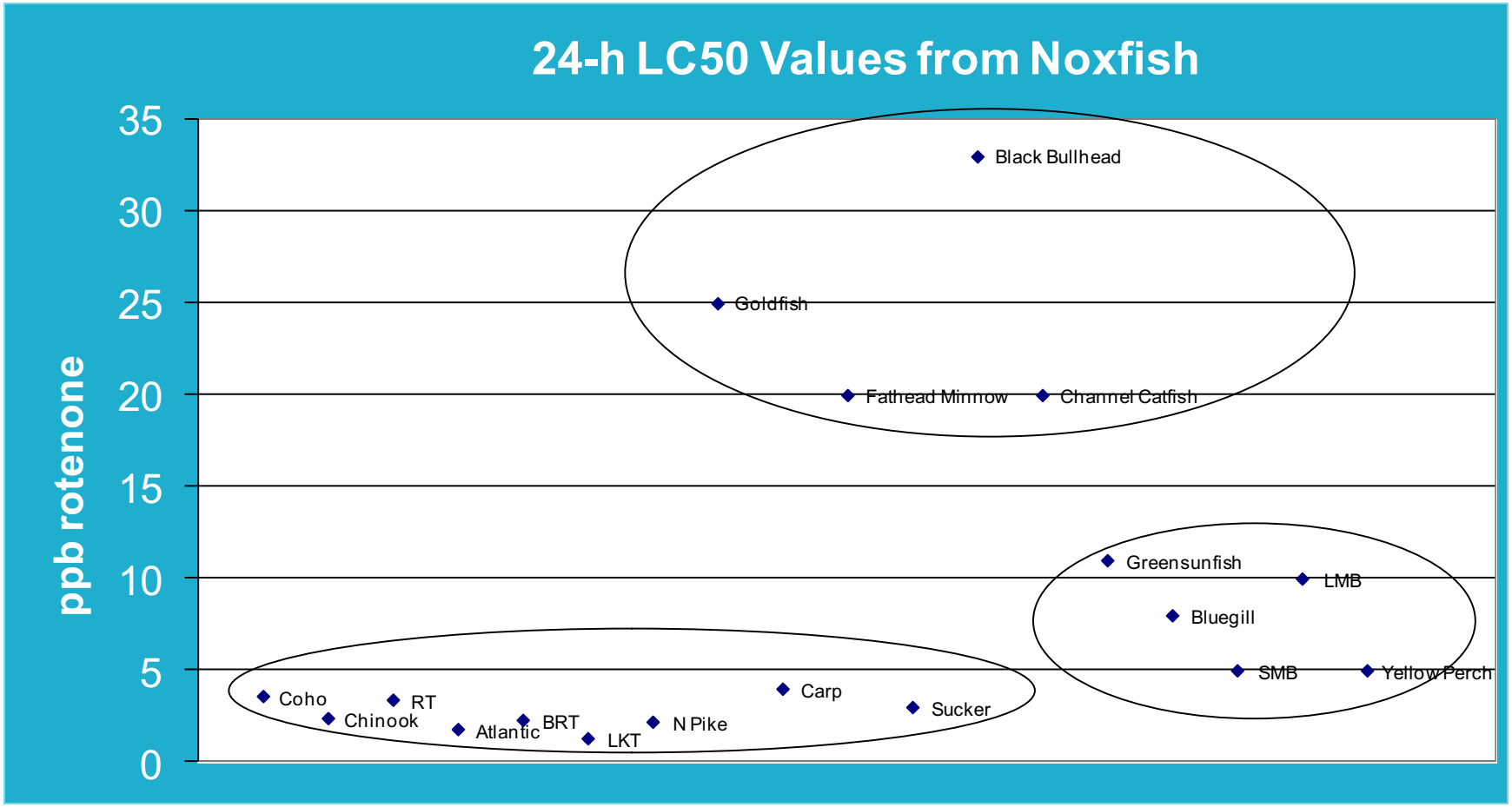
Key Findings: Eradication is now legal, feasible, and practical



Overview of Rotenone

- Botanical – comes from roots of plants in the bean family
- Centuries of use by Indigenous peoples in Asia, Australia & South America
- Insecticide on crops & livestock – certified organic
- Interferes with respiration of gill-breathing animals
- Breaks down rapidly in nature through exposure to light
- Used most commonly worldwide for AIS eradication, including in Canada each year
- Approved for use in Canada by PMRA under Health Canada
- Registered product: Noxfish Fish Toxicant II

Toxicity to Fish



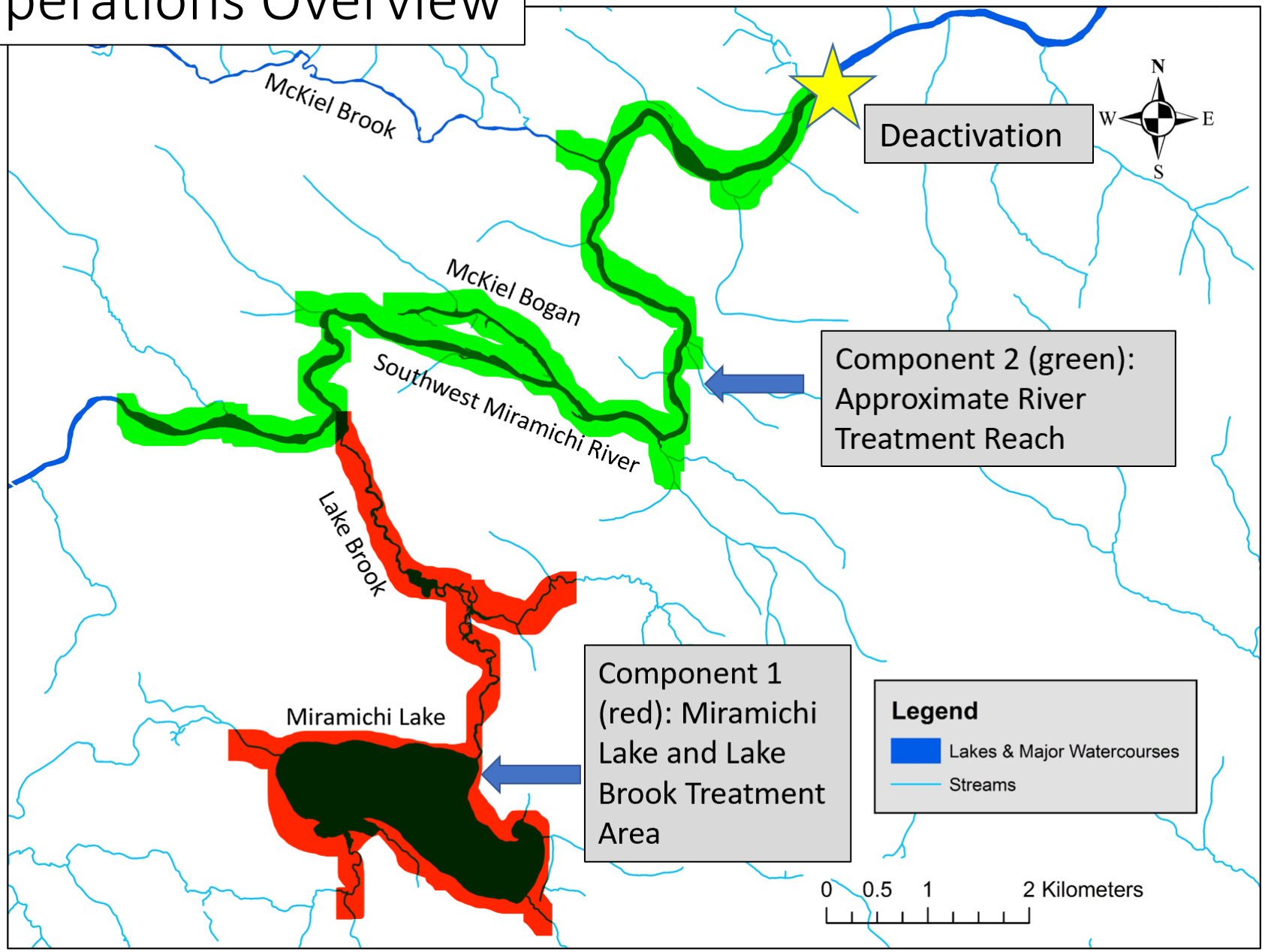
Project Components

1. AIS Application, consultation, public engagement
2. Treatment/deactivation
3. Mitigation
4. Fish re-introduction
5. Monitoring/recovery

Treatment Plan

- **Lake** - Apply rotenone to lake by boat over 2 days at 0.075 mg/L
- Drip stations in tributaries and Lake Brook to ensure coverage
- **River** - Drip stations at sites along 15 km reach of SW Miramichi River
- Applied by certified pesticide applicator team
- Naturally rapid breakdown of rotenone and other inert formulation ingredients of Noxfish II
  - 2.5 days half life
  - Undetectable after ~18 days
- Deactivation at downstream extent of treatment area
- Monitoring of rotenone levels during/after treatment
- Dead fish collection/disposal

Operations Overview



Comparison of Miramichi Lake to Successful Lotic Eradications

Parameter	Miramichi Lake - NB (SMB)	Gardom 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)	11.6			53.0	51.6
Temperature range (°C)	18-23			8-17	8-17
pH	7.3			9.7	7.5
Rotenone (ppm)	0.075	0.200	0.150	0.110	0.063
Rotenone $DT_{½}$ (d)	2.5 (est.)	≈2.0	≈2.3	4.5	5.6
Rotenone Longevity (d)	15 (est.)	≈14	≈14	39	34

Comparison of SW Miramichi River 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 m^3/s deleted.

Timing of Application

- Late August or early September
- Warm water temperatures
  - Active SMB & rapid response time
  - Rapid dissipation of rotenone
- Minimum discharge to minimize rotenone & $KMnO_4$
- SMB spawning/hatching completed
- Zooplankton and invertebrate eggs unaffected
- Post-spawned gaspereau and majority of juveniles will be gone

Mitigation & Monitoring

Mitigation

- Treatment timing in fall to avoid gaspereau presence
- Deactivation of rotenone at downstream extent of treatment
- Adult salmon relocation from SW Miramichi River
- Transplantation of non-migratory species from nearby lakes

Monitoring

- Carried out by Indigenous technicians for 5 years to document recovery
- 4 components
  - Treatment effectiveness, rotenone breakdown, SMB presence, ecological recovery
- Recovery expected to be rapid
  - Invertebrates and zooplankton typically return to pre-treatment levels within one year post-treatment and serve as the food base
  - Migratory species expected to re-colonize quickly

Mitigation & Monitoring

Species at Risk Considerations

- Mussel survey conducted by Anqotum, Brook Floater found
- Rotenone treatment level below known freshwater mussel toxicity values
- Provincial review of species at risk:
  - Atlantic salmon
  - American eel
  - Wood turtle
- Province concluded that long-term threat of SMB to ecosystem and Species at Risk outweighs short-term temporary impact of treatment

Overall, the treatment is a conservation action that will help protect the ecosystem and Species at Risk

Public Safety

- Noxfish II registered for use in Canada under PMRA
- Treatment applied by certified applicator team
- Applied according to product safety protocols
- Public protected by prohibiting contact with treated water for 3 days
- Rotenone used safely for decades, undergone many public safety reviews
- Does not penetrate substrate more than a few centimeters
- Not a risk to groundwater

Public Relations Plan

- First Nations & Indigenous communities, camp owners, NGOs, politicians
- Community meetings – to inform and hear concerns
- Media communications
- Education

Summary

Treatment/deactivation

Mitigation

- Timing
- Species at Risk
- Atlantic salmon

Fish re-introduction

- Goal is reproducing populations
- Transplant from nearby lakes if not naturally recolonizing

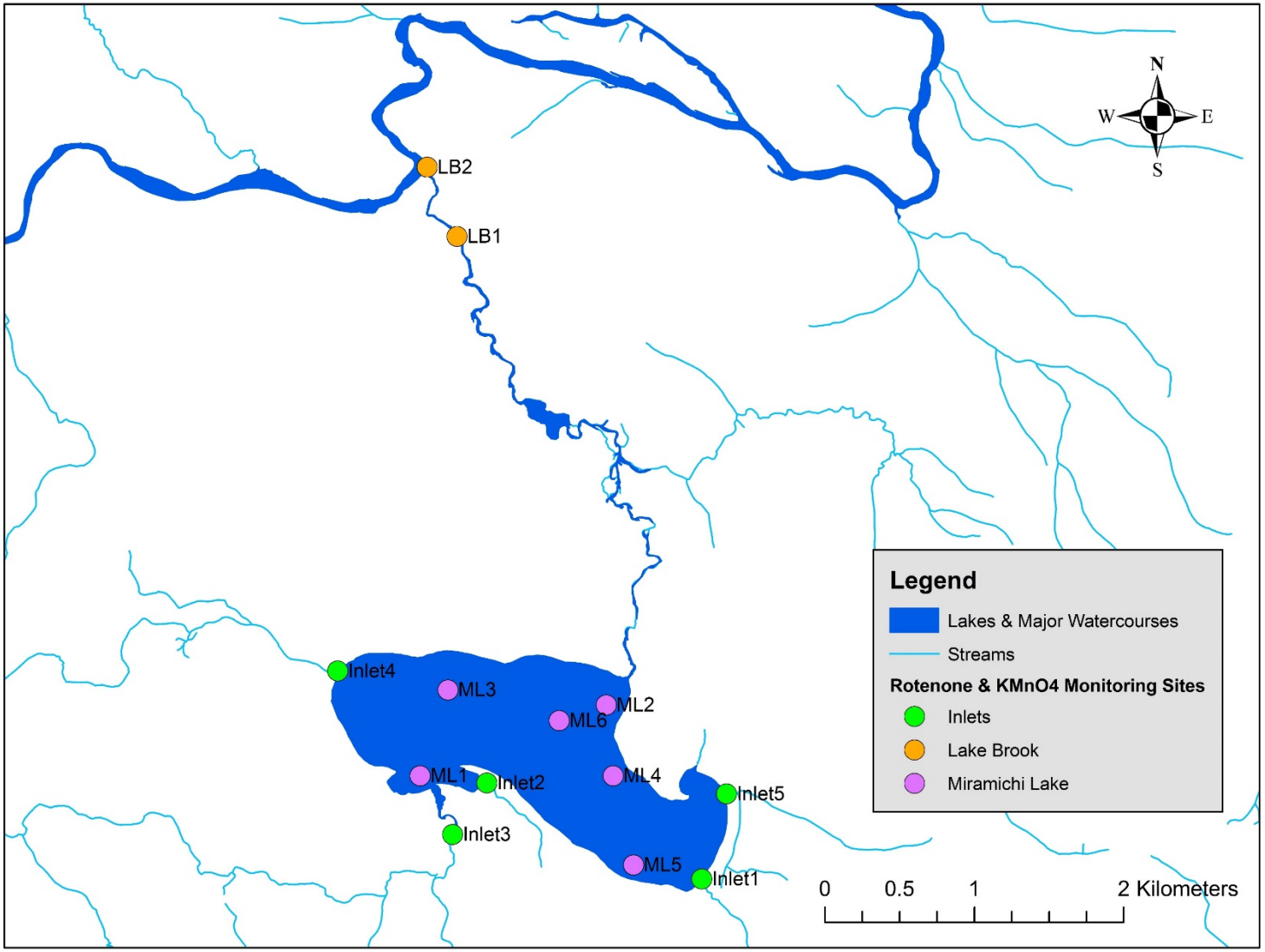
Monitoring (5 years)

