

2017 WHIRLING DISEASE PROGRAM REPORT

Alberta
Environment
and Parks



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Photo: Blair Reilly



Photo: State of Colorado



Photo: State of Colorado

EXECUTIVE SUMMARY

In August 2016, the presence of whirling disease was confirmed in fish from Johnson Lake in Banff National Park. Whirling disease has no impact on human health, but infectious spores can be transmitted to other water bodies through fish and fish parts, and gear or equipment that can transport infected water or mud. The Canadian Food Inspection Agency (CFIA) is the federal agency responsible for reportable diseases in Canada, including whirling disease. As of July 2017, the CFIA has confirmed the presence of whirling disease in the Bow River, Oldman River and Red Deer River watersheds and have declared these watersheds infected with whirling disease. The rest of Alberta has been declared a buffer zone.

Whirling disease has quickly become a prominent issue for fisheries management in Alberta. Since the initial discovery, Alberta Environment and Parks created a Whirling Disease Program and developed a three-point Whirling Disease Action Plan based on three core elements that include: Distribution, Education and Mitigation. This three-pillared approach is focused on determining the extent of the disease and using education and mitigation to prevent it from spreading.

Highlights of the Whirling Disease Program:

- A Whirling Disease laboratory has been established. This new facility is Canada's first laboratory exclusively dedicated to testing for and preventing the spread of whirling disease.
- Improvements to biosecurity standards at all provincial fish culture facilities are ongoing to protect the provincial fish stocking program and ensure the facilities remain free of whirling disease.
- Facilities licenced to stock fish provincially but have tested positive for the whirling disease pathogen have been placed under quarantine and are not be able to move live fish from their facility.
- A Common Risk Management Framework was developed to assess private and publicly stocked ponds for the risk of spreading or perpetuating whirling disease in the province.
- A comprehensive Decontamination Protocol for all Government of Alberta staff that work in aquatic environments was developed.
- Sampling and surveillance plans are developed for wild and hatchery produced fish to better inform management decisions around whirling disease in Alberta.
- Promotional material is produced to support the Aquatic Invasive Species “Clean, Drain, Dry” campaign, which has been developed to address whirling disease concerns.
- Research is being conducted in collaboration with the University of Alberta to develop risk assessment modeling and non-lethal sampling methods.

BACKGROUND

In August 2016, the presence of whirling disease was confirmed in fish from Johnson Lake in Banff National Park and the Bow River Basin in Alberta. This was the first confirmed occurrence of whirling disease in Canada. Whirling disease is native to Europe and was first detected in the United States in the 1950s. The disease was primarily associated with fish culture practices until the 1990s, at which time it was confirmed to be causing substantial population declines of wild trout in Colorado and Montana. Currently, whirling disease has been detected in 25 states in the United States.

Whirling Disease is caused by the parasite *Myxobolus cerebralis* (*M. cerebralis*) that has a two-host life cycle, alternating between an oligochaete worm, *Tubifex tubifex*, and a salmonid fish host. Whirling disease causes clinical signs such as skeletal deformities, darkened tail, and “whirling” behaviour. Whirling disease has only been diagnosed in salmonids and is not known to impact other species. The disease has no impact on human health, but infectious spores can be transmitted to other water bodies through fish and fish parts, and gear or equipment that can transport infected water or mud. Equipment used for swimming, paddling, boating and fishing, or industrial activities can potentially contribute to disease transfer.

Following the first detection of whirling disease, Alberta Environment and Parks (AEP) led a broad-scale sampling program to delineate the extent of the parasite, *M. cerebralis*, in susceptible fish species in salmonid-bearing waters within Alberta. As whirling disease has primarily been associated with aquaculture practices, private and public aquaculture facilities were also tested for *M. cerebralis*.

The primary goal of AEP is to ensure the conservation of healthy, productive fish habitats and sustainable fish populations. Whirling disease presence in Alberta adds a threat to the sustainability of Alberta's trout populations. AEP is committed to preventing the spread of whirling disease and implementing management strategies to reduce the risk to susceptible fish populations

CANADIAN FOOD INSPECTION AGENCY (CFIA) PROCESS

The Canadian Food Inspection Agency (CFIA) is the federal agency responsible for reportable diseases in Canada, including whirling disease. On August 25, 2016, the CFIA officially announced the presence of whirling disease in Johnson Lake in Banff National Park. As of July 2017, the CFIA has confirmed the presence of whirling disease (infection with *Myxobolus cerebralis*) in stream and river sites within the Bow River, Oldman River and Red Deer River watersheds and have declared these watersheds infected with whirling disease. The rest of Alberta has been declared a buffer zone (see Figure 1). Whirling disease has not been detected in all water bodies and tributaries of the declared watersheds. If whirling disease is detected in any portion of the watershed, the entire watershed is declared infected.

The CFIA declaration establishes a federal government role in management of this disease for Canada. Official confirmations of whirling disease test results can only be obtained through CFIA-approved labs. As a result of the declaration, a CFIA domestic movement permit is required if an aquatic animal or thing is moving from the declared infected area to the declared buffer area (remainder of the province) or from the declared buffer area to other areas of Canada, as whirling disease has only been detected in Alberta to date. Permits are not required to move aquatic animals or things within a declared zone or from a buffer area to an infected area or from the rest of Canada to Alberta (for whirling disease). As part of the process, CFIA conducted an epidemiology study of infected commercial fish farms and provided a list of waterbodies that had been stocked by a facility that tested positive for whirling disease in the last three years. These “trace-out” waterbodies are now considered to be infected by whirling disease.

