Fish Health Center

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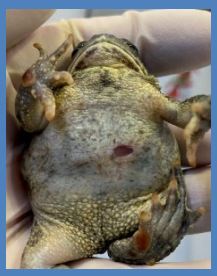
Spring 2023 Highlights:

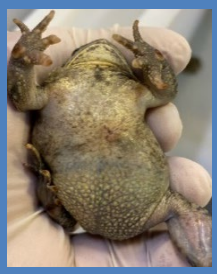
This spring, the Bozeman FHC has been busy in the lab and traveling all over our region to accomplish Mission-Critical work and strengthen relationships with our many hatcheries and partners!

Laboratory Services Supporting Federal Recovery, Restoration and Recreation – Complete Health Inspections done in 2023:

- Creston National Fish Hatchery: 2/6, 420 fish
- Garrison Dam National Fish Hatchery: 2/13, 170 fish
- Hotchkiss National Fish Hatchery: 2/14, 180 fish
- Ouray National Fish Hatchery: 3/1, 120 fish
- DC Booth National Fish Hatchery: 3/14, 195 fish
- Gavins Point National Fish Hatchery: 3/21, 60 fish
- Jackson National Fish Hatchery: 4/3, 60 fish
- Ouray National Fish Hatchery – Grand Valley Unit: 4/10, 120 fish
- Leadville National Fish Hatchery: 4/11, 240 fish
- Jones Hole National Fish Hatchery: 4/11, 240 fish
- Saratoga National Fish Hatchery: 4/18, 630 fish
- Ennis National Fish Hatchery: 5/15, 420 fish
- BFHC now uses flow cytometry as a quality control for triploid fish. We can test triploid groups against diploid controls and determine what percent of a lot was successfully converted to triploid. So far, this has been done for Ennis NFH and Colorado Parks and Wildlife.

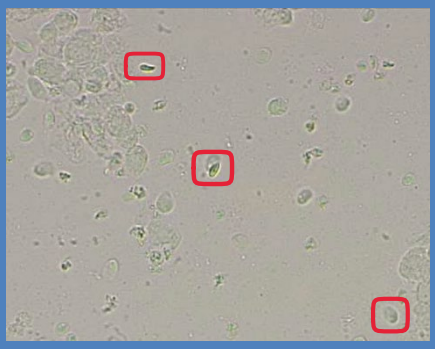
Fish Health Inspections
Top left: Cutthroat trout from Saratoga NFH. Photo: USFWS/T. Weiss
Bottom left: Pallid sturgeon from Gavins Point NFH. Photo: USFWS/J. Veilleux
Bottom right: Bonytail chub from Ouray NFH. Photo: USFWS/J. Veilleux





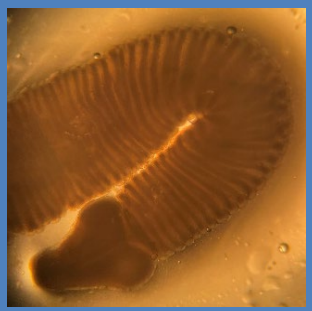
3-year-old male Wyoming toad (before and after) presented with an ulcerative lesion on its ventral surface. Treated with antibiotics & salt baths. Photo: USFWS/R. Frabasilio

Suspected *Saprolegnia* spp. Photo: USFWS/Z. Olsen



Ichthyobodo spp. (formerly Costia): small, swirling, potato chip-shaped parasites. Photo: USFWS/Z. Olsen

Fin erosion in a young rainbow trout - fins contain vasculature, skeletal, and nerve structures. Photo: USFWS/J. Veilleux



Asian tapeworm (*Schyzocotyle acheilognathi*) under light microscopy. Photo: USFWS/J. Veilleux

Laboratory Diagnostic Support to Reduce Hatchery and Wild Fish Losses:

- Staff participated in numerous phone calls, email conversations, and site visits with hatchery managers and partners regarding fish health issues, infrastructure and biosecurity questions, and treatment recommendations. This included nutritional concerns, water quality problems, and pathogens such as *Ichthyophthirius* multifiliis, *Ichthyobodo* spp., *Aeromonas* salmonicida, motile Aeromonas septicemia, and Asian tapeworm (*Schyzocotyle acheilognathi*).

- Provided veterinary support on several occasions to the Wyoming Toad colony at Saratoga NFH.

- Assisted Gavins Point NFH aquarium with a sick painted turtle. The turtle presented lethargic and inappetent with exophthalmia, ocular discharge, and a swollen foot. After antibiotics, fluids, and supportive care, he's back to normal.