- Led by indigenous biologists and technicians
- Document ecosystem recovery, expected to be rapid

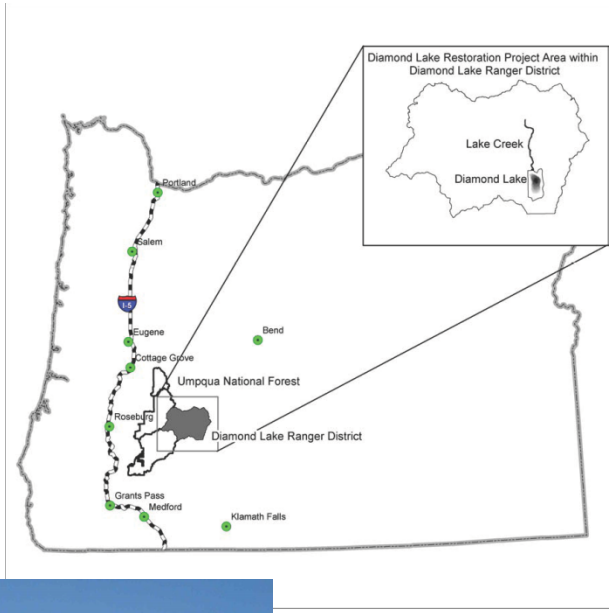
This effort is a conservation action that will help protect the Miramichi ecosystem from permanent colonization by SMB

Questions

Lake Monitoring Sites

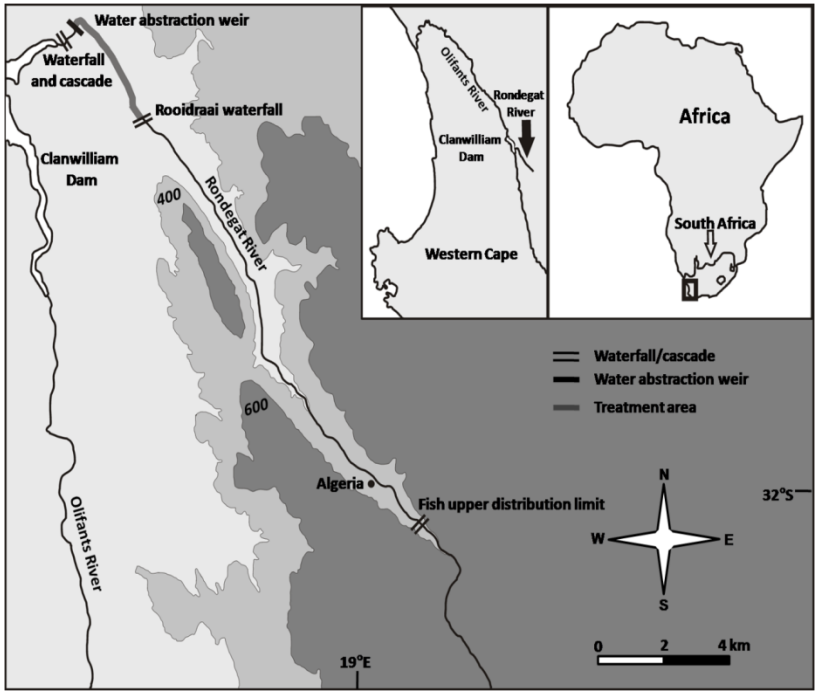


Tui Chub Eradication
Diamond Lake, Oregon

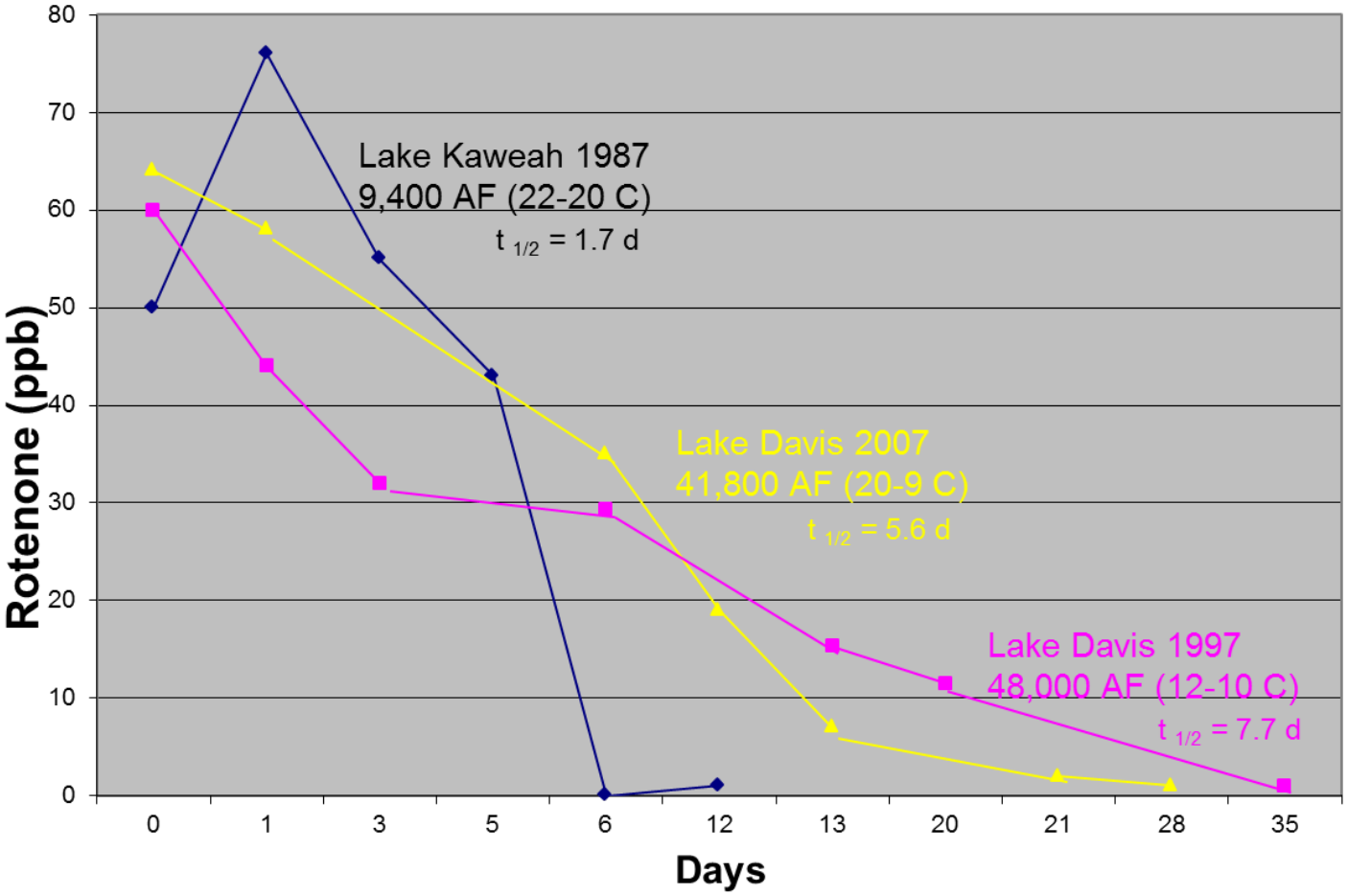


Eradication of Smallmouth Bass Rondegat River, South Africa

https://www.youtube.com/watch?v=bauVkU9hQ0s



Persistence in California Lakes



Weaknesses & Limitations of Rotenone Eradication Projects

- Insufficient planning & crew training (often emergencies)
- Inaccurate/incomplete target species mapping
- Insufficient rotenone exposure (low concentration & short exposure) & not correcting for dissipation over time & space
- Insufficient real-time monitoring to judge/correct for effectiveness of treatment & deactivation
- Generally, declining success rate with increasing treatment size & complexity due to compounding of the 4 factors above

Lessons Learned (1)

- Treat at rate based on toxicity of product in site water using target fish or surrogate (min 4 x LC_{50} value)
- Identify & verify presence/absence of target fish within eradication area & effectiveness of fish “barriers”
- Treat all known water within eradication area capable of affecting treatment including upwelling groundwater
- Utilize sentinel fish in strategic locations to allow for real-time corrections of rotenone and $KMnO_4$ rates
- Treat when water temperatures >10 °C
- Train crew on proper use of PPE & equipment

Lessons Learned (2)

- Begin deactivation prior to rotenone application to exhaust organic demand of streambed
- Have a backup deactivation system ready
- Monitor rotenone/$KMnO_4$ residues to demonstrate
  - Ability to attain prescribed rotenone dosage in treatment area
  - Ability to deactivate rotenone below treatment area
- Divide drainage into smaller manageable segments if necessary & feasible
- Treat an impoundment w/i 2 d & install booster stations on flowing waters (1-2 h travel time) to correct for dissipation

[DELIVERED VIA EMAIL] *Ref: WNNB [047-20]*

July 6, 2020

James P. Ward
General Manager
North Shore District Micmac Council

Re: Review of Application: Eradication of Invasive Smallmouth Bass from Miramichi Lake, NB

Dear Jim:

The following is a review of the proponent's application to authorize the deposit of a deleterious substance pursuant to the Aquatic Invasive Species Regulations. The following questions need to be addressed.

1. Proponent states that zoo plankton levels will recover in Spring, post treatment. There needs to be additional literature or further reasoning.

Justification: Studies have shown that rotenone is toxic to zoo plankton (the basis of all food in the food web in aquatic systems)[1]. Literature is very sparse in terms of recovery times of various species, since this approach is only used in dire cases like the introduction of an invasive species. But, recovery rates of the zooplankton population ranged from 1 month to 3 years depending on the species. The paper concluded that it took ultimately 3 years for the zooplankton population to recover to its pre-treatment abundance[2].

2. Proponent states that macroinvertebrate levels will recover the following spring after treatment. Literature shows that this is not the case. A majority of species will take longer than 8 months to recover. And in some cases, they will be extirpated from the system. We request additional information.

[1] Brown, D.C. & R.C. Ball. 1942. An experiment in the use of derris root (rotenone) on the fish and fish food organisms of Third Sister lake. Trans. Am Fish Soc 72: 267-284.
[2] Anderson, R.S. 1970. Effects of rotenone on zooplankton communities and a study of their recovery patterns in 2 mountain lakes in Alberta. J. Fish Res Board Can 27: 1335- 1356.

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150 CLIFFE ST. (2nd FLOOR), BOX 14
FREDERICTON, NB | E3A 0A1
t 506.459.6341 | f 506.459.0974

Justification: Macro invertebrates within the lake and brook, a 30-year monitoring study after rotenone treatment was conducted from 1977 to 2007[3]. They found a complete recovery of the macroinvertebrate system and established breeding populations. A time frame of when the populations recovered was not discussed. It is very likely that a majority of the inveterate population will recover after 5 years[4]. While I do recognize that some populations may recover faster, due to the lack of predators within the system, we request additional information or literature that would support your reasoning.

Table 3. Post-rotenone recovery of Strawberry River taxa - Station 3

Recovery Time	Taxa Recovered
0 months (Not Missing)	*Paraleptophlebia sp., Hydropsyche sp., Optioservus sp., Zaitzevia sp., Hexatoma sp., Tipula sp.*, Simuliidae, Chironomidae, *Chelifera sp., Bezzia sp., Pericoma sp., Euparyphus sp., Ostracoda, Oligochaeta, Hydracarina sp., Nematoda*
8-12 months	*Heptagenia sp., Drunella doddsi, Drunella grandis, Baetis sp., Cultus sp., Amphinemura sp., Podmosta besameta,* Capniidae, *Eucapnopsis sp., Isoperla fulva, Hesperoperla pacifica, Sweltsa coloradensis, Arctopsyche grandis, Dicosmoecus sp., Hydroptila sp., Rhyacophila hyalinata, Rhyacophila vagrita, Agabus sp., Atrichopogon sp., Limnophora* sp.
20-24 months	*Epeorus longimanus, Rhithrogena hageni, Serratella tibialis, Zapada haysi, Kogotus modestus, Plumiperla diversa, Hesperophylax sp., Helicopsyche borealis, Rhyacophila acropedes, Lepidostoma sp., Antocha monticola, Dicranota sp., Sialis* sp.
32-36 months	*Drunella coloradensis, Suwallia pallidula, Dixa* sp.
47 months	*Brachycentrus americanus*
Still missing after 5 years	*Caudatella hystrix, Podmosta delicatula, Isogenoides sp., Oligophlebodes sp.*, Carabidae

3. Reestablishment strategy was lacking any scientific backing on allowing “natural recolonization” or the number of fish that would be introduced. We request additional literature or reasoning behind the fish numbers.
4. Pre-post monitoring is not frequent enough to discover a trend or recovery or impact. We request further reasoning of how the proponent came to this.