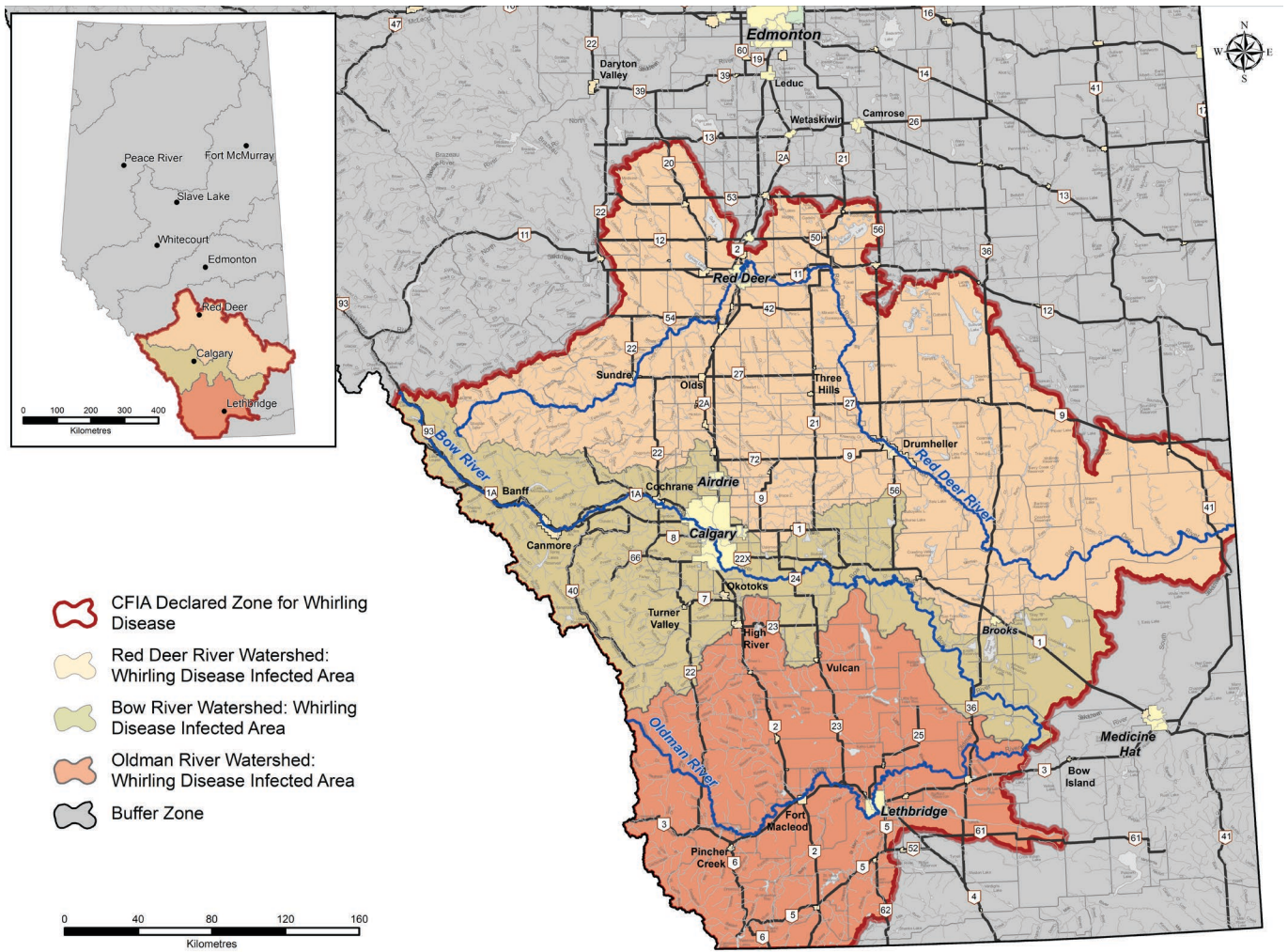


Figure 1: As of July 2017, the CFIA has confirmed the presence of whirling disease (infection with *Myxobolus cerebralis*) in the Bow River, Oldman River and Red Deer River watersheds and have declared these watersheds infected with whirling disease. The rest of Alberta has been declared a buffer zone.

ALBERTA ENVIRONMENT & PARKS WHIRLING DISEASE PROGRAM

Whirling disease has quickly become a prominent issue for fisheries management in Alberta. Since the initial discovery, Alberta Environment and Parks created the Whirling Disease Program and are working to build additional capacity to protect Alberta's trout fisheries. The following briefly describes Alberta's initial response to the detection of whirling disease in the province as well as the ongoing management.

ALBERTA'S INITIAL RESPONSE

Upon initial notification of the suspected case of whirling disease, Alberta formed a response team consisting of biologists, hydrologists and emergency response personnel to ensure that detection of the disease was met with a swift and coordinated response. This initial response was led by the Alberta Support and Emergency Response Team (ASERT), which coordinates training, planning and leads environmental emergency responses in Alberta for the Ministry of Environment and Parks. This includes floods, drought, spills, derailments and aquatic invasive species (AIS) detections.

Initially, the province implemented the Alberta Aquatic Invasive Species (AIS) Early Detection and Rapid Response Plan (EDRR). As part of the AIS EDRR Plan, an incident command structure was implemented that allowed coordination of the support requirements from staff across the Ministry. This provided Incident Management full tasking authority across AEP to realign reporting structures and reallocate resources to whirling disease response. The incident commanders from AEP, Banff National Park (BNP) and the CFIA worked collaboratively in their responses and action planning. All costs for the emergency phase were captured by an emergency fund.

Specialists from all regions were tasked with: planning and conducting sampling; developing an interim decontamination protocol; performing risk analysis and modeling; data management and mapping; internal and external communications; and aquaculture management.

Although Alberta experienced the first detection of whirling disease in Canada, several other jurisdictions in the United States have experience managing the disease. To ensure that Alberta capitalized on the lessons learned from other agencies, a jurisdictional scan was conducted. The jurisdictional scan assessed Alberta's response plan, decontamination protocols, lab analyses, and management of aquaculture facilities.

A Whirling Disease Committee (WDC) was established as a forum for gathering and sharing information and providing advice to decision makers in the Government of Alberta. This committee is made up of members from the Government of Alberta, federal government agencies and key stakeholders.

ALBERTA'S ONGOING RESPONSE

Within Alberta Environment and Parks, the Whirling Disease Program operates under both Fish and Wildlife Policy and Operations Branches (Figure 2). This speaks to the complex nature of running the program, developing new policies, and responding to the priorities for the department. Existing fisheries policies and regulations are being applied to whirling disease management.

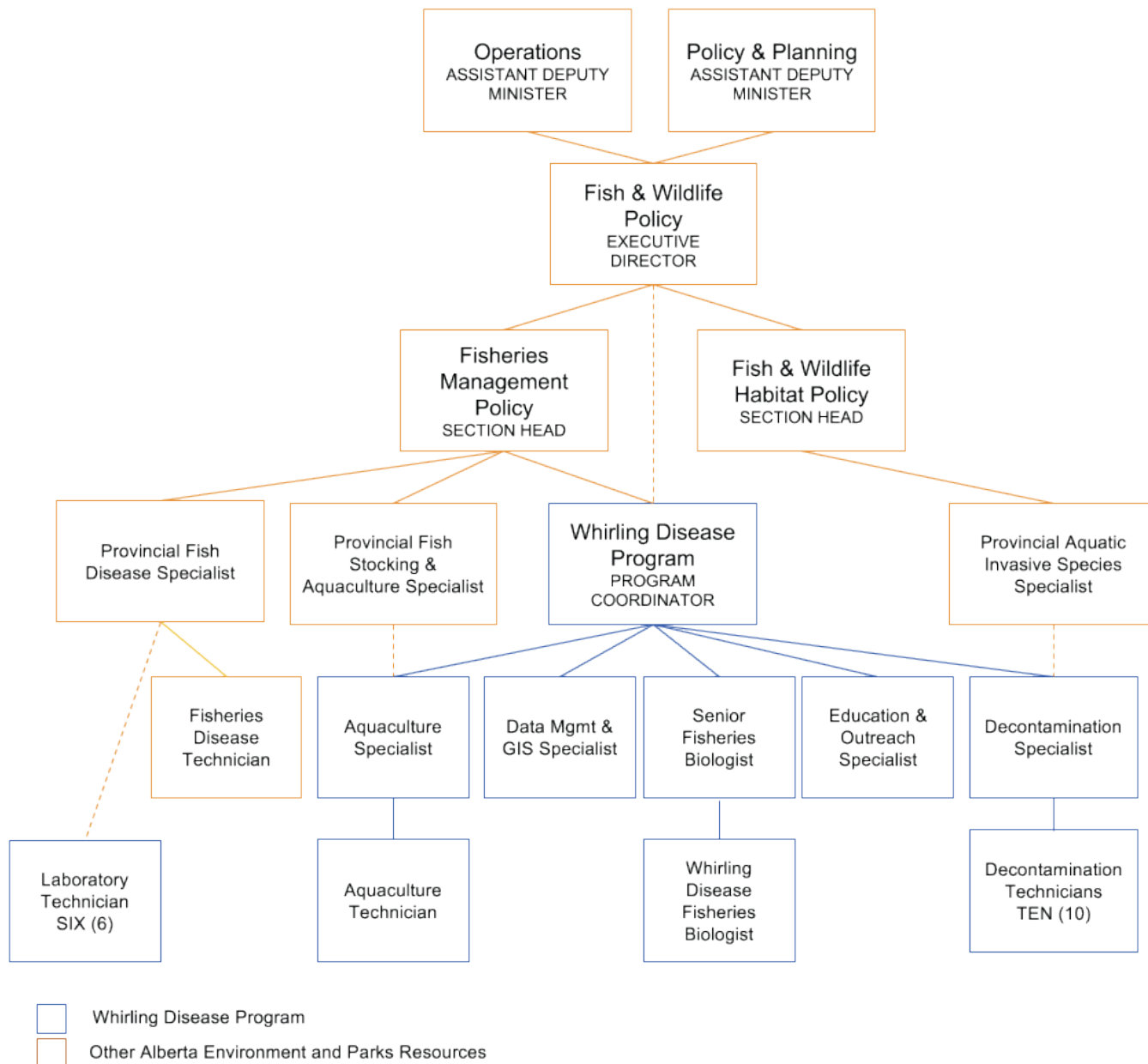


Figure 2: Structure of the Whirling Disease Program in Alberta Environment and Parks. The Whirling Disease Program operates under both Fish and Wildlife Policy and Operations Branches. This speaks to the complex nature of running the program, developing new policies, and responding to the priorities for the department.