Laboratory Services Supporting Partner Recovery, Restoration and Recreation:

- Big Springs Tribal Fish Hatchery (Utah): Complete fish health inspection on rainbow, brown, and cutthroat trout – 4/11, 96 fish

- Renee completed genotyping on 62 buccal swab samples collected from individual toads at six of the Wyoming toad recovery team partner facilities. The genetic markers identified from these samples can be used to improve genetic diversity in the breeding program.

- Montana Fish, Wildlife and Parks: from tissue samples submitted to the lab, staff conducted seven complete hatchery inspections, three troubleshooting cases, two virology cases, and six complete wild fish inspections. FWP also submitted Lernaeopodid copepods collected from wild kokanee for PCR identification.

- Kansas Wildlife and Parks Commission: from hatchery samples submitted to the lab, staff completed three virology inspections. In addition to these, Molly has expertly handled the constant flow of virology samples we receive each week.

- Montana Fish, Wildlife, and Parks has contracted Jake to serve as their veterinarian of record. Working closely with their excellent fish health team, he made site visits to seven state hatcheries to establish a veterinary-client-patient relationship (VCPR). After that, medicated feeds can be prescribed through a veterinary feed directive (VFD).

- Tammy has been hard at work in our histopathology lab, preparing a plethora of slides for partners such as the University of Idaho, MT FWP, and the Bozeman Fish Technology Center. It's an art like few others!

- Rick is the BFHC's point-person for the National Wild Fish Health Survey Data project. He has been part of regular meetings and numerous phone and email conversations as the new LIMS software has been integrated over the past year plus. This open-source database showcases wild fish health survey results in watersheds across the entire country, an invaluable tool for partners at all levels.

Renee and Tammy at the Gallatin Valley Earth Day Festival. Photo by USFWS/T. Weiss

Renee's FHC booth at the 27th Annual East Idaho Fly Tying and Fly Fishing Expo. Photo by USFWS/R. Yamamoto

Annual Grizzly Bear Safety training with the FTC and AADAP offices, led by Amber Kornak. Photo by USFWS/T. Weiss

Outreach and Education:

- FHC staff prepped over 400 wildflower seed planting kits for the Gallatin Valley Earth Day Festival. Tammy and Renee represented the FHC and USFWS at the event, educating people on everything from fish health to pollination. 1500 people attended the festival.
- Renee set up a FHC booth at the 27th Annual East Idaho Fly Tying and Fly Fishing Expo, where she educated attendees on fish health and the USFWS. Close to 4000 people attended this expo in Idaho Falls!
- Jake attended the Montana Science Center's STEAM Saturday, where local professionals are invited to teach kids about science. He focused on conservation, fish health, and veterinary medicine.
- Lacey completed a fish health inspection at Palisade High School in Colorado, where razorback suckers are raised in the classroom. She also gave an exciting educational presentation to the students. 240 of the endangered fish were released at Riverbank Park on Tuesday, May 10th with students watching.
- After long winter, we're excited for the return of the pollinator garden to the Bozeman FHC, spearheaded by Tammy. Consisting of mixed native and nonnative plants, the garden attracts pollinators like bees, wasps, moths, butterflies, and hummingbirds. Other non-pollinator species such as gophers, rabbits, marmots, birds, and spiders also enjoy the garden!
- Renee organized two exciting safety trainings that the FTC, AADAP, and FWCO offices also participated in. Amber Kornak, a USFWS Grizzly Bear Conflict Specialist, led our Annual Grizzly Bear Safety Training. Rocky Mountain Response led our Wilderness First Aid, CPR, and AED training.

Partnerships, Employee Development & Other News:

- The Bozeman FHC is co-hosting the annual fish health biologists meeting with the D.C. Booth Historic National Fish Hatchery in Spearfish, SD (6/12-6/16). Lacey has been leading the charge in setting an agenda and organizing meeting logistics.
- Staff attended the Rocky Plains Fish Pathologist meeting.
- Lacey participated in the USFWS National Broodstock Meeting as the point person for fish health matters.
- Jake participated in the combined 29th Annual Aquaculture Drug Approval Coordination Workshop and 46th Annual Eastern Fish Health Workshop.
- Staff have participated in numerous meetings and phone calls with multiple regional FAC/USGS partners and the Whitney Genetics Lab (WGL) in LaCrosse, WI to plan for the upcoming Alligator snapping turtle eDNA project.
- Staff participated in the Wyoming Toad Recovery Team call.
- The FHC continues to work towards the implementation of the new FWS National Aquatic Animal Health Policy.
- Staff received training in several new pieces of lab equipment, including our QuantStudio 6-Pro Real-Time qPCR System. Rick and Renee are our experts in molecular method laboratory techniques.

What's this?