[3] Ferreras-Romero, M., J. Marquez-Rodriguez, & C. Fernandez-Delgado. 2016. Long-time effect of an invasive fish on the Odonata assemblage in a Med

[4] Mangum, F.A. & J.L. Madrigal. 1999. Rotenone Effects on Aquatic Macroinvertebrates of the Strawberry Rover, Utah: a Five-year Summary. Journal of Freshwater Ecology 14.

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Justification: Proponent states that after post treatment monitoring, the monitoring would be done annually. While we do agree with the parameters of testing, the frequency is not enough. We request it be changed to 4 times a year (Spring, Summer, Fall, Winter) to find a trend of recovery and constant updates to adapt their post-management plan. The more information we collect, the better we can adapt a contingency plan, if the treatment is not successful. There can not be a proper contingency plan without any data of how populations responded. The time and cost of sampling is minimal, compared to the actual treatment and should be do-able.

Woliwon / Wəliwən,

Shyla O'Donnell
Wolastoqey Nation in New Brunswick
Consultation Director

cc: Russ Letica, RDCC, Matawaskiye (Madawaska Maliseet First Nation)
Jamie Gorman, RDCC, Neqotkuk (Tobique First Nation)
Amanda MacIntosh, RDCC, Wotstak (Woodstock First Nation)
Richard Francis, RDCC, Pilick (Kingsclear First Nation)
Tim Plant, RDCC, Sitansisk (St. Mary's First Nation)
Fred Sabattis Jr, RDCC, Welamoktok (Oromocto First Nation)
Gillian Paul, Legal and Governance Advisor, WNNB
Dr. Colin Curry, Fisheries Biologist, WNNB
Gordon Grey, EIA Coordinator, WNNB
Michael Arsenault, Fisheries Analyst, WNNB

Devin Ward, Anqotum
Victor Gionet, Anqotum
Nathan Wilbur, Atlantic Salmon Federation

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July 21st, 2020

Paulette Hall
Director, Ecosystems Management
Fisheries and Oceans Canada
Gulf Region
343 Université Avenue
PO Box 5030
Moncton, NB, E1C 9B6

RE: Application to deposit a deleterious substance, the piscicide Noxfish fish toxicant II with active ingredient rotenone, into Miramichi Lake, Lake Brook, and a section of the SW Miramichi River

Dear Ms. Hall,

On behalf of the New Brunswick Aboriginal Peoples Council (NBAPC), and the Maritime Aboriginal Aquatic Resources Secretariate (MAARS), the Aquatic Resources and Oceans Management (AAROM) body administered by the Maritime Aboriginal Peoples Council (MAPC), we are writing this letter in response to Fisheries and Oceans Canada's (DFO) request from Paulette Hall, Director, Ecosystems Management, Gulf Region to the Chief and President of NBAPC on May 4th, 2020 to engage on the application submitted by the North Shore Micmac District Council (NSMDC) to deposit a deleterious substance, the piscicide Noxfish fish toxicant II with the active ingredient rotenone into three parts of the Miramichi watershed: Miramichi Lake, Lake Brook, and a 15km stretch of the Southwest Miramichi River.

ORGANIZATION BACKGROUND

NEW BRUNSWICK ABORIGINAL PEOPLES COUNCIL

The New Brunswick Aboriginal Peoples Council (NBAPC), first organized as the New Brunswick Association of Métis and non-Status Indians, was formed in 1972 as the voice for (now) approximately 21, 915 off-Reserve Status and non-Status Aboriginal People continuing to reside on their traditional, ancestral homelands throughout the Province of New Brunswick.

Mission Statement

For NBAPC, self-government begins – but does not end – with control over our land. Government means jurisdiction over our renewable and non-renewable resources, education, health and social services, public order and the shape and composition of our political institutions. While some of our plans may sound far-reaching to some people, they should not be regarded as a threat. We do not want to recreate a world that has vanished. We do not want to turn back the clock. Far from it. We welcome the challenge to see our culture grow and change in directions that we have chosen for ourselves. We do not want to become the objects of sentimentality. Nor do we want our culture to be preserved in amber for the amusement or even the edification of others. What we do want, what we demand, is nothing more than control over our own lives and destiny. That control is called "SELF-GOVERNMENT".

Goals

NBAPC maintains six primary goals to serve the community, they are as follows:

1. To provide an organization for Off-Reserve Aboriginal People in New Brunswick for the purpose of advancing their cultural, traditional, economic and general living conditions.
2. To work together toward reaffirmation, protection and implementation of our Aboriginal, Treaty and Land Claim Rights as Aboriginal People of New Brunswick.
3. To work with all levels of government, public and private agencies and private industry to improve social, educational and employment opportunities for people of Aboriginal Ancestry of New Brunswick.
4. To foster and strengthen cultural identity and pride among people of Aboriginal Ancestry in New Brunswick.
5. To inform the general public of the special needs and rights of the people of Aboriginal Ancestry of New Brunswick and of their efforts to achieve full participation in the economic, social and political life of the Province.
6. To co-operate with all other Aboriginal Organizations whose aims are similar to those of this society.

MARITIME ABORIGINAL PEOPLES COUNCIL
MARITIME ABORIGINAL AQUATIC RESOURCES SECRETARIATE

The Maritime Aboriginal Peoples Council (MAPC) is the intergovernmental forum for three partner Native Councils, the: New Brunswick Aboriginal Peoples Council (NBAPC), Native Council of Nova Scotia (NCNS), and the Native Council of Prince Edward Island (NCPEI). MAPC also administers an Aboriginal Aquatic Resources and Oceans Management (AAROM) body, the Maritime Aboriginal Aquatic Resources Secretariate (MAARS), which provides expertise to the three Councils on matters related to aquatic resources, the fishing industry, aquaculture, oceans management, and governance.

MAARS has worked with NBAPC to review the deposit of a deleterious substance discussed in the proposal from the NSMDC. We have reviewed associated literature, case studies, and spoken with experts to provide a fulsome response to DFO and the project proponents outlining our opposition

related to the deposit of the piscicide Noxfish fish toxicant II for the purpose of eradicating smallmouth bass (*Micropterus dolomieu*) in the SW Miramichi watershed.

PROPOSAL

UNDERSTANDING OF THE PROPOSAL

Having been involved in the review of the application both prior to and preceding the amendment to include the ~15km section of the SW Miramichi River, NBAPC and MAARS have familiarized themselves with the details of the application, examined aspects related to the application, impacts of, components of, and dissipation of rotenone and the deactivator potassium permanganate. NBAPC and MAARS sought out additional information about the characteristics of smallmouth bass, in addition to the opinions of a number of biologists, chemists, and ecologists familiar with the various components of the application (e.g., smallmouth bass, eradication, Miramichi watershed). Various case studies involving the use of rotenone in other areas were also examined and taken into consideration. Additionally, MAARS has experience and expertise in matters related to biological diversity, ecological integrity, Atlantic salmon, associated Canadian environmental legislation, and fisheries. We are confident in our ability to review and interpret the information contained within the application from an empirical standpoint.

As we understand the proposal, the proponent, the NSDMC has made application to DFO to receive an authorization to deposit a deleterious substance, the registered product Noxfish fish toxicant II (Noxfish II), into Miramichi Lake, Lake Brook, and ~15km of the SW Miramichi River for the purpose of eradicating the aquatic invasive species, smallmouth bass. It is our understanding that the primary rationale for seeking this authorization is to prevent smallmouth bass from further dispersing into the watershed and impacting local Atlantic salmon populations.

PREVIOUS RESPONSES/STANCE OF NBAPC AND MAPC

Both NBAPC and MAPC have previously provided letters of opposition to the project when the proposal included only two locations: Miramichi Lake and Lake Brook. At that time, the former NBAPC Natural Resources Manager, Adam Samms, had expressed that the Council could not support the proposal due to concerns about the impacts to other species used by community members. Mr. Samms provided a number of recommendations, including: continuing and increasing the frequency of management and mechanical control measures; developing a plan to prevent the reintroduction of smallmouth bass; and plan adequately for preventing the destruction of the ecosystem.

Similarly, MAPC noted the documented catch, as well as the anecdotal reports, of smallmouth bass outside of the proposed area (at the time, only Miramichi Lake and Lake Brook) which required follow up by DFO. MAPC further raised concerns about the lack of research on the long-term effects of rotenone-based piscicide application. Most importantly, MAPC agreed that there needed to be some action to restrict the movement and population growth of smallmouth bass throughout the Miramichi watershed, but was not convinced that the use of a broadband piscicide would solve the problem, particularly considering that the introduction of smallmouth bass was intentional for the purposes of sportfishing.

PROPOSAL DEFICIENCIES

The burden of proof lies with the proponent to ensure that the purported benefits defined within the application are adequately described with supporting evidence or a plan to collect said evidence. Upon review of the application, NBAPC and MAARS have identified the following deficiencies, the rationale for determining that the proposal is deficient is outlined within the sections below:

- Does not detail how the eradication of smallmouth bass in the three proposed areas will benefit Atlantic salmon
- Does not consider the broader ecosystem
- Does not consider the impacts that may be caused by the other components of the piscicide
- Does not consider unintended consequences
- Does not consider the impact on other Rightsholders
- Does not describe how the risk of re-introduction will be managed
- Is misinformed about the extent of smallmouth bass distribution

ECOSYSTEM

ATLANTIC SALMON

While we can understand the urgent need for Atlantic salmon conservation measures, there is some uncertainty as to how this project will directly benefit the species and whether a piscicide application is justifiable in its manipulation of biodiversity, looking outside the scope of solely Atlantic salmon. The burden of proof to demonstrate the direct benefits towards Atlantic salmon falls to the proponent and that has not been adequately provided.

To date, there is little literature that can help predict the ecological impacts that smallmouth bass will have on Atlantic salmon productivity and abundance. Additionally, since the discovery and sampling of smallmouth bass only dates back to 2008, there is little information known regarding their population size and structure in the Miramichi watershed and the ecological impacts they have on native fish communities thus far, including Atlantic salmon.

With the main goal of this project being to eliminate and reduce the negative impacts that this invasive species has on Atlantic salmon, there is a need to examine other stressors facing the species and assess the tangible benefits that will arise from the eradication of smallmouth bass alone, if successful. It is also important to ensure that this proposal is not being perceived as an initiative to 'end all problems' if eradication is achieved, but rather a small step in conservation towards the Gaspe–Southern Gulf of St. Lawrence Atlantic salmon population, recognized by COSEWIC as a species of special concern.

State of Atlantic salmon

The Atlantic Salmon Federation (ASF) publishes an annual *State of Wild Atlantic Salmon Report* which provides details about annual returns for spawning adults to the regions defined by ICES (International Council for the Exploration of the Sea): Labrador, Newfoundland, Quebec, Gulf of St. Lawrence, and Scotia-Fundy. While the details are not consistently reported, the data on returns has shown a general decline, with most years since 2015 not meeting the conservation limits for the Gulf of St. Lawrence.

The most recent report, published on June 25th, 2020, showed the lowest number of returning fish in the 49-year data series, bringing into consideration the major threats facing the species including warming river temperatures, changing ocean conditions and pressure from human development. This brings into question the feasibility of the project resulting in any sizeable advancement towards increasing Atlantic salmon populations to sustainable levels, if at all.

Unknown predator-prey interactions

It is widely known that Atlantic salmon face high levels of predation at sea (or in estuaries) and that this is a key contributing factor in the declining number of returning spawning adults. While inland, it has been documented (Carr & Whoriskey, 2009)[1] that smallmouth bass prey on out-migrating salmon smolts, the significance of this predation and its effects on the greater population are unknown. Further, the role that smallmouth bass play in displacing other species that prey on Atlantic salmon in the Miramichi watershed should be examined, including yellow perch (Sanderson et al., 2009)[2], brook trout (Mohler et al., 2002)[3] and striped bass (Blackwell & Juanes, 1998)[4] to fully understand the possible food web alterations leading to ecological imbalance, or potential steady predation rates on Atlantic salmon.

While it can be suggested that smallmouth bass will prey upon juvenile salmon, with the lack of data provided, there is an urgent need to examine their stomach contents throughout the Miramichi watershed to prove their predation on salmonids. This data should be forefront in the justification of the eradication proposal, and yet there is no mention of confirmed smallmouth bass predation despite years of capture data. For example, stomach content analyses in the Penobscot River in Maine, U.S. expected to find high predation rates of smallmouth bass on Atlantic salmon, and instead they found no smolts in the stomach contents (van den Ende, 1993)[5]. Conversely, large numbers of out-migrating Pacific salmon smolts were found in the stomach contents of smallmouth bass in watersheds in Washington, U.S. (Fresh et al., 2003)[6]. Due to the complexity of the habitat, available food sources and overlap between the species, there can be no sound prediction made on how smallmouth bass predation will affect Atlantic salmon.

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[1] Carr, J.W. & Whoriskey, F.G. (2009). Atlantic Salmon (*Salmo salar*) and Smallmouth Bass (*Micropterus dolomieu*) Interactions in the Magaguadavic River, New Brunswick. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/074. iv + 10 p.

[2] Sanderson B, Barnas K.A, & Wargo Rub A.M. (2009). Nonindigenous species of the Pacific Northwest: an overlooked risk to endangered salmon? *Bioscience*, *59*, 245- 256.

[3] Mohler, J. W., M. J. Millard, & Fletcher, J.W. (2002). Predation by captive wild brook trout on calcein-marked versus nonmarked Atlantic salmon fry. *North American Journal of Fisheries Management*, *22*, 223–228

[4] Blackwell, B.F. & Juanes, F. (1998). Predation on Atlantic Salmon Smolts by Striped Bass after Dam Passage. *North American Journal of Fisheries Management*, *18*, 936-939.

[5] van den Ende, O. (1993). Predation on Atlantic salmon smolts (*Salmo salar*) by smallmouth bass (*Micropterus dolomieu*) and chain pickerel (*Esox niger*) in the Penobscot River Maine. MSc Thesis. University of Maine.