IMPACTS OF WHIRLING DISEASE

ENVIRONMENTAL IMPACTS OF WHIRLING DISEASE

Alberta is home to both native and naturalized fish species in the Family Salmonidae (e.g., trout, whitefish, charr, grayling, and salmon). These species experience high angling pressure in conjunction with habitat degradation and other stressors which contributes to declines in native populations. Five salmonid species are listed in Alberta under the *Alberta Wildlife Act*: Athabasca Rainbow Trout, Westslope Cutthroat Trout, Bull Trout, Shortjaw Cisco and Pygmy Whitefish. Westslope Cutthroat Trout populations have also been listed federally under the *Species at Risk Act*; while Athabasca Rainbow Trout and Bull Trout have been federally recommended as Endangered and Threatened, respectively.

Whirling disease is an additional stressor to these important salmonid populations. In affected waters, whirling disease may cause mortalities of up to 90% of native and non-native trout and mountain whitefish. Prior to the detection of whirling disease in Alberta, no salmonid population declines were observed that were attributed to an as-yet unknown source of mortality. Whirling disease has only been observed in salmonids and is not known to affect other species. Within this family, species and strains of species vary in susceptibility. In Alberta, the most susceptible species are thought to be Rainbow Trout, Cutthroat Trout, Mountain Whitefish and Brook Trout; Brown Trout and Bull Trout may be less susceptible and Arctic Grayling is thought to be refractile. AEP is committed to minimizing the impact of whirling disease on native trout and whitefish populations.

ECONOMIC IMPACTS OF WHIRLING DISEASE

The market value of recreational angling in Alberta is approximately \$500 million (65-75% wild and 25-35% stocked lakes or ponds). Protection of this valuable sport fishing industry will require investment in:

- Increased biosecurity protocols and improved infrastructure in provincially and privately operated fish culture facilities;
- Closure of some private fish culture facilities that cannot be decontaminated;
- Investment to develop an accredited fish disease laboratory in Alberta;
- Increased disease surveillance of wild and stocked fish;
- Decontamination protocols for government and industry working in aquatic environments; and,
- Education and outreach activities.

Trout stocking contributes approximately \$110 million annually to the market value of recreational angling in Alberta. One of the largest operational risks to facilities and the provincial fisheries management program is disease, including: the introduction of disease into a facility resulting in a hatchery epizootic event; the transmission of the disease between facilities; or the transfer of a disease from a facility to wild fish populations.

In 2006, the private aquaculture industry was estimated at \$10 million. Sixty percent of this revenue is from table fish sales, which include salmonids. Forty percent of this revenue is from operators that raise fingerlings for sale to recreational licence holders, other commercial fish farmers, bioassay labs and wholesalers. These fingerling sales include u-fishing opportunities, government contracts, and private pond stocking.

SOCIAL IMPACTS OF WHIRLING DISEASE

Alberta's fisheries are managed for Indigenous people's sustenance and recreational use, and to maintain healthy and robust ecosystems. Many Albertans use this fisheries resource for consumptive or non-consumptive purposes; over 300,000 angling licenses are sold annually. Stewardship is the responsibility of all Albertans and everyone benefits from healthy ecosystems. The presence of whirling disease in the province highlights the need for all Albertans to follow "Clean, Drain, Dry" practices while angling or recreating in Alberta waters. Whirling disease may result in reduced angling opportunities as some public and private stocked waters may experience closures or continue to be managed for catch and release fishing opportunities.

HIGHLIGHTS OF THE WHIRLING DISEASE PROGRAM

Alberta Environment and Parks have developed a three-point Whirling Disease Action Plan based on three core elements: **Distribution** (to determine the scope of where the disease exists), **Education** (to provide public messaging and direction) and **Mitigation** (to reduce the risk of whirling disease to our wild trout populations). This three-pillared approach is focused on determining the extent of the disease and using education and mitigation to prevent it from spreading. Alberta has hired additional staff to work throughout the province, including fisheries biologists, aquaculture specialists, a data management and GIS specialist, a decontamination specialist, and outreach and education staff.

Highlights of the Whirling Disease Program include:

- A new Whirling Disease laboratory has been established and has played an important role in testing and analysis of whirling disease samples. This new facility is Canada's first laboratory dedicated to testing for and preventing the spread of whirling disease.
- Facilities licenced to stock fish provincially but have tested positive for the whirling disease pathogen have been placed under quarantine and are not be able to move live fish from their facility.
- AEP is working towards improving the biosecurity standards at all of the provincial fish culture facilities to protect the provincial fish stocking program and ensure the facilities remain free of whirling disease.
- AEP is using a Common Risk Management Framework to assess private and publicly stocked ponds for the risk of spreading or perpetuating whirling disease in the province.
- As part of a cross-ministry team, AEP developed a comprehensive decontamination protocol for all Government of Alberta staff that work in aquatic environments. This protocol takes a geographic risk-based approach to work in or near water.
- Sampling/surveillance plans are being developed for wild and hatchery produced fish to better inform management decisions around whirling disease in Alberta.
- Promotional material is being produced to support the Aquatic Invasive Species "Clean, Drain, Dry" campaign, which has been modified to focus on anglers and equipment to address whirling disease concerns.
- Research is being conducted with the University of Alberta to develop risk assessment modeling and non-lethal sampling methods.

UPDATES ON PROGRAM ELEMENTS

1. AQUACULTURE

Movement of live fish from private and provincial fish culture facilities was halted immediately after the confirmation of whirling disease in Johnson Lake in August 2016. The following sections describe the actions taken by AEP in provincial hatcheries, private facilities and public waters.

Provincial Hatcheries

The risk of disease transmission into provincial aquaculture facilities is high due to the movement of mud and water contaminated with infectious spore stages or infected fish into the facility. Further risk exists for potential disease transfer from public visitations to provincial hatcheries, as well as from normal fish stocking operations. For instance, fish stocking trucks may move between more than 200 public waterbodies and provincial fish culture facilities annually. Fish from all provincial facilities have been sampled and tested on multiple occasions and *Myxobolus cerebralis* has not been detected. Stocking, with permitting from the Canadian Food Inspection Agency where required, is continuing as per the provincial stocking plan.

Actions For Provincial Facilities

- A hold was placed on planned fall fish stocking from all provincial hatcheries in August 2016, prior to CFIA confirming whirling disease in Johnson Lake.
- Public access to facilities was closed pending test results for whirling disease.
- Provincial aquaculture facilities have been tested for *M. cerebralis*, the parasite which causes whirling disease. Sample preparation was expedited through partnership with the Ministry of Agriculture and Forestry.
- Provincial hatcheries were found to be free of *M. cerebralis* and provincial facilities were allowed to resume stocking.
- Enhanced procedures have been put in place to prevent possible transmission of parasites and disease between waterbodies via stocking operations.
- Hatchery infrastructure is being assessed and updated to meet industry standards for operating in a whirling disease positive zone.
- Enhanced biosecurity protocols for all provincial facilities are being developed and will be implemented consistently in all hatchery facilities.
- Long-term testing will continue; annual or biannual testing of fish from hatcheries will be implemented for due diligence in surveillance of the disease.

Private Facilities – Class A

Class A Commercial Aquaculture facilities are licenced to rear and distribute live salmonids in Alberta. All Class A facilities were placed under quarantine on September 6, 2016 by Ministerial Order. The quarantine prohibited the movement of live fish from these facilities (i.e. no fall stocking until 175 fish were tested from each facility – and results were negative for *M. cerebralis*). The sale of dead fish is allowed. Several of these facilities transitioned to either Recreational or Class C Commercial Aquaculture licences consistent with their business model. The following lists the status of the twenty-one Class A facilities in Alberta:

- Ten Class A facilities have tested negative for *M. cerebralis*;
- Five Class A facilities tested positive for *M. cerebralis*: one of these facilities was able to successfully decontaminate, one transferred to a Class C status, and three were deemed as unable to eradicate the disease and remain under quarantine;
- Two Class A facilities have been sampled and are awaiting results; and,
- Four Class A facilities remain untested as they did not have fish at the time of fall sampling. These facilities will remain under quarantine until they can be shown (by testing 175 fish) to be negative for *M. cerebralis*.

Actions For Class A Aquaculture Facilities

- Upon confirmation of whirling disease-free status, holds on fish stocking are lifted on a licence-by-licence basis so facilities can get back to business.
- Where *M. cerebralis* tests were positive, a duplicate sample was provided to CFIA labs for confirmation. For those facilities where a positive result is confirmed, the facility in question will remain under quarantine and further actions will be considered on a site-by-site basis.

Private Facilities – Class C And Recreational & Public Waters

Class C Commercial and Recreational Aquaculture facilities are licensed to culture live salmonids but cannot sell live fish. The CFIA conducted an epidemiology study of infected commercial fish farms and created a list of waterbodies that had been stocked within the previous 3 years by a facility that tested positive for *M. cerebralis* in the fall of 2016. These “trace-out” waterbodies are now considered to be contaminated by the whirling disease parasite. Six hundred eighty-four private (Class C, Recreational) and 34 public ponds were recognized as receiving fish from a facility that tested positive for whirling

disease (see Figure 3). A risk management framework was developed to assess the risk of spreading or perpetuating whirling disease from these ponds (see Mitigation section for details). Approximately 200 private and 11 stocked public ponds have been deemed moderate to high risk of spreading or perpetuating whirling disease in native salmonids because of their stocking history, location, hydrogeological connection to natural water bodies, or location within a floodplain. These ponds (both public and private) have had their licences temporarily suspended and they cannot be stocked until further assessment is completed.

Density of CFIA Trace-out* Private Aquaculture Facilities

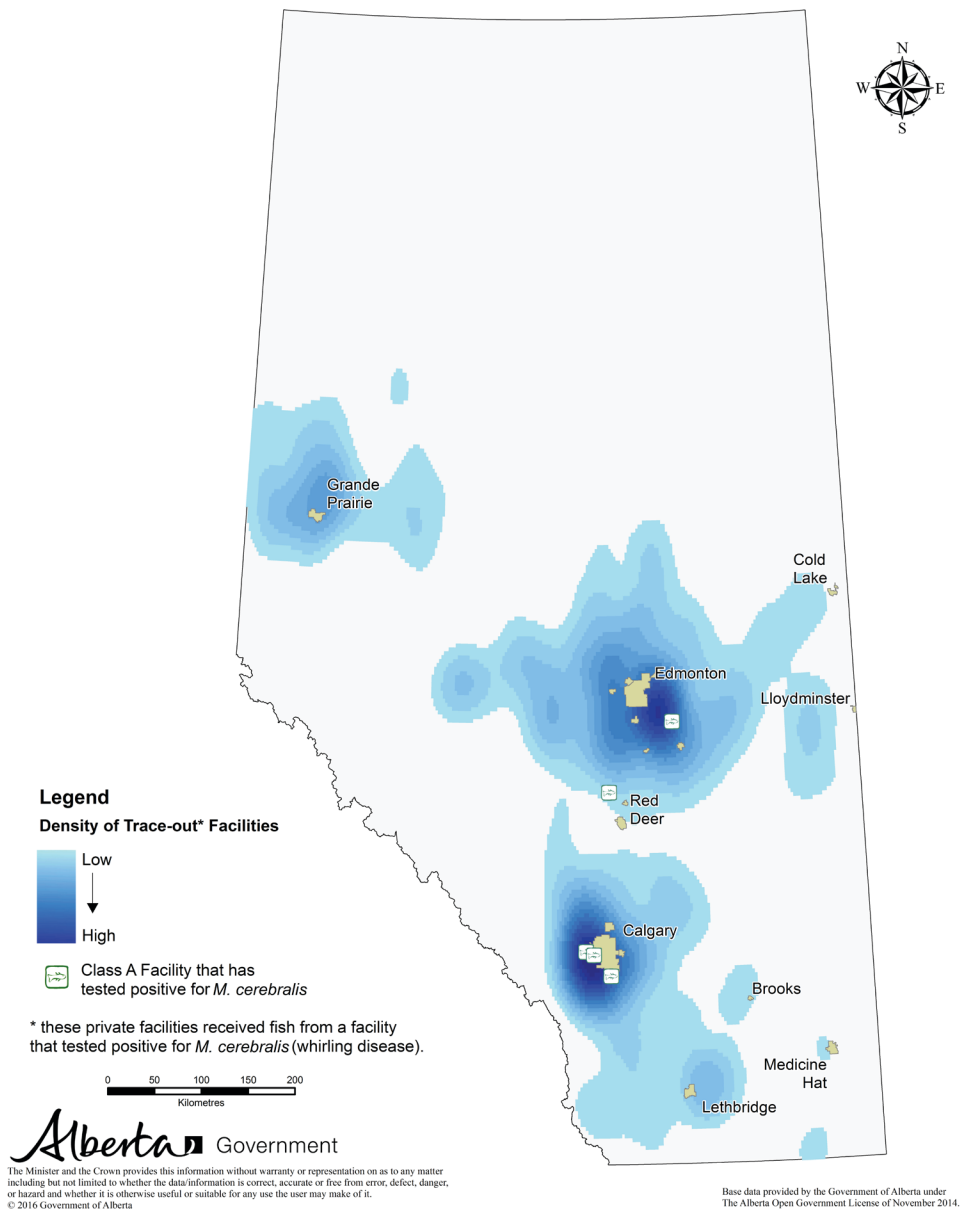


Figure 3: This figure illustrates the locations of “trace-out” waterbodies across the province that have been stocked by a facility that tested positive for *M. cerebralis* in the last three years. Class A facilities that have tested positive for *M. cerebralis* are also identified on the figure.

2. WHIRLING DISEASE LABORATORY

A new whirling disease laboratory has been established in Vegreville, Alberta, with an important role in testing whirling disease samples. This new facility is Canada's first laboratory exclusively dedicated to testing for and preventing the spread of whirling disease. The new lab is part of a \$9.3 million commitment in the 2017 Government of Alberta Budget to expedite testing as part of efforts to prevent the further spread of the disease.

"Whirling disease is a threat to some of Alberta's most iconic species. Accurate and timely testing is our first step in reducing that threat. We also need to ensure Albertans clean, drain and dry any gear that touches water."

- Shannon Phillips, Minister of Environment and Parks

The new lab is located within an InnoTech Alberta facility (a subsidiary of Alberta Innovates), formerly used for autopsies on large animals. Nearly \$2.9 million is allocated towards the lab's equipment and operational costs, in addition to six full-time technicians responsible for the labour intensive processing of samples for expedited molecular testing by the University of Alberta.

The province began collecting samples to test for whirling disease in August 2016, when the first case was discovered at Johnson Lake in Banff National Park. Since then, more than 6,000 samples have been collected and tested from six of Alberta's watersheds, as well as another 4,000+ fish from provincial hatcheries and commercial fish farms.

"This is a great example of collaboration, leveraging InnoTech's unique facilities and technical expertise into testing and research into whirling disease."

- Ross Chow, Managing Director, InnoTech Alberta

The whirling disease laboratory is moving towards obtaining accreditation to act as an external laboratory for the National Aquatic Animal Health Program (NAAHP) in conjunction with CFIA. The CFIA's program is consistent with international standards set by the World Organization for Animal Health (OIE). This recognition will demonstrate AEP's competency in delivering reliable, accurate and consistent results for the detection of fish pathogens, such as *M. cerebralis*. These collaborative efforts not only benefit Alberta, but also Canadian western provinces by facilitating fish disease testing.

3. DISTRIBUTION

The immediate objective for whirling disease management in Alberta's wild fish populations is detection and delineation, and where possible containment. Although first identified in Johnson Lake in Banff National Park, where clinical signs of whirling disease were observed, the culprit pathogen, *M. cerebralis* (in absence of observed disease) has also been confirmed in several locations in the Bow River, Oldman River and Red Deer River watersheds which support wild trout and mountain whitefish populations.