[6] Fresh, K.L., Rothaus, D., Mueller, K.W. & Waldbillig, C. (2003). Habitat utilization by smallmouth bass in the littoral zones of Lake Washington and Lake Union/Ship Canal. Greater Lake Washington Chinook Workshop. King County Department of Natural Resources. January 24, 2003. Shoreline, WA. Retrieved from https://www.govlink.org/watersheds/8/pdf/Fresh-Abstract03.pdf

We respect the use of the precautionary principle in presuming that this invasive species will have a negative impact through high predation rates on Atlantic salmon; however, the proponent has failed to provide evidence of this in the Miramichi watershed specifically before proposing the drastic measure of applying a broadband piscicide. As this proposal is based on eradicating smallmouth bass due to concerns regarding the impact that they will have on Atlantic salmon, proof of predation and dominance should be at the forefront of this application before introducing a toxicant to the entire ecosystem and the species inhabiting it.

Ecological impacts

While it is known that smallmouth bass are capable of establishing themselves in watersheds quite easily once introduced, researchers have documented different ecological impacts in lotic and lentic systems – something that needs to be considered in the Miramichi eradication plan, especially given that there is concern that they will expand their range (if they have not already) into the river system.

Since the discovery of smallmouth bass in the Miramichi watershed in 2008, sampling has occurred annually and there has been only one documented capture of an Atlantic salmon smolt in Miramichi Lake in 2010 (Chaput & Moore, 2018)[7]. While smallmouth bass in lentic systems are predicted to have high ecological impacts with low uncertainty, there is no concern in this case for Miramichi Lake as Atlantic salmon do not utilize it to the least (DFO, 2009)[8]. Similarly, DFO (2019)[9] suggests that there is no evidence shown in the catch data that smallmouth bass have negatively impacted other native fish communities in Miramichi Lake thus far, although it is acknowledged that this may be skewed due to the intensive control and reduction measures implemented.

Instead, the problem lies with smallmouth bass establishing themselves in the Southwest Miramichi River and Lake Brook, where there is overlap between the two species. Smallmouth bass are suggested to have reduced ecological impacts on native species in lotic systems due to the availability of more spatially complex habitats and because predation risk primarily depends on the overlap of predator-prey habitat and habits (Hampton, 2004)[10]. A study examining Atlantic salmon and smallmouth bass in an in-situ river scenario can provide insight into ecological interactions between the species, information that is rather unknown in ex-situ cases. Wathen et al. (2009)[11] suggests that Atlantic salmon did not change their initial habitat upon smallmouth bass invasion as expected, and that the two species displayed different diel activity patterns (nocturnal v. diurnal) meaning that the interspecific competition was low due to spatial and temporal habitat partitioning, although, these results could vary wildly in a natural setting.

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[7] Chaput, G., & Moore, D. (2018). Results of a control and eradication program for illegally introduced smallmouth bass (Micropterus dolomieu) in Miramichi Lake, New Brunswick, 2010. Can. Tech. Rep. Fish. and Aquat. Sci. 3273. 53 p

[8] DFO. (2009). Potential Impact of Smallmouth Bass Introductions on Atlantic Salmon: A Risk Assessment. DFO Can.Sci. Advis. Sec. Sci. Advis. Rep. 2009/003.

[9] DFO. (2019). Review of elements of proponent application to use rotenone for the purpose of eradicating Smallmouth Bass (Micropterus dolomieu) from Miramichi Lake, New Brunswick. DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/040.

[10] Hampton, S.E. (2004). Habitat overlap of enemies: temporal patterns and the role of spatial complexity. *Oecologia, 138*(3), 475-484.

[11] Wathen, G., Zydlewski, J., Coghlan, S.M., Jr., & Trial, J.G. (2012). Effects of Smallmouth Bass on Atlantic Salmon Habitat Use and Diel Movements in an Artificial Stream. *Transactions of the American Fisheries Society. 141*, 174-184.

Alternative control methods

Before using a lethal piscicide, it is important to examine the alternative control methods that have been employed since the discovery of smallmouth bass in 2008, and their success (or not) in containing and eradicating the population. While there is no known population size or age structure of the smallmouth bass currently in Miramichi Lake, the annual catch rates using electrofishing, fyke nets and gill nets suggest that the population is quite small (Biron, 2018[12]; DFO, 2013[13]; Biron et al., 2014[14]; Chaput & Moore, 2018[15]). Considering the lower catch-per-unit-effort and reduced distribution of smallmouth bass in the lake (Biron et al., 2014), it could be suggested that these control measures might not be feasible in achieving complete eradication, but they do have the ability to reduce population abundance.

DFO (2019) similarly suggests that while electrofishing, angling and netting may have a lower success rate for eradication, they are successful in their ability to suppress smallmouth bass abundance. While it is understood that the use of a piscicide, including Noxfish II, is proposed to have the highest success rate for eradication (DFO, 2009; Halfyard, 2010[16]), the continuation of intensive control measures should not be disregarded in their ability to reduce the population size and mitigate potential negative impacts towards Atlantic salmon.

Due to the lack of understanding of the current population size and establishment, it is difficult to predict the scale and the effects that smallmouth bass have had or will have on Atlantic salmon. Scale samples from captured smallmouth bass throughout 2009-2012 suggested ages ranging from 0+ - 11+ years (Biron, 2018). This study concluded that some fish captured were 2000 cohorts, and suggests that they have been co-inhabiting the waters with Atlantic salmon for multiple years going undetected and showing no obvious signs of negative ecological impacts.

BROADER ECOSYSTEM CONSIDERATIONS

Biological Diversity

Canada is a proponent of, and the first industrialized country signatory to, the UN Convention on Biological Diversity (CBD) in 1992. During the drafting of the CBD, a great deal of discussion occurred regarding the conservation of biodiversity, resulting in 42 Articles and three Annexes. Article 8: In-situ Conservation, includes section 8(h) which describes how States shall handle alien species: "prevent the of introduction of, control, or eradicate those alien species which threaten ecosystems, habitats or species". Much emphasis was, and is still, placed on the paramountcy of preventing introductions, as

[12]Biron, M. 2018. Review of the control and monitoring activities for Smallmouth Bass (Micropterus dolomieu) in Miramichi Lake, New Brunswick, in 2009 to 2017. Can. Manuscr. Rep. Fish. Aquat. Sci. No. 3166: ix + 38 p.

[13] DFO. 2013. Review of control and eradication activities in 2010 to 2012 targetting Smallmouth Bass in Miramichi Lake, New Brunswick. DFO Can. Sci. Advis. Sec. Sci. Resp. 2013/012.

[14] Biron, M., Clément, M. Moore, D., and Chaput, G. 2014. Results of a Multi-year Control and Eradication Program for Smallmouth Bass (Micropterus dolomieu) in Miramichi Lake, New Brunswick, 2011-2012. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/073.

[15] Chaput, G., and Moore, D. 2018. Results of a Control and Eradication Program for Illegally Introduced Smallmouth Bass (Micropterus dolomieu) in Miramichi Lake, New Brunswick, 2010. Can. Tech. Rep. Fish. and Aquat. Sci. 3273. 53 p.

[16] Halfyard, E.A. 2010. A review of options for the containment, control and eradication of illegally introduced smallmouth bass (Micropterus dolomieu). Can. Tech. Rep. Fish. Aquat. Sci. 2865.

efforts for control, and especially for eradication, have proved ineffective at best and in many cases disastrous[17].

Successive reports by the CBD, including the Global Biodiversity Outlooks and the Global Assessment Report on Biodiversity and Ecosystem Services, clearly show that the status of biodiversity is much worse now than it was in 1992 (IPBES, 2019)[18]. The downward trend of biodiversity has not been slowed despite numerous efforts to improve the situation, including the Aichi Biodiversity Targets 2011-2020, which called for identifying and managing pathways to prevent the spread of invasive species, as well as controlling or eradicating priority species in Target 9. Canada's 5th National Report to the CBD (Government of Canada, 2014)[19] identifies that the status of invasive species in Canada is in the worst ranking of "impaired" and getting worse. There has been little to no progress on addressing invasive species in Canada, despite years of developing policies, programs, and strategies; one of the main contributors being a lack of understanding about invasive species in Canada. In fact, of the 22 measures for the healthiness and diversity of Canada's ecosystems, 15 showed a worsening or unknown situation (Government of Canada, 2014).

In response to the failure to meet the global targets, Canada and the other 195 signatories to the CBD are currently negotiating a new Global Biodiversity Strategy and set of 20 targets. To succeed, we must: embark on a whole of government, whole of society approach to embrace the 2050 Vision of "Living in Harmony with Nature"; mainstream the concept and value of biodiversity throughout all of society, economy, and government; and address the drivers of biodiversity loss, not the consequences. Above all, we must seek "Transformative Change" built on the model of the "Theory of Change"(Convention on Biological Diversity, 2020)[20].

Instead of attempting to address the direct drivers of biodiversity loss, it is increasingly recognized that a broader approach is required to transform economic, social, and political structures (the indirect drivers of biodiversity loss) in order to attain biodiversity objectives. In other words, actions must be considered together as a whole, so as to avoid the all too common situation of other economic, social, and political priorities undoing or overriding biodiversity priorities. The results of such effort should raise such questions as, what is the overall value of Miramichi Lake, its endemic species, and its alien species, beyond a fisheries valuation? It is noted in the proponent's commissioned expert review paper that invasive alien species are the second most important threat to biodiversity (CRI and Fish Control

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[17] Wittenberg, R., & Cock, M.J.W. (Eds.). (2001). *Invasive alien species: A toolkit of best prevention and management practices.* CAB International, Wallingford, Oxon, UK, xvii - 228

[18] IPBES (2019): *Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* S. Díaz, J. Settele, E. S. Brondízio E.S., H. T. Ngo, M. Guèze, J. Agard, A. Arneth, P. Balvanera, K. A. Brauman, S. H. M. Butchart, K. M. A. Chan, L. A. Garibaldi, K. Ichii, J. Liu, S. M. Subramanian, G. F. Midgley, P. Miloslavich, Z. Molnár, D. Obura, A. Pfaff, S. Polasky, A. Purvis, J. Razzaque, B. Reyers, R. Roy Chowdhury, Y. J. Shin, I. J. Visseren-Hamakers, K. J. Willis, and C. N. Zayas (eds.). IPBES secretariat, Bonn, Germany. 56 pages. https://doi.org/10.5281/zenodo.3553579

[19] Government of Canada (2014). Canada's 5th National Report to the Convention on Biological Diversity. Environment Canada. 114 pages

[20] Convention on Biological Diversity (2020). Zero Draft of the Post-2020 Global Biodiversity Framework. United Nations Environment Program. UNEP/CBD/WG2020/2/3.

Solutions, n.d.)[21]; however, this glosses over the fact that the first threat of habitat loss is so much larger that such comparisons are deceiving.

This is not to say that we should not act, but actions should have a reasonable certainty of long-term success. We are governed by the precautionary principle that "lack of scientific certainty about the various implications of an invasion should not be used as a reason for postponing or failing to take appropriate eradication, containment, or control measures" (Convention on Biological Diversity, 2002)[22]. However, in the case of depositing a deleterious substance into a natural waterbody, the precautionary principle works both ways and there are reports (Dalu et al., 2015; and Wu et al., 2020)[2324] questioning the impacts, including long-term impacts, on previously understudied species (such as planktonic invertebrates and submerged macrophytes).

Can the proponent show that their proposal adheres to the precautionary principle and more importantly, what impact would the proposed actions have on the larger question about how we as a society adopt "Transformative Change" as our new banner for the next generation?

Chemical composition – Noxfish II

Rotenone is often described as a "naturally-occurring" compound that has been used for a millennia, but Noxfish II, and other rotenone-based formulations are no longer anything that could be considered "natural". Although technically 'inert', meaning that these compounds do not readily react with other chemicals, some of the synergistic compounds found within Noxfish II are nevertheless still toxic. Furthermore, these compounds make up the greatest proportion of the formulation, including; benzyl alcohol (20%), propylene glycol (10%), solvent naphtha (52.79%), and naphthalene (0.53%), as compared to the 5% rotenone, the latter of which is where most of the focus rests. Solvent naphtha alone (52.79%, CAS No: 64742-94-5) is described to be "toxic to aquatic life with long lasting effects" (see Safety Data Sheet (SDS) (Comet Chemical Company Ltd., 2015)[25]). Of the estimated 17,372 L of Noxfish II required for one treatment of Miramichi Lake, over 9,170 L of the solution will be solvent naphtha (52.79%; commonly used as "camp fuel"), 92 L of naphthalene, 1,700 L of propylene glycol, and 2,400 L of benzyl alcohol. In comparison, the 5% rotenone in the formulation only equates to a mere 868 L, or as is stated, 5% of the entire solution.

As an example, the SDS for solvent naphtha indicates a median lethal dose (LC50) for rainbow trout at 3.6 mg/L (96 h) and a half maximal effective concentration (EC50) for *Daphnia Magna* at 1.1 mg/L

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[21] CRI and Fish Control Solutions. (n.d.). Smallmouth Bass Eradication in Miramichi Lake. Available from https://www.miramichismallmouth.com/expert-report

[22] Convention on Biological Diversity (2002). *Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species.* Sixth Meeting of the Conference of the Parties. Decision VI/23. Annex. United Nations Environment Program. UNEP/CBD/COP/6/20. Pages 249-261.

[23] Dalu, T., Wasserman, R.J., Jordaan, M., Froneman, W.P., & Weyl, O.L.F. (2015). An assessment of the effect of rotenone on selected non-target aquatic fauna. *PLoS ONE 10*(11), e0142140. doi:10.1371/journal.pone.0142140

[24] Wu, A.P., He, Y., Ye S.Y., Qi L.Y., Lu L., Zhong W., Wang Y.H., & Fu H. (2020). Negative effects of a piscicide, rotenone, on the growth and metabolism of three submerged macrophytes. *Chemosphere, 250.* doi:10.1016/j.chemosphere.2020.126246

[25] Comet Chemical Company Ltd. (2015). Safety Data Sheet: Comsol 150. Retrieved from http://www.cometchemical.com/MSDS/Comsol%20150EN.pdf

(48h). Although expected to remain below the LC50 for rainbow trout, the concentration of solvent naphtha should reach 1.47 mg/L, assuming a molecular weight of 0.86 g/ml coupled with the water and solvent volumes indicated in the proposal, which is above the EC50 for *Daphnia Magna*. Although these synergistic compounds have various uses, including either increasing the toxicity of rotenone (i.e., effectiveness) or, ensuring proper mixing within the lake, the use of rotenone powders (vs. the liquid formulations) is generally recommended to avoid environmental contamination by petrochemical solvents (Ling, 2003); however, it is also understood that a liquid formulation reduces the risk of inhalation and dermal exposure to humans. While we understand that the goal of Noxfish II is to create a toxic environment for aquatic organisms (in this instance, smallmouth bass), very little information has been provided on the persistence and chemical breakdown of these petrochemical solvents.

Recolonization and monitoring

The proponent's application describes the anticipated rapid breakdown of rotenone which is expected to be undetectable after 18 days. In 1997, Lake Davis, California[26] received a treatment of a rotenone-based piscicide to eradicate northern pike. In this case, rotenone and rotenolone (a derivative of rotenone) persisted in the sediments for 55 days post-treatment. Additionally, volatile organic carbons (VOCs) and semi-VOCs persisted in the water for two weeks post-treatment. The persistence was presumed to have resulted from cold water temperatures during the treatment. In this same case, there was an unintended fish kill in a downstream creek due to the neutralization zone not being fully effective. These unintended consequences in the surface water environment of the Lake Davis watershed led to extensive monitoring of well water to ensure the pollutants did not enter the ground water system. The proponent cited that this monitoring effort concluded that the pesticide did not enter the ground water, and therefore that it is unlikely to do so in the area of Lake Miramichi. We are satisfied in this regard (with respect to the groundwater impacts); however, this example is a more substantial demonstration of the unintended consequences that could arise when the results are not as anticipated. While the 1997 treatment was not successful, the lake was treated again in 2007 where the presence of rotenone and rotenolone again persisted longer than anticipated, for six months post-treatment.

Mangum and Madrigal (1999)[27] compared pre and post macroinvertebrate community for a five-year period in the Strawberry River Watershed in Utah after using 3 mg/L Noxfish (0.15 mg/L active ingredient – rotenone) to try and eradicate Utah Chubs (*Gila atraria*) and Utah suckers (*Catostomus ardens*). The invertebrate taxa were classified to the genus and species levels to better determine the effects of the rotenone on the species. Macroinvertebrate samples were collected one week prior to treatment, and 7-10 days following each rotenone application. After the first rotenone application, up to 59% of the taxa was removed. A second application of rotenone further reduced the invertebrate taxa up to 73%. At one Strawberry River monitoring station, after one year, 40% of the macroinvertebrate taxa had not returned – of that 40%, 42% were still missing after five years. At one of the lowest levels of the trophic system, the macroinvertebrate community is extremely important to multiple life stages of many

[26] Details of the case study derived from the Rotenone Review Advisory Committee: Rotenone Review Advisory Committee Final report and recommendations to the Arizona Game and Fish Department, December 31, 2011. Retrieved from https://www.fs.usda.gov/nfs/11558/www/nepa/96742_FSPLT3_2066848.pdf

[27] Mangum, F., & Madrigal, J. (1999). Rotenone Effects on Aquatic Macroinvertebrates of the Strawberry River, Utah: A Five-Year Summary, Journal of Freshwater Ecology, 14:1, 125-135, DOI: 1-.1080/02705060.1999.96663661 Retrieved from https://www.tandfonline.com/doi/pdf/10.1080/02705060.1999.9663661

fish and other aquatic organisms – the removal of a large component of the macroinvertebrates, in addition to the planktonic community, has impacts that last beyond the scope of eradicating a species.

LEGAL

FISHERIES ACT

As is customary, the Canadian *Fisheries Act* contains a version of the non-abrogation or derogation clause which states, in section 2.3, that "this Act is to be construed as upholding the rights of Indigenous peoples recognized and affirmed by section 35 of the Constitution Act, 1982, and not as abrogating or derogating from them." NBAPC has requested of DFO to add the smallmouth bass to the Aboriginal Fisheries Strategy (AFS) agreement for the Gulf region in the past. Recognizing that Indigenous peoples are resourceful peoples, who have been forced to make difficult decisions for time immemorial, the NBAPC community has elected to harvest those smallmouth bass that have found their way to a hook or net as a means of subsisting on the fruits of the Earth. It would not be prudent to return these fish to the water and in adhering to the Netukulimk principles, as well as in the era of food insecurity, it was determined to be in the best interest of all to harvest these fish for consumption. DFO has repeatedly denied the requests of NBAPC on the grounds that the smallmouth bass is an invasive species. In recognizing this, we argue that the smallmouth bass is also an invasive species in other watersheds and yet, NBAPC has secured access to smallmouth bass in the watersheds associated with DFO's management-driven separation of the Scotia-Fundy (or Maritimes) region. We ask for consistency or rationale in DFO's position taken with the NBAPC on the Constitutional Right to harvest smallmouth bass (and other aquatic species) for sustenance.

IMPACT ON NBAPC RIGHTSHOLDERS

Recognizing that the proponent represents seven individual *Indian Act* bands, the NBAPC and MAARS position is not an abrogation or derogation from their Rights. Upon review of the resolution by the Assembly of First Nations and its use by the proponent in their application, the presence of smallmouth bass in the SW Miramichi watershed does not support the assertion of a *prima facie* infringement on section 35 of the *Constitution Act, 1982*. Inaction by DFO in certain situations could be considered as infringements; however, not in this matter of smallmouth bass in the SW Miramichi watershed where there exist other greater threats to the survival of Atlantic salmon.

Similar to the proponents, Atlantic salmon are critically important to our community members, but we have found ourselves unable to harvest enough salmon to meet the needs of our community which resulted in the harvesting of less desirable fish for subsistence, one of those other species includes smallmouth bass. Our community is not supportive of catch and release activities which can be harmful to our source of food. Our fishing activities are primarily to provide nourishment to community members, as well as teaching our youth to appreciate the gifts provided by the Creator. Recognizing that, this is not a statement to devalue the importance of Atlantic salmon; both our community and partners remain committed to the conservation of Atlantic salmon. It is clear that the position of NBAPC and the support team at MAARS cannot support the project proposal. The fact that smallmouth bass have persisted in Miramichi Lake for over a decade and have also been recorded outside of the lake does

not give us great confidence that the species is not already distributed throughout the watershed beyond the areas specified in the proposal.

The NBAPC membership is comprised of Mi'kmaq, Wolastoqiyik (Maliseet), and Peskotomuhkati (Passamaquoddy) people and acknowledge and agree with Mr. Ward's comments about the importance of Atlantic salmon to our people, but our knowledge and understanding of Atlantic salmon and the greater threats to this species leave us unconvinced that the attempted eradication of smallmouth bass will improve salmon abundance. As previously noted, there is evidence to support predation on juvenile salmon by smallmouth bass in general, which is not explicitly identified for this proposal. The recorded decline in returns to the rivers in the Gulf of St. Lawrence area poses a bigger problem that will not be rectified by applying poison to eradicate one predator in the proposed areas. As such, the deposit of a deleterious substance which includes only five percent of the noxious compound rotenone with the remaining components including petroleum-based solvents **must** be sufficiently defined in terms of probable and measurable benefits. It is our assertion that the application does not adequately define those declared benefits. The approval of this application will impact the Rights of NBAPC community members when they lose another species on which we rely for food.

Recall that the *Fisheries Act* is explicit that it is to be construed as upholding the rights of Indigenous peoples recognized and affirmed by section 35 of the *Constitution Act, 1982*, and not as abrogating or derogating from them. We also call attention to section 2.4 which describes the duty of the Minister that when making decisions under the Act, he or she **will** consider any adverse effects that the decision may have on the rights of Indigenous peoples. We recognize that, in this particular case, there are two assertions of thought, opinion, and understanding which will be a challenge in making the Ministerial decision. We request that the Minister take extra care to consider the application of the precautionary approach and an ecosystem approach, the sustainability of fisheries, the scientific information to support the arguments, and the Indigenous knowledge that has been provided in this response, as well as that which was provided in the NBAPC letter to the Honourable Bernadette Jordan, Minister of Fisheries, Oceans and the Canadian Coast Guard on July 17th, 2020.

Further, DFO has powers under the *Fisheries Act* to establish advisory panels, enter into agreements, or implement projects and programs. Invasive species are a part of DFO's mandate and we agree that the prevention and control of these invasive species are an important part of responsible ecosystem management; to date, DFO has not yet well-established any sort of ecosystem management that is fully ecosystem-based. In fact, based on our significant experience and involvement in fisheries management, we would argue that, in most cases, the data does not exist to proficiently manage for an ecosystem approach. Some of the requirements under the abovementioned powers would allow for public oversight and transparency in the development and undertaking of the project which could be guided by ecosystem assessments, such as the Environment and Climate Change Canada's Ecosystem Services Toolkit.

ENFORCEMENT AND COMPLIANCE

The release and introduction of live fish into fish habitat without authorization through the *Fishery (General) Regulations* has been illegal since the legislation was enacted. Clearly, this has not deterred individuals from introducing non-native fish for reasons generally related to sportfishing. Without a

clear plan forward on how to prevent these types of individuals from reintroducing smallmouth bass, or introducing other types of popular sport fish (e.g., chain pickerel or muskellunge), it becomes difficult to see beyond the high risk of reintroduction to any hope of long-term success. Smallmouth bass have become established in other parts of New Brunswick and the Maritimes where there are active recreational fisheries and derbies. In fact, the New Brunswick Wildlife Federation has a 'Master Angler Award Program' in which it rewards an angler for catching the largest fish in twenty qualifying species (including smallmouth bass, chain pickerel, and muskellunge), but does not differentiate the value of a native species to an invasive species. This program, in addition to the general establishment of recreational fisheries on species like smallmouth bass in New Brunswick, incentivizes the persistence of invasive species for sport purposes. Recognizing that there is appeal (and value for some people) in maintaining populations of invasive species within New Brunswick waters, the enforcement and prompt follow up of reports is critical. The enforcement of inland fisheries has never been a priority for Conservation Officers or Fishery Officers and we cannot presume that this will change any time soon.

With respect to the eradication plan, it is understood that the lake itself is of moderate size with only few access points largely situated to one side of the lake. Lake Brook and the proposed treatment section of the SW Miramichi River appear to be more remote with limited access. Signage and advertisements only have so much success in reaching people – and, in the case of the former, are often ignored (prime example in posted speed limit signs). There exists an incident report wherein an individual, reported to be in opposition of a proposed fish kill in Washington state, was filming the application (of Prentox CFT Legumine Fish Toxicant) and became distressed with respiratory symptoms (Pesticide Product Information Database, 2017)[28]. Considering the contentiousness of exercising a fish kill using a broadband piscicide, including the public opposition from adjacent cottage owners, it will be imperative to ensure that potential spectators are dissuaded from standing in the vicinity of the areas during the application.

KEY QUESTIONS – DFO

We appreciated having the opportunity to raise some questions and concerns in the MS Teams web meeting held on June 30th, 2020; however, we were left with a number of additional questions.

As we understand it, DFO was responsible for undertaking the eDNA survey in the Miramichi watershed. Considering that NBAPC community members have reported catching smallmouth bass outside of the project boundaries, NBAPC and MAARS believe that the survey boundaries of the eDNA survey were adequate only for the purposes of the project proposal, but does not satisfy the need to verify reported catches outside of that area. Additionally, given the fact that the resurvey of McKiel Pond in October resulted in a non-detection following an inconclusive results does not confirm that smallmouth bass are not present at other times of the year given the similar non-detected results in October for areas where smallmouth bass are known to be present, such as the confluence of McKiel Brook and the SW Miramichi. Recognizing the seasonality rationale provided, we are not convinced that the 'inconclusive' and 'not-detected' results elsewhere are absolute confirmation that smallmouth bass are not present elsewhere.

[28] Pesticide Product Information Database. (2017). *Incident Report Details.* Retrieved from https://pesticide-registry.canada.ca/en/incident-report-details.html?q=2017-1877

- Will DFO do its due diligence to follow up on reports of smallmouth bass occurring elsewhere in the Miramichi watershed?
- Has there been investigation into the other lakes within the watershed for evidence of smallmouth bass?
- What does DFO have planned for additional eDNA or other survey work to explore the presence of smallmouth bass in the SW Miramichi watershed?

Familiar with the legislation and appreciating the slide deck regarding the regulatory process for permits and authorizations related to controlling and eradicating aquatic invasive species, we are left with questions regarding the process of approval or refusal. Given that the proposal is for the treatment of three different areas for treatment, with the lake itself having been described as "moderate complexity", in addition to the uncertainty around the true distribution of smallmouth bass in the Miramichi watershed, the chance of success should be measured based on a complex environment.

- The slide deck describes that there is a higher likelihood of being authorized when the benefits outweigh the impacts. What mechanisms and/or tools exist for DFO to tangibly measure the benefits and impacts?
- Given that there is a possibility that the single application of Noxfish II will not fully eradicate smallmouth bass in the project area, yet the proponent's application does not anticipate more than one treatment of Noxfish II, is DFO only considering the requested single treatment for approval?
    - If yes, what is the anticipated recourse if the single treatment does not fully eradicate smallmouth bass?
    - What additional information and steps are necessary to extend an approval of a single treatment to become an approval for multiple treatments in order to achieve total eradication?
    - Do supporters of the proposal and the public understand that there is a chance that there may need to be multiple treatments and/or extension of the treatment area to achieve the goal and that it is likely there would be greater pressure from the proponents for DFO to approve subsequent treatments or expansion, otherwise considerable resources for the first treatment would be viewed as wasted?

We agree that education is a critical component in actively preventing the introduction of invasive species, including for the prevention of reintroducing the smallmouth bass. Part of DFO's mandate includes protecting oceans, freshwater, and aquatic ecosystems and species from the negative impact of humans and invasive species by using sound science and collaborating with Indigenous communities. Based on the slide deck provided by DFO in the June 30th meeting, there is a "very high risk" of re-introduction if there are established populations and the species has other economic benefits, like recreational fisheries. Given the appeal of smallmouth bass, and other aquatic invasive species, to recreational fisheries, we perceive the risk of reintroduction to be very high.