The initial sampling program in Alberta was designed to detect and delineate the presence of whirling disease within wild trout and mountain whitefish range along the East Slopes from the Crowsnest Pass to Grande Prairie. The most susceptible species and likely habitats were selected for sampling. Two hundred sites across six watersheds were sampled to determine the extent of whirling disease occurrence in flowing waters. Sampling and surveillance for 2017 will focus on gaining a better understanding of *M. cerebralis* distribution across the province.

Surveillance Program 2016 Results

In 2016, extensive sampling was undertaken in watersheds occupied by trout along the East Slopes of the Rocky Mountains (Figure 4). A total of 6,320 individual wild fish samples were collected for diagnostic testing. Within each site, individuals of each species were pooled for testing, with a target of 5 individuals per pool. Using this method it is not possible to quantify the number of infected individuals in each positive pool. Results presented here assume every individual from a positive pool was infected which may overestimate the infection prevalence experienced in Alberta.



Figure 4: Sample locations and results for 2016 whirling disease program. Whirling disease has been confirmed in several locations in the Bow River, Oldman River and Red Deer River watersheds which support wild trout and mountain whitefish populations. Detections in the North Saskatchewan River watershed have not been confirmed by the CFIA.

Up to eighteen percent of all pooled samples tested positive for the whirling disease parasite, *M. cerebralis*, in the province (Figure 5). However, not all watersheds had the same level of infection. Watersheds confirmed to be infected by the CFIA- the Oldman, Bow and Red Deer River watersheds- had the highest prevalence of infection. Up to 25-30% of samples from these watersheds tested positive for *M. cerebralis*. In the North Saskatchewan River watershed, AEP detected *M. cerebralis* in a small percentage of samples (up to 2%); these detections have not been confirmed by the CFIA and are treated as “suspect positives”. All samples from the Athabasca and Peace River watersheds tested negative for the parasite.

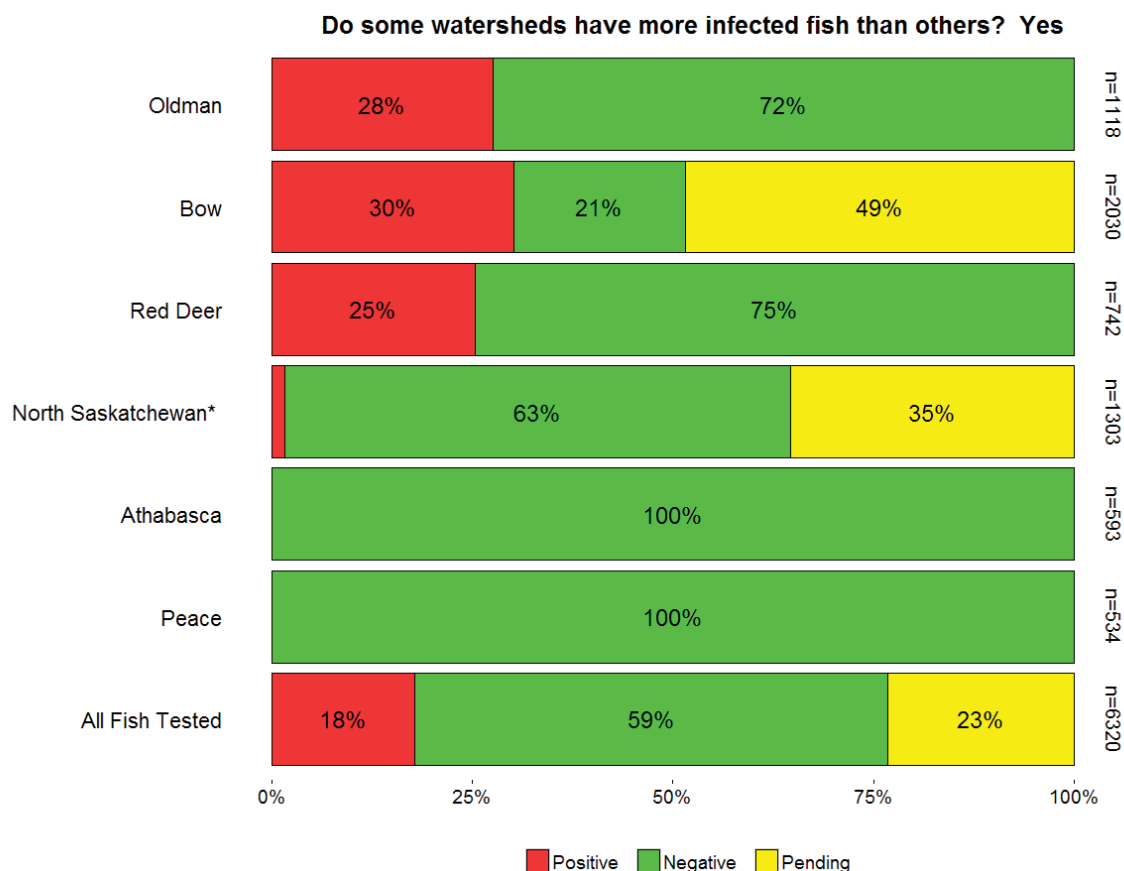


Figure 5: Test results for *M. cerebralis* for each watershed from 2016 sampling. Sample size (n) is displayed to the right of each watershed bar. In watersheds confirmed as infected by the CFIA (Bow, Oldman and Red Deer River), up to 25-30% of pooled samples tested positive for *M. cerebralis*. In the North Saskatchewan River watershed, AEP detected *M. cerebralis* in a small percentage of samples (up to 2%). *These detections have not been confirmed by the CFIA and are treated as “suspect positives”. All samples from the Athabasca and Peace River watersheds tested negative for the parasite.

Samples were tested from Rainbow Trout, Mountain Whitefish, Cutthroat Trout, Bull Trout, Brook Trout and Brown Trout. AEP detected *M. cerebralis* in all species tested except Bull Trout. In infected areas, not all species and individuals were infected evenly. Where *M. cerebralis* was present, up to 82% of pooled Rainbow Trout were infected compared to 70% of Brown Trout, 62% of Mountain Whitefish and 48% of Brook Trout (Figure 6). Cutthroat Trout appear to be infected at a lower prevalence; however, only a small number of individuals were present at infected sites.