The costs associated with education and outreach programs should not be fully borne by the proponent and members of the working group, or groups like the ASF.

- If the application is approved, what role will DFO play in preventing the reintroduction of smallmouth bass to the Miramichi watershed?

- Likewise, what steps are being taken by DFO Gulf region to prevent the introduction of aquatic invasive species in the overall region?
- What is DFO's threshold for considering an invasive species to be "established"?

KEY QUESTIONS – PROPOSAL/PROPONENT

Again, we appreciate the proponent and other members of the working group making themselves available for the above described MS Teams meeting to describe the proposed project and address some of the questions from our team.

Ling (2002)[29] highlights that unless all parts of a large water body or catchment are treated simultaneously, rotenone breakdown can be so rapid during the summer that fish can migrate back into previously treated areas. It is not uncommon in Atlantic Canada to have high summer temperatures in late August through September.

- The proponent has described the specific volumes necessary to treat the proposed areas; recalling that the water depths in most of the lake is less than four metres, is the proponent adequately prepared for treatment when water temperatures are higher than anticipated?

Noting that the proponent and members of the working group described a need for an education blitz to prevent the reintroduction of smallmouth bass after treatment and given the history of smallmouth bass in New Brunswick beginning with an illegal introduction in the 1869 to being the target of a sport fishery currently.

- Recognizing that the cost of treating the areas a single time is proposed to be in the vicinity of $1 million, is the proponent prepared to move forward with the treatment without a strong plan for preventing reintroduction – the lack of which drastically increases the risk of needing to apply multiple treatments – and which may not have the financial and/or technical support from DFO?

The bathymetry of the lake indicates that there are two deep pools (relative to overall average depth), but does not provide detail on the presence or location of any springs or seeps in the lake. The application describes that cold, clear streams and shoreline water seepage was observed at the lake which suggested significant groundwater input (p.11). Appendix B (p.7) also describes that any upwelling groundwater flowing into the treatment area will be treated with a 50:50 combination of Noxfish II and Vectocarb. Similarly, in addition to the known pools, there are three small inlet streams and two larger inlet streams which will also be treated. Dawson et al. (1998)[30] noted that rotenone may be detected by fish and avoided, suggesting that there can be no possible refugia where the aquatic invasive species are present.

- How will the proponent ensure that all of the upwelling areas are identified in order to assess where the Vectocarb/Noxfish II mixture will be applied?
- As we understand it, the plan includes electrofishing prior to treatment and if there are no smallmouth bass recovered, the inlets will only be treated 100m upstream from the confluence with the lake. Given the length and branching of the two larger inlets, in addition to the need to

[29] Ling, N. (2002). Rotenone - review of its toxicity and use for fisheries management. Science for Conservation 211. 40 p.

[30] Dawson, V.K., Bills, T.D., and Boogaard, M.A. 1998. Avoidance behaviour of ruffe exposed to selected formulations of piscicides. *Journal of Great Lakes Research 24*: 343-350.

kill every smallmouth bass to achieve project success, how will the proponent ensure that all potential refugia have been identified?

The application describes only limited pre-project monitoring. Recalling that the species assemblage may differ from season to season, in addition to inter-annual variability, pre-monitoring is a critical component in measuring the impacts to an affected system. Ideally, the pre-monitoring would have occurred for at least five years, but we certainly recognize the challenges associated with allocating resources from the 'should be done' to the 'can be done'. It has been noted repeatedly that the expectation is that most species will have recolonized within one year, but we must question if what has been done is adequate to provide an accurate representation of the rate of recolonization, as well as identify those species which may not return. Additionally, MAPC has experience in and well understands the challenges in surveying for wood turtle and agree that the risk is likely low to the species; however, there is the potential for this species to be in the water during the treatment and confirming the presence or likelihood of absence may still be warranted, considering it is listed as Threatened under the *Species at Risk Act*.

- Has the proponent completed a list of macroinvertebrate species present over different seasons?
- Is the proponent confident in their ability to understand the true cost to the macroinvertebrate community with the limited pre-monitoring that has occurred to date and that which will continue up until the treatment?
- Is the habitat in either Lake Brook or the section of the SW Miramichi River suitable for Atlantic salmon spawning? If so, how will the impact to food availability for emerging fry be measured, considering that the lack of available food may impact the survivability?
- Have there been any dedicated surveys for wood turtle? Alternatively, has there been any habitat suitability assessments or modelling for the likelihood that wood turtle would be present?

We have noted concerns above related to the downstream toxicity of and persistence of synergistic compounds which are not "detoxified" by adding potassium permanganate.

- Given the time of year and stream/river temperatures, has the proponent ensured that these additional compounds will volatilize prior to winter?
- Will the proponents also be monitoring for the presence of these additional compounds in combination with the existing monitoring plan?

As noted above, there is at least one incident report where a spectator became affected by respiratory illness during the observation of the application of a rotenone-based piscicide.

- Recognizing the limitations of signage, how will the proponents ensure that the local residents, lake users, and the general public will not sustain injury or illness associated with the application of Noxfish II?

CONCLUSIONS

We have grave concerns that the proponent and partners have not adequately performed pre-project monitoring which leaves no means to understand the complete impacts of the Noxfish II application. Given the variability in recolonization rates, for those species that return at all, it is believed that the proponent should be able to accurately reflect the impact on the benthic macroinvertebrate community throughout seasonal variations. There is no indication that any sort of surveys to identify taxa richness,

or even a description of the families present in the macroinvertebrate community, has taken place. As a primary source of food for multiple life stages of many fish, and a critical part of the food web, we believe it is important to understand how impactful the interruption of the food chain will be. Given that there exists evidence of slow recolonization and the non-return of some species after a five-year period, we must question how recently emerged Atlantic salmon fry and other newly hatched species will be affected by the macroinvertebrate losses.

The application and associated public outreach by the proponent and members of the working group purport to have broad support for the proposal. As evidenced by the opposition from landowners on the lake presented in the media (Smith, C., 2020 June 17)[31], those immediately impacted are not all on board with the plan as proposed. We understand that the proponent and members of the working group had planned for additional public outreach which was derailed as a result of COVID-19 restrictions; however, the application itself describes that "[o]btaining broad public support for SMB eradication in Miramichi Lake will be a precondition for success". What is meant by "broad public support" is not defined within the application and we would hope that it includes those beyond the membership of the Atlantic Salmon Federation.

We are in agreement that, left unchecked, smallmouth bass have the potential to devastate some ecosystems. We are not convinced that the proposed eradication will be successful and have concerns that the impacts of using the Noxfish II will have unintended consequences that have not been considered in any sort of contingency planning.

We have documented the presence of smallmouth bass outside of the boundaries described in the application; as such, we cannot support the notion that smallmouth bass are solely restricted to the proposed treatment area because we know it to be false. With this knowledge, we believe that the treatments will not, and cannot, achieve eradication because smallmouth bass are already broadly distributed throughout the watershed. Furthermore, the notion that this treatment, if successful, will yield positive changes for Atlantic salmon goes against the existing data which portray predation outside of freshwater systems (striped bass and other marine predators) as the greater hindrance. We also suggest that the weight of evidence for the costs/benefits does not favour broadband piscicide application, particularly where new evidence shows a wider array of species being impacted, including important food-web species, and that recolonization can be lengthy and result in a different ecology.

On behalf of the New Brunswick Aboriginal Peoples Council's community of s. 91(24) Status and non-Status Mi'kmaq/Wolastoqiyik/Peskotomuhkati/Indian/Aboriginal/Indigenous Peoples continuing to reside on their traditional, ancestral homelands (off-Reserve), as heirs to Treaty Rights and beneficiaries of Aboriginal Rights who hold Interests in Other Rights, including land claims, we remain opposed to the proposed application requesting authorization to deposit a deleterious substance into Miramichi Lake, Lake Brook, and a ~15km section of the Southwest Miramichi River.

[31] Smith, C. (2020 June 17). Cottage owners try to stop fish kill in Miramichi Lake. CBC News. Retrieved from https://www.cbc.ca/news/canada/new-brunswick/rotenone-invasive-fish-smallmouth-bass-1.5613984

One community, three nations, one voice

President and Chief Barry LaBillois
New Brunswick Aboriginal Peoples Council

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Response to WNNB Consultation Questions Regarding Proposal for Smallmouth Bass Eradication from the Miramichi Watershed

Submitted by: Jim Ward, North Shore Micmac District Council

Date: 6 August 2020

1. **Zooplankton Recovery -** Thank you for bringing to our attention additional studies on the recovery of zooplankton. Indeed the literature is sparse on this topic; however, there are several studies that demonstrate relatively rapid zooplankton recovery after rotenone treatments.

   The impact of rotenone treatments and ecosystem recovery times depend on a variety of factors, from treatment concentrate, to treatment scope (e.g., full watershed or only part of a watershed), distance to a recolonization source, whether or not there are successive rotenone treatments, environmental conditions such as water temperature, and which life stages are present depending on the time of year.

   While we cannot claim, and have not claimed, with certainty the recovery timeline for zooplankton, we can use evidence from studies of other treatments to anticipate recovery timelines on the Miramichi. In Section 5.1 of the main body of the AIS application and in Appendix E, we provide evidence from studies (i.e., McGann 2018, Eilers 2008) that found both zooplankton and macroinvertebrate communities recover to provide an adequate food base for fish by the following spring post-treatment, and recover to pre-treatment levels within 1 year. We use these studies to anticipate at a minimum that there will be a level of recovery in the lake by the following spring to provide a food base for fish.

   All of the studies we are aware of indicate that full recovery occurs within 1 week to 3 years (e.g., Kiser et al. 1963, McGann 2018 [assessed 7 treated lakes], Neves 1975, Anderson 1970). Vinson and Vinson (2007) (page 7) provided a literature review of several studies documenting impacts to zooplankton and recovery times. The review found that assemblage recovery across multiple studies ranged from 1 month to 3 years, with most studies demonstrating full recovery in less than 1 year.

   Rotenone at the dosage prescribed for treatment in Miramichi Lake is not toxic to phytoplankton, and no decrease in phytoplankton abundance is expected following the treatment. There will likely be an increase in phytoplankton abundance as nutrients from the decaying fish carcasses are released into the water column. Subsequently, an increase in zooplankton abundance is expected to occur when rotenone subsides to nonlethal levels (Bradbury 1986; Eilers et al. 2011).

2. **Macroinvertebrate Recovery –** As described in the answer to #1 above, there are a variety of factors that influence the impact of a rotenone treatment on macroinvertebrates. It is important to note that our proposed treatment concentration is 0.075 mg/L (ppm), whereas many treatments reviewed for their impact to invertebrates used a significantly greater concentration of rotenone typically between 0.5 mg/L and 3 mg/L. Whelen (2002) notes that a key mitigation measure is to only use the required concentration of rotenone required to achieve the eradication objectives. Many of the older

treatments used concentrations higher than required and therefore had a greater impact on the invertebrate community.

In addition to a literature review on zooplankton recovery, Vinson and Vinson (2007) also provides a review of several studies that monitored macroinvertebrate recovery. The study notes that aquatic invertebrates in general have a wide range of sensitivity to rotenone, ranging from 96hr LC50 values of 0.002 to 100 ppm, with the greatest impacts at >1 ppm (again, our proposed treatment concentration is 0.075 ppm).

Vinson and Vinson (2007) note that most of the studies report on overall community assemblage recovery, rather than individual taxon recovery. While some taxa are not found post-treatment, overall the vast majority of taxa were identified post-treatment and in high diversity and abundance within 3 years post-treatment (e.g., Whelan 2002).

A more recent study of the recovery of Diamond Lake, Oregon, by Eilers (2008) demonstrates that macroinvertebrate biomass not only recovers to pre-treatment levels within 1 year post-treatment, but far exceeds pre-treatment levels (17 lbs/ac to 200 lbs/ac). Furthermore, the study found taxa that had not been present in the lake for years, or only rarely present, returned to the lake post-treatment. These responses are likely in part due to removing an invasive species that had been having an impact on the native ecosystem, similar to what has been experienced in British Columubia (Steve Maricle, Pers. Comm.). The control efforts on Miramichi Lake have kept smallmouth bass abundance low and we do not expect that they have had an impact on the invertebrate population like in these examples; however, they have now escaped into the river and have begun colonizing the watershed. If not eradicated, they will establish throughout the river system and we would then anticipate significant impacts to the native ecosystem including aquatic invertebrates and certainly fish species.

An important consideration in assessing the timeline for recovery in aquatic invertebrates is proximity to a recolonization source (Vinson and Vinson 2007). Given that we propose to treat only a small portion of the Miramichi watershed and that the treatment area is open ended in both the downstream and upstream directions, there will be immediate opportunities for invertebrate recolonization of treated areas once rotenone levels subside to habitable conditions several days post-treatment.

Kjaerstadt et al. (2015) provides another example of macroinvertebrate recovery assessment. The study investigated recovery after 3 successive rotenone treatments and found that temperature and concentration were major drivers of the impact to macroinvertebrates. The first 2 treatments caused only temporary impact to a few sensitive taxa, while the 3rd treatment used a much higher concentration of rotenone and had the greatest impact. Densities had not returned to pre-treatment levels 8 months post-treatment, but most taxa had recolonized the treatment areas within 1 year.

We acknowledge recovery times will vary between taxa, and that the composition may not be exactly as it was pre-treatment; however, the data from other treatments demonstrate that we can reasonably expect an overall macroinvertebrate community recovery within several months to 3

years. We consider this to be an acceptable short-term impact that is outweighed by the long-term ecological benefit to the entire Miramichi river system by preventing the establishment of invasive smallmouth bass. Furthermore, our 5-year long-term monitoring plan will assess the invertebrate recovery and provide a valuable contribution to the growing body of knowledge on ecosystem recovery after a rotenone treatment.