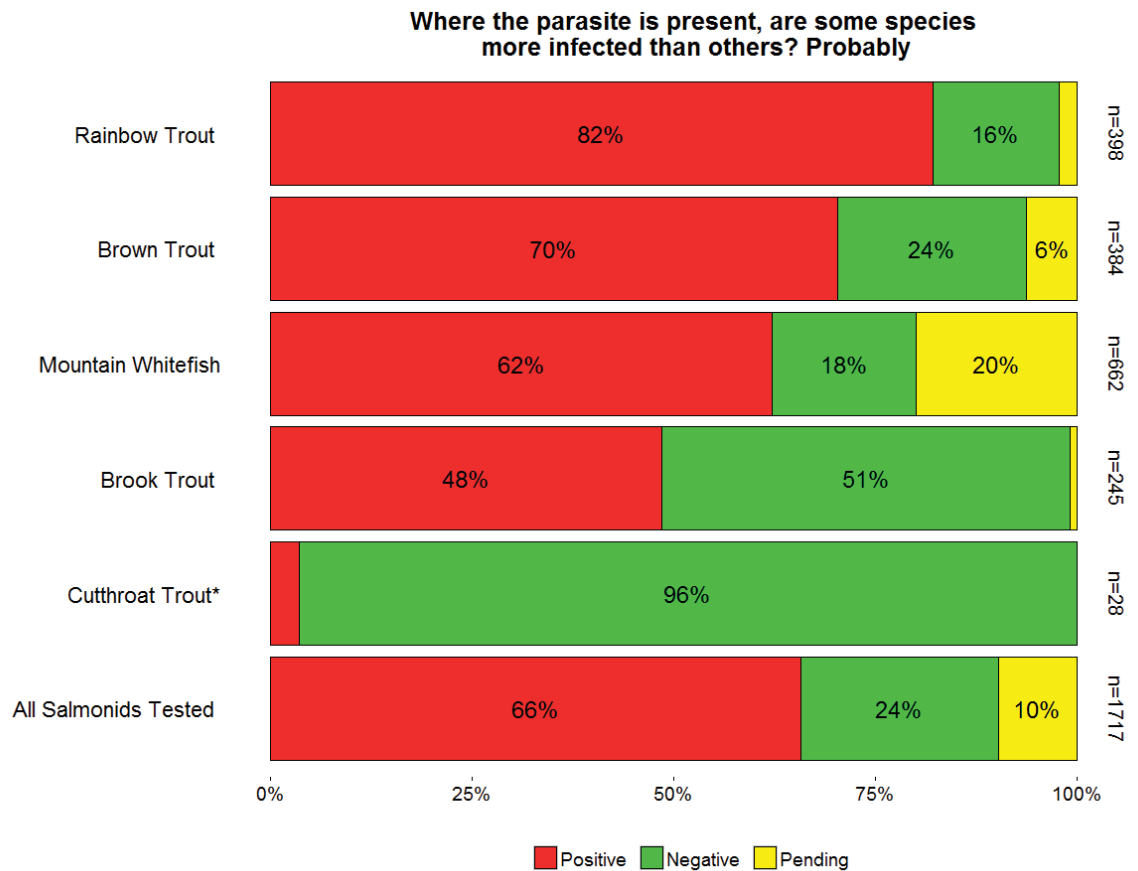


Figure 6: Test results for each species at sites where the parasite, *M. cerebralis*, was present. These results are not meant to indicate susceptibility of each species as some species or strains of species may carry the parasite without contracting whirling disease. Additionally, highly susceptible juveniles exposed to the parasite prior to AEP's sampling efforts may have experienced high mortality which is not captured in this figure. Sample size (n) is displayed to the right of each species bar. *There is a small sample size for Cutthroat Trout at infected sites.

Surveillance Program Plans – 2017

Sampling conducted in 2016 provided valuable information on the broad-scale distribution of the whirling disease parasite in Alberta. The focus for surveillance in 2017 will be to:

1. Refine the distribution of the parasite in wild populations by delineating the extent at a smaller scale that can be used by fisheries management; and,
2. Identify the risk of spreading and perpetuating the whirling disease parasite on the landscape through stocking practices.

To achieve the first objective, disease-freedom testing will occur throughout the East Slopes of Alberta. Disease-freedom testing is designed to detect *M. cerebralis* if present at a low prevalence. Disease-freedom testing requires extensive sampling to ensure positives are detected even if present at a low abundance in the population. Confidently making the distinction between negative and positive areas within the province will allow AEP to manage vectors of disease transfer and mitigate additional spread of the whirling disease parasite.

To achieve the second objective, a stocked pond surveillance program will occur in 2017 to test fish, water and sediment samples from a selection of stocked ponds in Alberta. AEP's ability to identify and predict the location of high-risk stocked ponds on the landscape will be essential for managing the risk of spreading *M. cerebralis* from stocked to native populations. Unintentional transfer of *M. cerebralis* can occur from stocked ponds to nearby waterbodies in areas with hydrogeological connections, floodplain connectivity or high usage. As part of AEP's surveillance program for 2017, samples will be collected from stocked ponds presumed to be positive or negative based on the aquaculture "trace-out" to verify the parasite presence or absence in these ponds. Fish, water and sediment samples will be collected at these sites to test for all stages of the parasite throughout its lifecycle. If the parasite is found to complete its lifecycle in ponds stocked with presumptively positive fish, these waterbodies may act as hot spots for spreading and perpetuating the disease on the landscape. High-priority stocked ponds will additionally be sampled to answer supplementary questions such as:

- When did commercial aquaculture facilities become infected with whirling disease?
- If stocking is to resume in whirling disease infected waterbodies, what species and size classes should be stocked to reduce the risk of perpetuating the disease?
- What other vectors may be moving the parasite between waterbodies in Alberta?

Data gathered from the 2017 surveillance program will provide valuable information for the three core elements of the Whirling Disease Action Plan: Distribution, Education, and Mitigation.

4. EDUCATION AND OUTREACH

Protection of Alberta's vulnerable fish populations from further spread of whirling disease can be assisted through education of the public, stakeholders and partners across Alberta. Development, implementation and delivery of educational programs and tools will raise awareness and literacy of whirling disease and prepare Albertans to uphold stewardship actions outlined by the province.

The overall goal of the education and outreach strategy is to prevent the spread of whirling disease to currently unaffected waterbodies in Alberta and nation-wide. The following education and outreach resources and strategies have been implemented:

- Various educational resources were developed to promote the "Clean, Drain, Dry Your Gear" and "Prevent the Spread of Whirling Disease" messaging. The resources were aimed at key audiences to help raise awareness and understanding of whirling disease. These resources include display and educational materials such as quick facts cards, angling awareness posters, pamphlet stands, display banners, displays of felt soled boots and a whirling disease infected fish taxidermy mount, in addition to promotional items such as angling lures, trout stress balls, and boot brushes.
- Print copies of the quick fact cards and posters were mailed out to angling retailers, tourism centers, Government of Alberta offices, as well as Watershed Planning and Advisory Councils (WPACs) and any other stakeholder groups that expressed interest in having the resources. The resources are available for download from the AEP website or print copies can be ordered through the AEP information center.
- Many stakeholder organizations have become active partners in educating target audiences through the dissemination of information within their organizational channels (e.g. delivering presentations at their events, including articles in their newsletters, distributing quick fact cards and posters, etc.)
- Outreach has taken place at numerous trade shows and public events in the form of a display, drop-in booth or interactive activity.
- Presentations have been delivered to various organizations upon request.
- Emergency response signage was installed throughout the province in the fall of 2016 with Clean, Drain, Dry messaging.
- Advertising has been conducted through a variety of media (e.g. magazine, newspaper, digital newsletter and social media).
- Interviews with radio, TV and newspaper have also been conducted to raise awareness of the issue.
- Video clips have been commissioned to increase understanding of the issue and assist with decontamination training.

Communications

The objectives of the communications plan include demonstrating the Province's commitment to protecting Alberta's fish populations and the sport fishing industry as well as efforts to prevent the spread of whirling disease. The communications strategy includes:

- Coordination with CFIA on news releases regarding whirling disease declarations;
- Maintaining and updating Key Messages and Whirling Disease FAQ on the AEP website;
- A strong focus on public education, including the whirling disease brochure, infographics, and relationships with key stakeholders; and,
- Identification of AEP spokespeople and coordination of all media inquiries through the designated public affairs officer.

Social media will be a large component of ongoing communications. Blogs will be used to keep the public up to date of AEP's action plan and any new information while communicating in a conversational, friendly style.

5. MITIGATION

Alberta is committed to preventing further spread of whirling disease and leveraging best practices to manage the disease where it exists through aquaculture planning and management, decontamination and risk assessments.

Aquaculture Planning & Management

As of July 2017, the CFIA has declared the Bow, Oldman and Red Deer River watersheds infected with whirling disease. This declaration results in Alberta requiring permit(s) to conduct typical fish stocking operations from provincial fish culture facilities to ponds outside of the declared whirling disease positive zone. Provincial fish culture facilities and private aquaculture operations require testing to ensure they are disease free. Provincial facilities also require biosecurity protocols to ensure they remain disease free.

Provincial Hatcheries

As a long term goal, Alberta will apply for "Compartmentalization" status for all provincial aquaculture facilities under CFIA's National Aquatic Health Program. If facilities meet the specific premise requirements of CFIA's Compartment Recognition Program, movement of fish outside a declared zone can occur without a permit. In order to obtain CFIA Compartment Recognition, an aquaculture facility must submit a comprehensive "Preventative Control Plan" (PCP), which meets national standards and addresses the rigorous requirements for biosecurity; undergo regular disease testing; and receive on-site quality assurance audits.

Provincial aquaculture facilities have implemented several interim measures (i.e. Alberta Fish Stocking Safe Operating Procedures 2016) in an effort to minimize the potential for transmission of whirling disease. However, there is no comprehensive aquaculture biosecurity plan available, or facility specific Fish Health Management Plans in place. Additionally, older facilities built to deliver a now dated stocking strategy, employing recirculating systems and outdated disinfection technology, also pose an elevated risk of intra- and inter- facility disease transmission. It is important to implement these plans as it can be costly to eradicate disease once established in aquaculture facilities. For example, in the late 1980s the Sam Livingston Fish Hatchery became infected with Infectious Pancreatic Necrosis Virus (IPNV). It cost \$11.5 million over a two year period for the facility to decontaminate and restart the operations.

Preventative Control Plans will be developed to provide an overarching framework and specific policies (e.g. rule set for transferring fish between facilities) to guide provincial fish culture and stocking operations for the next 10 years. Documented, auditable biosecurity plans will be in place for each provincial aquaculture facility. Biosecurity protocols will be developed to prevent transmission of disease into and out of provincial fish culture facilities, thereby protecting facilities from infection and transmission of disease to wild fish. The biosecurity protocols will also identify any requirements to

upgrade existing hatchery infrastructure and will form the basis for capital infrastructure requests in the future. These plans will be available to private Class A aquaculture facilities, and the Province will encourage their adoption. Long term planning includes having PCPs for all facilities that move live fish on the landscape.

Alberta Environment and Parks has contracted out the task of creating a Preventative Control Plan to improve biosecurity at all of provincial fish culture facilities. This work will begin in the summer 2017.

Private Facilities & Public Waters

Class A commercial fish farms or portions of the operations of such facilities (e.g. earthen-bottomed ponds) that test positive for whirling disease and are unable to be decontaminated will no longer be licenced to cultivate and distribute live salmonids and will remain under quarantine until the fish are disposed of and the site is decommissioned. Licences will be revoked and will not be reissued. Class A commercial fish farms that test positive for whirling disease that can be decontaminated will continue to be quarantined until such time as decontamination is completed by the operator in accordance with AEP and CFIA requirements, following an approved decontamination and monitoring plan.

Public waters are stocked to provide recreational fishing opportunities for Albertans. A Common Risk Management Framework was developed to assess the risk of spreading or perpetuating whirling disease to public waters, Class C and Recreational Aquaculture ponds that were stocked with fish from a facility that tested positive for *M. cerebralis* (Figure 7). The framework was based on stocking history, known salmonid locations, hydrogeological connection to natural water bodies or floodplains.

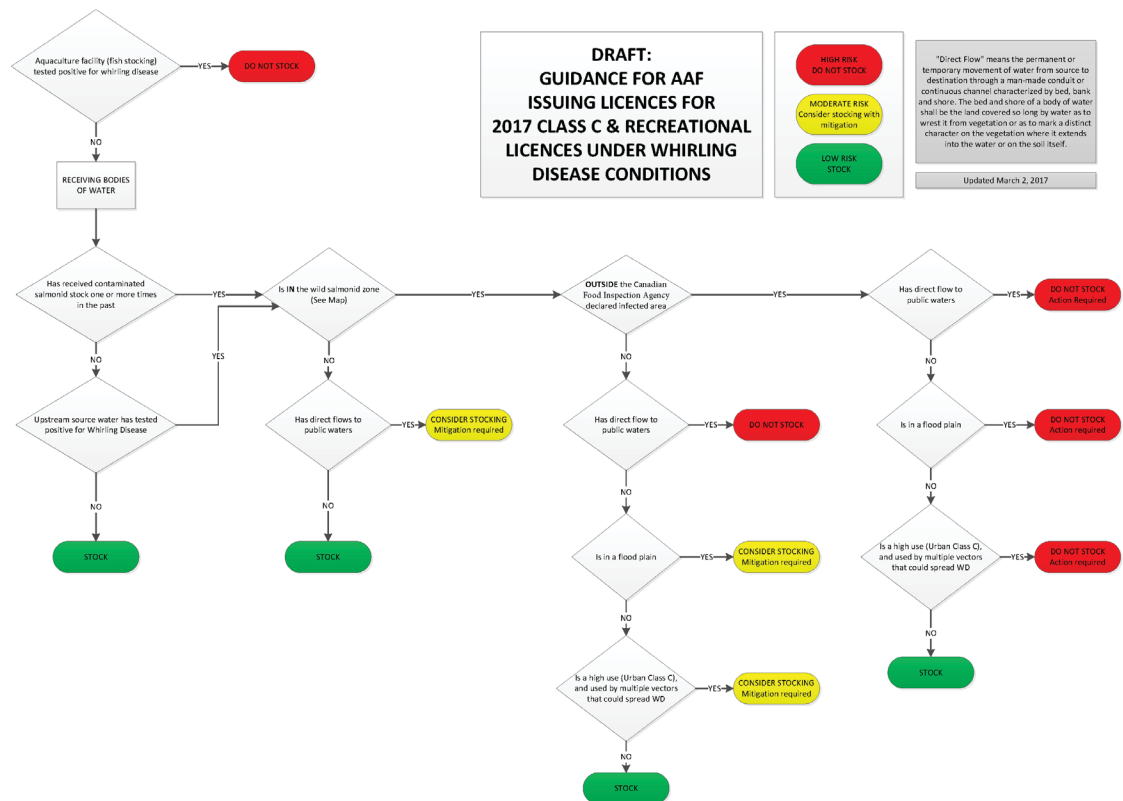


Figure 7: The Common Risk Management Framework was developed to assess the risk of spreading or perpetuating whirling disease in public waters. The framework assesses a site's stocking history, location, hydrogeological connection to natural water bodies, and whether or not they are within a floodplain.

Approximately 200 out of 3,500 private, and 11 stocked public ponds have been deemed moderate to high risk of spreading or perpetuating whirling disease. Stocking of moderate to high risk ponds has been suspended. These ponds will undergo further assessment to determine if mitigation measures can be put in place to lower risk and allow stocking. Alberta Environment and Parks is working with local organizations and municipalities on mitigation for these ponds that may allow stocking.

Decontamination

Policy: Government of Alberta Decontamination Protocol for Watercraft & Equipment

The Government of Alberta Decontamination Protocol for Watercraft & Equipment was developed to address an immediate need for containment of whirling disease and other aquatic invasive species. The protocol was developed by a multi-agency task team of field staff from program areas throughout the province that conduct in-water and near-water work. The mitigation measures outlined in the protocol are consistent with the best available standards and research. They provide the best measures for containing the parasite causing whirling disease in the province and ensure Government of Alberta staff, Government of Alberta contractors and Fish Research Licence and Parks Research and Collection Permit holders are not spreading *M. cerebralis* or aquatic invasive species (AIS) in Alberta.

Prior to the first detection of whirling disease in Alberta in 2016, there were no standards for Government of Alberta staff to mitigate the spread of fish disease and aquatic invasive species in the province. This led to inconsistency and a lack of knowledge and understanding about the risk that our in-water work poses to the protection of our freshwater resources in the province. Establishing standards for staff to conduct cleaning procedures after using watercraft and/or equipment is the best means of preventing the spread of harmful invasive species and fish diseases. As an example, when whirling disease was first detected in Colorado, state fisheries workers were deployed to sample fish from waters across the state. It later became clear that the staff conducting the monitoring became a primary vector of the spread of *M. cerebralis* to previously uninfected waters.

This new protocol replaces the existing 'Interim Guidelines for the Disinfection of Fisheries Equipment to Reduce the Spread of Whirling Disease in Southern Alberta,' that was developed immediately after the discovery of whirling disease in the province. There is also a moderate policy shift from the 'Interim Guidelines' currently in effect, as they only apply to AEP fisheries staff in southern Alberta, whereas the new Decontamination Protocol would be required for all Government of Alberta staff (with the exception of emergency activities), Government of Alberta contractors, Fish Research Licence holders, and Parks Collection Permit holders. This new protocol is, in many ways, more protective of conserving freshwater resources in the province as it addresses the risk of fish disease and aquatic invasive species province-wide, and for all program areas.

The Decontamination Protocol will be posted on AEP's external website so that it can be accessed by all staff, contractors, research or permit holders, and interested stakeholders.