3. **Re-establishment Strategy –** Our initial plan was to capture native species from the lake, hold in tanks during treatment and for several weeks afterwards until water was safe for fish and then release to kickstart recovery. However, DFO (2019), in its CSAS scientific review of our initial proposal, advised that holding fish would create problems of its own and recommended to allow natural recolonization and to assess recovery as an experiment. We are heeding that advice and allowing migratory species to naturally recolonize, but we are taking a more proactive approach with non-migratory species that may take longer to recolonize. The plan is to monitor for all native species in the lake post-treatment, and if after two years some non-migratory species are not present, we will transplant 100 individuals from nearby lakes in the watershed to Miramichi Lake. There is no literature that we are aware of specifying optimal transplantation numbers; however, we are open to advice should you have any. Again, the treatment area is open ended on both the upstream and downstream ends, so there will be natural recolonization sources in close proximity to the treatment area. We expect these sources to contribute to recovery, and our monitoring program will document metrics such as species composition and relative abundance, for example, as the lake recovers.

4. **Sampling Frequency –** Thank you for the advice and recommendation on the sampling frequency. Since the amended AIS application was submitted in April, Anqotum Resource Management has refined the monitoring plan to include a sampling frequency of spring, summer, and fall. The monitoring frequency will mirror DFO's sampling/control program that has been in place since 2009 in order to utilize the long history of pre-treatment data. DFO's program samples in spring, summer, and fall. A winter sampling period is not currently included in our plan because of challenging environmental conditions and safety concerns.

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August 14th, 2020

To: Chief Barry LaBillois, New Brunswick Aboriginal Peoples Council
320 St. Mary's Street
Fredericton N.B.

RE: Smallmouth bass eradication in the Miramichi

Chief LaBillois,

Thanks to you and your staff for the opportunity to meet virtually on June 30th and the subsequent letter of July 21st from the New Brunswick Aboriginal People's Council and Maritime Aboriginal People's Council. The letter included several comments and questions for the North Shore Micmac District Council and our partners in the Miramichi smallmouth bass eradication project. I hope this letter eases your concerns about this project by showing that our efforts are a conservation action with known, short-term impacts and long-term benefits.

Please get in touch if you have any subsequent questions. Sincerely,

Jim Ward, North Shore Micmac District Council

I. General comments in reply to the NBAPC/MAPC letter

The reply letter asserts the proponent and working group are looking through "the scope of solely Atlantic salmon," and that we have failed to demonstrate how eradication of smallmouth bass from the Miramichi watershed will result "in any sizeable advancement towards increasing Atlantic salmon populations to sustainable levels."

Our intention is to safeguard the ecosystem of the Miramichi watershed for the sake of all native species and prevent a harm from occurring. We have said this repeatedly in public communications and regulatory documents. Here are two recent examples:

In a June 2020 op-ed from the Working Group published in the Daily Gleaner and Times Transcript it was stated, “If we turn our back and let smallmouth bass find new homes throughout the watershed, an ecosystem that has supported the same composition of fish for thousands of years will be forever altered.”

In our amended application to eradicate, submitted to DFO in April 2020, the stated rationale for the project is, “A [smallmouth bass] escape from Miramichi Lake and colonization in the Southwest Miramichi River risks devastating effects on native fish species in the Miramichi system, such as the Atlantic salmon. Native species would suffer effects of predation and competition for habitat and resources, and overall food web disruption.”

Assuming that salmon is the only intended beneficiary of our efforts is narrow and incorrect. Our cost benefit analysis weights the consequences of smallmouth bass colonization to all species and human communities in the 13,500 square kilometer watershed against the short-term, spatially limited impacts of eradication.

The letter asserts that the application to eradicate does not provide sufficient detail to prove smallmouth bass will have significant negative effects on wild Atlantic salmon in the Miramichi. For example, the letter states, “it is difficult to predict the scale and the effects that smallmouth bass have had or will have on Atlantic salmon,” and “the proponent has failed to provide evidence of [high predation] in the Miramichi watershed specifically.”

It is not possible or necessary to predict the detailed impacts that smallmouth bass would have on the Miramichi ecosystem, however as DFO states in CSAS Science Response 2019/040, “There is no expectation that native fish species in the Miramichi River will benefit from the presence of smallmouth bass.”

Previous studies provide details on the real and potential impacts to ecosystems when smallmouth bass become established (Carr and Whoriskey 2009, Valois et al. 2009). There are no healthy Atlantic salmon populations where smallmouth bass have become established, for example, in the Nashwaak and St. Croix rivers.

Providing evidence of smallmouth consuming native Miramichi fish is not possible without allowing widespread colonization; precisely what we are acting to prevent. Currently smallmouth densities are low in the treatment area and there is limited overlap with native species.

Finally, the letter states that the eradication of smallmouth bass will not address other drivers of Atlantic salmon decline in the Miramichi watershed. For example, the authors write, “The recorded decline in returns to rivers in the Gulf of St. Lawrence area poses a bigger problem that will not be rectified by applying poison to eradicate one **predator** in the proposed area.”

Smallmouth bass are properly characterized as an **invasive species**, but more importantly such criticism is not relevant to this project. Our action is preventative and not intended to mitigate other causes of decline. However, collectively our groups are addressing other threats like

warming water, striped bass predation, land use issues, and the Greenland fishery. We are not pursuing smallmouth bass eradication to the exclusion of other known issues.

II. Noted deficiencies

The letter identifies seven specific deficiencies in our application to eradicate. For ease of reference I have copied them here and will address each in order:

1. Does not detail how the eradication of smallmouth bass in the three proposed areas will benefit Atlantic salmon
2. Does not consider the broader ecosystem
3. Does not consider the impacts caused by other components of the piscicide
4. Does not consider unintended consequences
5. Does not consider the impact on other Rightsholders
6. Does not describe how the risk of re-introduction will be managed
7. Is misinformed about the extent of smallmouth bass distribution

Does not detail how the eradication of smallmouth bass in the three proposed areas will benefit Atlantic salmon

While this concern is largely addressed in the general comments above, it bears repeating that our proposed actions are preventative. The primary benefit of eradicating smallmouth bass in the Miramichi watershed is preventing their establishment, spread, and future impacts to native species and recovery efforts.

Does not consider the broader ecosystem

As noted, the proposal is fundamentally about the broader ecosystem of the Miramichi watershed and this is explained explicitly in the AIS application. We feel this point was missed by the authors of the letter. For example, the writers ask, "What is the overall value of Miramichi Lake, its endemic species, and its alien species, beyond a fisheries valuation?"

Recognizing that smallmouth bass, if not eradicated, will spread throughout all lakes, rivers, and streams in the Miramichi watershed, the proper question to ask is, *'what is the value of the Miramichi ecosystem and the native biodiversity that it supports?'.*

Does not consider the impacts caused by other components of the piscicide

Noxfish II is approved by Health Canada for the eradication of aquatic invasive species. When a product is registered it means it is effective and safe when used according to the label instructions. All of the product ingredients have undergone review and scrutiny

by Health Canada and have been deemed effective and safe to use by humans in the environment.

Nonetheless, we have investigated the other ingredients and found that they are inert and dissipate from the environment as quickly or more quickly than the active ingredient rotenone. These chemicals are what make the formula safe and effective. For example, using pure powdered rotenone would require significantly more product be applied to the water, increasing the risk to non-target organisms while creating significant hazards to applicators.

Fisheries and Oceans Canada has consulted with Health Canada concerning our application and no concerns have been raised with us regarding other components of Noxfish II.

Does not consider unintended consequences

Our treatment plan does consider unintended consequences and proposes specific mitigation measures to address them. These include the risk that the product will persist longer than anticipated in the environment, that it will travel in lethal concentrations outside the proposed treatment area, and that ecosystem recovery is slower than anticipated.

Regarding the persistence of rotenone in the environment, our principle mitigative strategy is timing. Our plan is to apply Noxfish in August and September when water temperatures are at or near their maximum based on years of temperature monitoring data (Finlayson et al. 2017), contributing to the known rapid breakdown of the formulation.

Regarding the travel of Noxfish at lethal concentrations outside the proposed treatment area, our plan includes the use of potassium permanganate, a commonly used water purifying agent, to neutralize the active ingredient at the downstream extent of the treatment area. We will also be continuously monitoring the downstream environment during and after treatment.

There are many studies demonstrating that the base of the food web, including zooplankton and macro invertebrates recover rapidly post-treatment, usually between several week to three years, with most recovering in a one to two year period (Kiser et al. 1963, McGann 2018, Neves 1975, Anderson 1970, Eilers 2008, Whelan 2002, Kjaerstadt et al. 2015). Phytoplankton are not impacted.

Our 5-year long-term monitoring plan will assess ecosystem recovery and provide a valuable contribution to the growing body of knowledge on rotenone in fisheries management. Our re-establishment strategy includes a contingency plan to transplant fish species from nearby lakes should our monitoring detect they are not quickly recolonizing Miramichi Lake. This will accelerate recovery.

In the river, the treatment area is open-ended. We anticipate rapid recolonization by invertebrates through drift and fish species through natural movements.

Does not consider the impact on other Rightsholders

The letter asserts that a successful eradication will "impact the rights of NBAPC community members when they lose another species [smallmouth] on which we rely for food." However, there is no food fishery for smallmouth bass in the Miramichi watershed, therefore eradicating this invasive species is not affecting any food fishery. Allowing smallmouth to colonize the watershed would negatively affect Indigenous food fisheries for other species.

Does not describe how the risk of re-introduction will be managed

The reintroduction of smallmouth bass is a risk and our Working Group is taking significant steps to educate the public.

We have been forthcoming and proactive with communications through digital, social, and traditional media. We have held information sessions with Miramichi Lake camp owners, conservation groups, Indigenous communities, politicians, and government officials. More than 250 people attended a webinar on this project on April 28th. Many of our members are also active in the New Brunswick Invasive Species Council which has a mandate to educate and inform the public.

Each of these actions raise awareness of invasive species problems and our proposed action will act as a significant deterrent to reintroduction in Miramichi Lake and elsewhere.

Is misinformed about the extent of smallmouth bass distribution

Your letter makes repeated reference to smallmouth bass caught outside the proposed treatment area in the Miramichi watershed, including statements like, "We cannot support the notion that smallmouth bass are solely restricted to the proposed treatment area because we know it to be false." The letter claims that statement is based on a "documented catch."

To the knowledge of the Working Group, including the extensive network of researchers, Indigenous, and recreational fishermen active on the Miramichi, there have been no incidents of smallmouth bass caught outside of our proposed treatment area. If

NBAPC has evidence to the contrary, we ask that you please provide it to help inform eradication planning.

Notwithstanding the concerns about DFO's eDNA sampling outlined in the letter on page 13, this technique coupled with physical surveys like electrofishing, seining, and angling is the best method for confirming distribution. EDNA surveys in 2019 indicate the distribution of smallmouth bass is limited to the proposed treatment area. These surveys are ongoing in 2020.

II. Questions for the proponent

1. **Is the proponent adequately prepared for treatment when water temperatures are higher than anticipated?**

   Yes. It is well-known that rotenone half-life and the duration of acute levels is lower at water temperatures above 12 degrees Celsius. In other words, rotenone is most effective and breaks down most quickly in the environment at warmer water temperatures (i.e., >12C). The risk is applying rotenone at lower water temperatures, rendering it less effective and allowing it to persist longer in the environment. We will avoid this by treating in August/September. DFO's containment and removal efforts at Miramichi Lake since 2008 provides evidence for a predictable water temperature profile. At the time of treatment in August/September, we expect average temperatures to be well above 12C. This has informed our intended concentration of 0.075 mg/l active ingredient, and the volume of product that will be deposited.

   It is standard operating procedure to conduct a lethality test 24-hours prior to treatment using water and fish captured from the treatment area. This will ensure the design concentration is achieved based on water characteristics at the time of treatment.

   In addition to the rapid breakdown, the ability of potassium permanganate to deactivate rotenone is also enhanced at higher water temperatures, further reducing the risk of lethal effects to native species outside the treatment area.

2. **Is the proponent prepared to move forward with the treatment without a strong plan for preventing reintroduction?**

   Preventing a reintroduction of smallmouth bass into the Miramichi watershed is critically important to the long-term health of the ecosystem. However, allowing the risk of reintroduction to determine whether eradication projects proceed would halt all such efforts. There will always be a risk, just like there is always the risk of a forest fire, but that doesn't mean we don't take action to put the fire

out. As mentioned above, we have taken extensive action on public education and awareness on this issue as a strategy to reduce the risk of reintroduction. Table 1 provides a summary of these activities, and here is a list of educational items we have produced:

- An educational brochure on the SMB issue in the Miramichi watershed
- Website with educational materials for the public (www.miramichismallmouth.com)
- Several blog posts available on www.asf.ca
- Several articles in the Atlantic Salmon Journal, read by thousands of people
- Webinar recorded and publicly available on www.asf.ca (Google search: "ASF alien invaders")

Table 1. Ongoing communication and education activities carried out by the Working Group (updated from February Communications Plan).

Activity	Description/Timeline	Targeted Group
Media relations	Respond to media requests regarding the eradication of smallmouth bass from the Miramichi. **Ongoing:** Several CBC interviews on Shift and articles by Connell Smith; Op-Ed published in Telegraph Journal.	All
Website design and launch	Create a website for Miramichi smallmouth bass eradication to educate the public and key groups about the project. **Complete** (www.miramichismallmouth.com)	All
Proactive communications	Develop blog posts, op-eds, and social media on key messages. **Blog:** complete/ongoing (https://www.asf.ca/news-and-magazine/salmon-news/clear-and-present-danger); blog also prepared in conjunction with resumption of spring work in June 2020; another blog planned for summer 2020	All

	Social media: ongoing, timed with media relations and proactive communications **Webinar**: public webinar held ins spring 2020 with ~250 attendees locally and from across the world (session recorded and publicly available (google: "ASF alien invaders") **Articles**: several published in the Atlantic Salmon Journal	
Meeting with camp owners	Conduct a public meeting with Miramichi Lake camp owners involving experts on rotenone eradication **Completed January 26th with follow-up with steering committee in March; educational brochure produced**	Miramichi Lake camp owners
Meet with members of Eel Ground and Red Bank FN	Conduct a public meeting with Miramichi Lake camp owners involving experts on rotenone eradication **Completed January 27th**	Miramichi First Nations
Brief public officials	Hold meetings with key officials and politicians from federal and New Brunswick government to share project details, update progress, and seek support **Several sessions have been held, more briefings to occur as necessary or requested**	Public officials
Engage with salmon stakeholders	Engage with camps, outfitters, guides in the Miramichi River Valley to inform of project, answer questions **Meetings held & ongoing**	Stakeholders, public officials
Engage with non-government organizations	Contact all environmental and conservation NGOs in New Brunswick to inform them of the eradication project and urge that	Environmental/Conservation NGOs

	questions or concerns be raised with the Working Group. **Complete/Ongoing**	

We are also considering pursuing legislative and regulatory reforms with the Province of New Brunswick. In British Columbia, when a new discovery of an aquatic invasive species occurs, that waterbody is immediately closed to fishing until an eradication takes place, disincentivizing spread. The province also offers a $20,000 reward for information that leads to the conviction of an individual involved with illegal introductions, a further deterrent. Both could be applied here.