Decontamination Hubs – Regional Stations And Mobile Units

The newly developed Government of Alberta Decontamination Protocol for Watercraft and Equipment includes specific instructions for each type of field work (e.g. fisheries, enforcement, monitoring, fire management, etc.). To support Government of Alberta staff and contractors, fully contained decontamination stations will be established in Edmonton, Calgary, and Lethbridge. Mobile decontamination units will support regional operations. The decontamination stations and mobile units will be used by all Government of Alberta staff for decontaminating field gear and equipment, as well as to house products and specialized equipment needed for decontamination protocols. The regional decontamination stations and the mobile decontamination units will provide hot water wash and disinfection support, as detailed in the Protocol, to fisheries operations as well as Government of Alberta contractors working within or around provincial waters.

Risk Assessments

The parasite that causes whirling disease has a complex life-cycle that is difficult to detect and impossible to eradicate or control in wild waters once established, primarily because the spore-stage is resistant and persistent in the environment. As a result, whirling disease can be spread easily and unknowingly on fish, gear, mud, or in water, even when the best intuitive measures are taken to clean gear. Due to the risk of high mortalities on juvenile fish, and subsequent overall declines of fish populations, it is important to understand the various risks and how to manage them.

Although removal and elimination of the parasite *M. cerebralis* is not practical, it may be possible to mitigate the risk of exposure for populations in areas where the disease is not yet established. A spatial model was developed to describe the probability of the parasite occurrence as high, medium, and low based on the life-history characteristics of the parasite and environmental variables. The subsequent results and map, are used to guide field sampling crews to locations with the highest probability of whirling disease presence (Figure 8).

Additional risk assessment modeling will be completed in collaboration with the University of Alberta to develop a decision support tool to aid managers in estimating the likelihood of salmonid exposure to *M. cerebralis* and the spread of the parasite within a stream system following infection (see Research Initiatives section for further details).

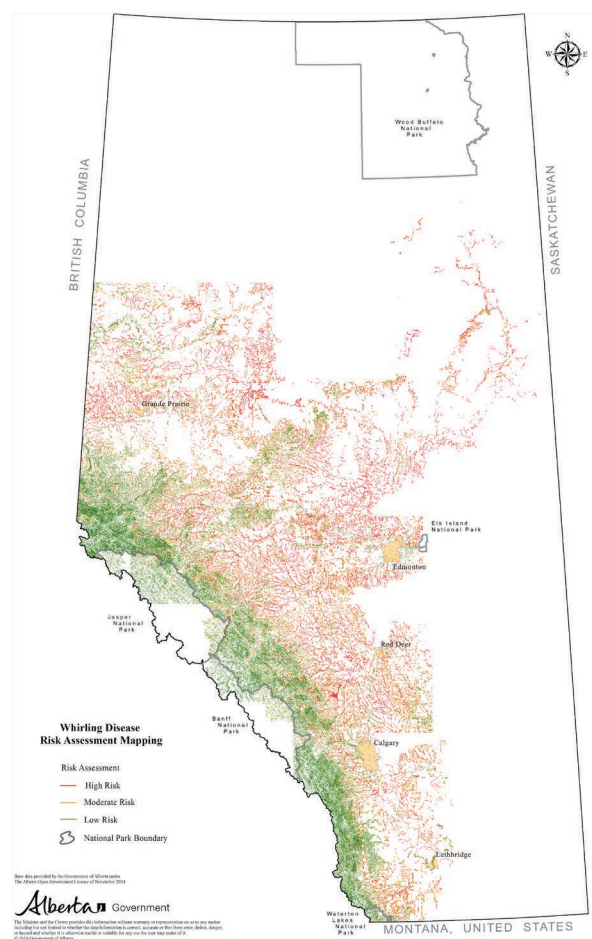


Figure 8: Map showing the results of risk assessment modeling to categorize the probability of *M. cerebralis* occurrence as high, medium, and low based on the life-history characteristics of the parasite and environmental variables.

6. RESEARCH INITIATIVES

Alberta Environment and Parks has initiated research on whirling disease to provide fisheries managers with a complete and effective set of management tools to maintain populations of wild and native salmonids in the presence of the whirling disease parasite.

University of Alberta – Risk Assessment Modeling

A comprehensive framework is required to assess the potential risk of transferring whirling disease from known infected areas to uninfected areas so that Alberta Environment and Parks can choose appropriate mitigation measures to reduce, minimize or eliminate whirling disease vectors and the subsequent spread of the disease. The aim of this collaborative work with the University of Alberta is to develop a robust and scientifically defensible decision framework to assess the potential risk of whirling disease transfer within and amongst watersheds. The framework will also assess the effectiveness of management actions to reduce the spread of whirling disease. For instance, if recreational angling is identified as a high risk for spreading whirling disease through infected equipment, then changes to angling regulations may reduce the likelihood of transfer. The project objectives are two-fold:

1. To quantitatively assess the potential risk of whirling disease transfer from known infected locations to unknown and potentially uninfected locations, and
2. To quantitatively assess how management actions can reduce the spread of whirling disease. This assessment would include a cost benefit analysis, where the costs and benefits would be assessed for different management scenarios.

At completion, the project will provide an overarching framework that will help AEP understand how whirling disease behaves on the landscape, including how whirling disease is likely to spread, what vectors are most likely responsible for spreading whirling disease and what management actions will have greatest impact on reducing or containing the spread of whirling disease.

University of Alberta – Non-lethal Sample Methods for Whirling Disease

Current methods to detect the whirling disease parasite require lethal sampling of susceptible fish species. While these methods are successful at detecting the parasite, there are obvious disadvantages. First, the requirement for lethal sampling is problematic in areas with species at risk such as, Athabasca Rainbow Trout, Westslope Cutthroat Trout, and Bull Trout. It is pertinent to know how whirling disease may affect these species at risk; however, many of these populations have a small remaining distribution and the additional stress of lethal testing for whirling disease could have negative effects on the population. Second, traditional lethal detection methods focus on detecting positives in fish. Detection of positives when present at a low abundance requires a substantial lethal sampling effort making it difficult to confidently delineate negative areas. The lack of confidence in negative detections (when testing low numbers of fish) provides challenges for managers to prevent the spread of the parasite before it occurs. Third, by testing fish that are mobile across the landscape, it is difficult to determine the location of infectious hot spots where fish may have originally contracted the parasite. Finally, the process of collecting and testing fish samples is time consuming and can cause a long delay between the initial field collection and obtaining final results.

Non-lethal diagnostic methods may provide an alternative to traditional lethal methods by allowing managers to obtain quick results by testing water and/or sediment samples. Development of non-lethal testing methods is underway at the University of Alberta. AEP is working with the University of Alberta to help validate these non-lethal methods as part of the stocked pond surveillance in 2017. At each pond, fish, water and sediment samples will be tested to link results obtained through traditional lethal methods (e.g., fish sampling) to non-lethal methods (e.g., water and sediment sampling) and allow for a comparison of detection efficiency between the different methods.

The development of non-lethal detection methods will allow managers to quickly delineate the extent of the parasite and implement “Early Detection and Rapid Response” management of the whirling disease parasite.

Future Research

Future research initiatives may fall within a wide range of categories and may involve researchers from many disciplines, agencies and jurisdictions. These initiatives may include epidemiological or ecological research such as the susceptibility of northern salmonid species and strains of species not yet documented in the literature.

Other areas of potential research include: understanding the distribution and vectors of dissemination of the parasite *M. cerebralis*, parasite research, oligochaete (*Tubifex tubifex*) research (determining presence of susceptible & refractile lineages), and novel management and controls for whirling disease.

FOR MORE INFORMATION

AEP Whirling Disease Website: <http://aep.alberta.ca/fish-wildlife/wildlife-diseases/whirling-disease/default.aspx>

CFIA Whirling Disease Website: <http://www.inspection.gc.ca/animals/aquatic-animals/diseases/reportable/whirling-disease/eng/1336685663723/1336685826959>

AIS Hotline for reports and inquiries (24/7): 1-855-336-BOAT (2628)

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