3. **How will the proponent ensure that all upwelling areas are identified in order to assess where the Vectocarb/Noxfish II mixture will be applied?**

   The treatment area is surveyed on foot and from helicopter prior to treatment and all discernable springs, seeps, and upwelling ground water that contain SMB or could negatively influence the treatment, either through dilution or by creating refuge, are located, GPS marked, and scheduled for treatment. We do not expect a major problem with upwelling groundwater in the treatment area due to its timing in the dry season and the relatively flat topography of the area.

   With the help of the NB wet areas GIS map layer, which is based on a digital elevation model, we have ground-truthed the river and identified the small streams and springs that will be treated with drips or vectocarb to prevent a refuge area. The wet areas map was highly accurate at predicting the location of even very small springs entering the river.

4. **Given the length and branching of the two larger inlets, in addition to the need to kill every smallmouth bass to achieve project success, how will the proponent ensure that all potential refugia have been identified?**

   There are five incoming water sources to Miramichi Lake that may provide refuge to smallmouth bass or dilute the treated water to sub-lethal levels in localized areas. These were physically surveyed in July 2020, with measurements and flow data captured.
   Prior to treatment, electrofishing will be conducted in these inlets from the point where they meet the lake upstream to a point where no smallmouth bass have been found for 300m. In some areas, there are barriers to fish migration and we do not expect smallmouth bass to be present. For example, one inflow near the cottages has a hanging culvert which smallmouth bass could not overcome.

A drip station will be installed in each of the tributaries, beginning 2 hours prior to lake treatment, to ensure bass do not find refuge, maintaining lethal toxicity in waters downstream for the duration of the treatment

To understand the entire treatment area and potential problem spots, we have conducted a helicopter survey of the lake, Lake Brook, and the proposed treatment reach of the SW Miramichi River. Backwaters and peripheral areas will be treated by backpack and/or boat sprayers.

Based on the experience in other eradications in flowing waters, another strategy we have taken to maximize the likelihood of success is to treat Lake Brook and the SW Miramichi twice with a 30-day gap between treatments. Flowing waters are more complex environments than lakes and by treating twice it reduces the chance that target fish survive. This strategy has been very effective in other projects.

5. **Has the proponent completed a list of macroinvertebrate species present over different season?**

Both plankton and invertebrate surveys are components of our ecological monitoring plan and the Anqotum team will conduct these surveys pre and post-treatment continuing for 5 years. As discussed above and based on a variety of studies available, we can reasonably expect these communities to re-establish within 1-2 years.

6. **Is the proponent confident in their ability to understand the true cost to the macroinvertebrate community?**

Although the study cited in the letter, Magnum and Madrigal (1999), demonstrates adverse effects to macroinvertebrate assemblages, it is important to highlight key differences between the treatment of Strawberry Marsh in Utah and the proposed treatment area in the Miramichi watershed.

In Utah, the entire watershed was treated. In our case a very small portion of the entire Miramichi watershed will be treated. In Utah, managers used a rotenone concentration of 0.15 mg/l active ingredient. In our case, we are proposing to use half that concentration. An important consideration in assessing the timeline for recovery in aquatic invertebrates is proximity to a recolonization source (Vinson and Vinson 2007). Given that we propose to treat only a small portion of the

Miramichi watershed and that the treatment area is open ended in both the downstream and upstream directions, there will be immediate opportunities for invertebrate recolonization of treated areas once rotenone levels subside to habitable conditions, a few days post-treatment.
Vinson and Vinson (2007) note that that aquatic invertebrates in general have a wide range of sensitivity to rotenone, ranging from 96hr LC50 values of 0.002 to 100 ppm, with the greatest impacts at >1 ppm. Our proposed treatment concentration is 0.075 ppm.

A study of Diamon Lake in Utah, Eilers (2008), demonstrates that macroinvertebrate biomass not only recovers to pre-treatment levels within 1-year post-treatment, but far exceeds pre-treatment levels (17 lbs/acre to 200 lbs/acre). Furthermore, the study found taxa that had not been present in the lake for years, or only rarely present, returned to the lake post-treatment after invasive species were gone

Kjaerstadt et al. (2015) provides another example of macroinvertebrate recovery assessment. The study investigated recovery after 3 successive rotenone treatments and found that temperature and concentration were major drivers of the impact to macroinvertebrates. The first 2 treatments caused only temporary impact to a few sensitive taxa, while the 3rd treatment used a much higher concentration of rotenone and had the greatest impact. Densities had not returned to pre-treatment levels 8 months post-treatment, but most taxa had recolonized the treatment areas within 1 year.
We acknowledge recovery times will vary between taxa, and that the composition may not be exactly as it was pre-treatment; however, the data from other treatments demonstrate that we can reasonably expect an overall macroinvertebrate community recovery within several months to 3 years. We consider this to be an acceptable short-term impact that is outweighed by the long-term ecological benefit to the entire Miramichi river system by preventing the establishment of invasive smallmouth bass. Furthermore, our 5-year long-term monitoring plan will assess the invertebrate recovery and provide a valuable contribution to the growing body of knowledge on ecosystem recovery after a rotenone treatment.

7. **Is the habitat in either Lake Brook or the section of the SW Miramichi River suitable for Atlantic salmon spawning? If so, how will the impact to food availability for emerging fry be measured considering that the lack of available food may impact survivability?**

   The stretch of the SW Miramichi River and Lake Brook that would be treated does hold spawning habitat for wild Atlantic salmon. Juvenile salmon have been found in Lake Brook and this stretch of the river during electrofishing surveys.

As a mitigation measure for salmon, we will install a barrier fence downstream of the treatment area in August, which will prevent upstream migration during the treatment, and be removed once water conditions return to normal, likely late September, allowing fish to continue to their preferred spawning grounds. For salmon holding in cold water pools in the treatment reach, we will conduct a fish rescue and place those fish below the barrier.

As explained above with references, we anticipate the invertebrate community to recovery quickly, particularly on the open-ended treatment reach on the river which will be recolonized primarily through downstream drift. We acknowledge there may be limited food availability for salmon fry on Lake Brook in the first spring after treatment; however, this is a limited impact in space and time, and negligible at the watershed scale. It is a small potential impact that is outweighed by the long-term benefit to the species in the entire watershed by the eradication of an invasive threat.

8. **Have there been any dedicated surveys for wood turtle? Alternatively, has there been any habitat suitability assessments or modelling for the likelihood that wood turtle would be present?**

There have been no dedicated surveys for wood turtle and no modelling. Its presence has not been confirmed in the proposed treatment area. If turtles were present, as stated in the letter, "the risk is likely low to the species." The project's potential impact to wood turtle has been assessed by the province's DNRED species at risk group, who also deemed the risk is low. DNRED indicated that there may be some limited impacts, but that they manage the species on the landscape scale and any potential impacts from this project are negligible.

The risk to this species if present is low and negligible for the following reasons:

- Limited potential for exposure to rotenone: the species nests on land and is omnivorous, largely feeding on terrestrial organisms which are not exposed to rotenone
- The United States Environmental Protection Agency (EPA 2006; 2007) uses the sensitivity of birds as a surrogate for reptiles, and rotenone is practically non-toxic to birds. Because of the rapid natural break down, piscivorous birds and mammals are not able to consume sufficient quantities of rotenone to result in acute toxicity. In British Columbia, where the provincial government led a successful campaign to eradicate smallmouth bass and yellow perch from 12 lakes in the Thompson River watershed, painted turtles were held captive in active rotenone treatment areas with no mortality or observed ill effects (Steve Maricle, personal communication).

9. **Given the time of year and stream/river temperatures, has the proponent ensured that [formula] compounds will volatize prior to winter?**

   The timing of the treatment and the extensive knowledge about rotenone products in aquatic environments indicate that all components of the formula will dissipate and break down as predicted and outlined in the AIS application. This will occur in the days and weeks post-treatment, well before winter.

10. **Will the proponents also be monitoring for the presence of these additional compounds in combination with the existing monitoring plan?**

    We will not be monitoring for the inert ingredients in the formulation. Previous monitoring studies (Finlayson et al. 2001 and Vasquez et al. 2012) have shown that, by the time rotenone dissipates from the environment, the inert ingredients found in Noxfish II are gone as well.

11. **Recognizing the limitations of signage, how will the proponents ensure that the local residents, lake users, and the general public will not sustain injury or illness associated with the application of Noxfish II?**

    In addition to the mandatory signage which is required by provincial regulators and the product label, we will use traditional and digital media to notify the general public of the treatment area, timing, and restrictions. We will personally communicate with all lake users, including the cottage and landowners on the lake.

    There are some natural advantages afforded by the remoteness of the treatment area; there is a single road access point to Miramichi Lake and all road access to the river is behind the gate at J.D. Irving's Deersdale forestry district.

    Additionally, during the entire treatment period, there will be dozens of trained personnel in the area to speak to and redirect anyone who appears.

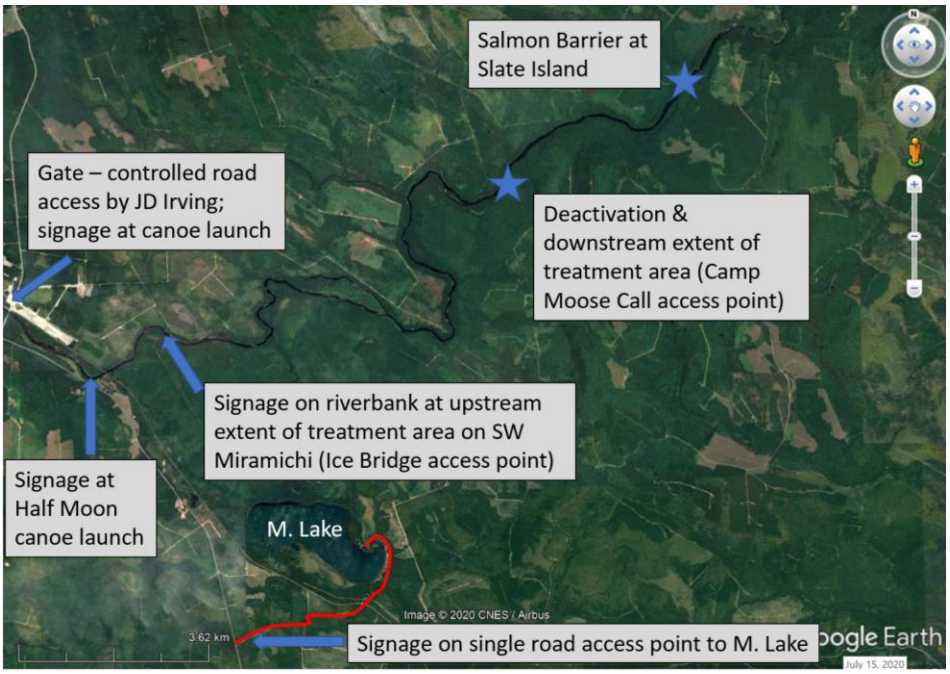
    Lake - There is only one road access to Miramichi Lake; it will have signage and the access road will also be monitored for the duration of treatment and the 3-day post-treatment period by a public safety officer informing any visitors of the eradication activity and treatment area use restrictions. The lake is typically only accessed by the few cottage owners, with little public use and so we expect no, or low, volume of traffic on the lake road during the eradication.

Lake Brook - There is no road access to Lake Brook.

SW Miramichi River - Road access to the treatment reach on the SW Miramichi River is controlled by J.D. Irving and is restricted by a continuously manned gate. Irving is supportive of the project and employees will we briefed on the eradication timing. There are occasional canoers on this reach of river (not typically in low water conditions during the time of year we propose to treat) and signage will be placed at the known launch points at Deersdale and Half Moon. There will also be signage placed at the upstream extent of the treatment reach at the Ice Bridge, which will have personnel on-site carrying out the treatment who can inform any canoers that may have disregarded the signs upriver at Deersdale and Half Moon.

McKiel Salmon Club, Camp Moose Call, and Slate Island Camp are the only camps on this reach of river and members will be notified of treatment timing. The few camps that are located immediately downriver of the treatment area will also be notified; however, we do not expect any boat traffic upriver from these camps because the river will likely be too shallow to motor, and the camps do not use motor canoes in this reach regardless.

Map 1. Signage locations at publicly accessible points throughout the treatment area.



III. Conclusion

We appreciate the opportunity to engage with your organizations as part of DFO's consultations on our proposed smallmouth bass eradication project. We are committed to following-through and hope this letter alleviates your concerns. We welcome any further meetings or discussions requested by your respective organizations.

CC: The Honourable Bernadette Jordan, Minister of Fisheries and Oceans Canada
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Julie Richter, Senior Advisor to the ADM, Aquatic Ecosystems
Serge Doucet, Regional Director General, DFO Gulf Region
Alain Hebert, Director of Ecosystems Management, DFO Gulf Region
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Nathan Wilbur, Director, N.B. Program, ASF
Mark Hambrook, President, Miramichi Salmon Association
Peter Cronin, New Brunswick Salmon Council

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