Each newsletter will have a new installment of **Fish Health 101**. It will briefly cover a topics of fish health you may find of interest

In this first edition, we'll walk through how to work up a fish health case. Many of these steps could be topics all on their own, so this is a general overview. If you have further questions, don't hesitate to reach out. If you'd like to request a topic, email Jacob_Veilleux@fws.gov

Taking some time to watch the fish in a raceway before sampling can pay great dividends! Photo: USFWS/J. Veilleux

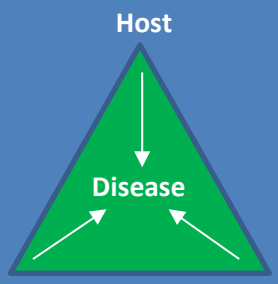
Not buffering MS-222 with sodium bicarbonate can cause external parasites to drop off the fish before you get a chance to see them!

Using basic light microscopy to view gills and other superficial tissues can be a powerful tool. In addition to spotting pathogens, you can determine whether tissues appear normal or not. This can provide great insight into possible pathology and causes. Photo: USFWS/J. Veilleux

Fish Health 101: Working up a Case

1. **Gather a history**
   - Talk to staff about what's going on. Ask questions like how old are the fish, how long has it been happening, what are the clinical signs, are any other fish affected, any recent changes, have they already received any type of treatment, etc.?
   - Use previous records to find possible connecting links. Has this happened before, where'd the eggs/fish come from, did the facility bring any new fish in recently?
   - Determine the urgency and whether it's a potential biosecurity threat to other fish.
2. **Examine the hatchery**
   - Observe the fish swimming and consider things such as:
     - Where are they located in the water column and tank? Does their swimming pattern appear normal or abnormal? Can you see any lesions? Depending on life stage, are they interested in feed? Are there carcasses in the system?
   - Observe neighboring tanks and reportedly non-affected fish and compare to the problem tank. Do you notice any similarities and/or difference between them?
   - Review mortality sheets and water quality measurements. Consider testing water chemistry.
   - Make sure to understand hatchery infrastructure, life support systems, and water source.
3. **Collect fish for examination and necropsy**
   - From the tank(s) in question, collect a sample of the overall population. This should be about 10 fish. Try to grab an equal amount of normal vs abnormal individuals. Avoid runts unless that is part of the bigger picture (i.e., a third of the population are runts/pinheads). External diagnostics (skin scrape/gill clips) can be non-lethal. Humanely euthanize if collecting internal samples.
     - Collect samples from neighboring tanks or tanks that share the same water (full or partial re-use). Make sure to label samples so you can trace them back to a specific location.
   - Before anything else, conduct a physical examination on the fish. How does it look compared to a normal, healthy fish. Check for things such as symmetry, gill color, fin condition, skin health/mucus level, expected size for that age, etc.
   - Light Microscopy: skin scrapes, gill clips, and fin clips should be taken to view tissue health and search for pathogens such as external parasites, bacterial infections, and fungus.
   - Necropsy:
     - Before collecting samples, examine the body cavity and internal organs for any abnormalities including hemorrhage, free fluid, and tumors. Make note of fat reserves. Compare sick fish to apparently normal fish and note differences.
     - Collect your lab samples: kidney for bacteriology plus any suspicious lesions and kidney and spleen for virology. Other samples may be relevant depending on the species in question and your clinical suspicions.
4. **Interpreting diagnostic results**
   - Each case in a Fish Health workup is unique and it is important to note that the presence of a pathogen does not equal disease. A case is like a puzzle. If steps 1-3 are all the pieces, then your diagnostic results are the box they came in with a picture on it to help guide you. You still need to put everything together.
     - Determine what is causing morbidity and mortality in your system. This may be a single cause or multifactorial. There may not even be a definitive answer.
       - One way to do this is with a problem list identifying each of the issues plaguing the system and/or fish. Order them by priority. Then based on what you found in your case work-up, list what could be causing each problem. Once done, take a step back and look at the whole list. Are there causes that overlap between each problem?
     - If a pathogen is present, don't jump the gun and assign blame! Considering all the pieces of the puzzle, is the presence of this pathogen relevant? If it is indeed causing disease, is it a primary infectious agent or secondary infectious agent? To answer these questions, you need to consider the following:

EPIDEMIOLOGIC TRIANGLE



The epidemiologic triangle highlights the complex relationships between a host (fish), the agent (pathogen), and the environment. Each corner and side (connection between the factors) of the triangle plays a role in the outbreak of disease and must be considered when deciding on an intervention plan for a facility. Image by USFWS/J. Veilleux

A strong biosecurity plan covering aspects such as isolation protocols, which disinfectant to use, designated equipment for different rooms and tanks, and foot baths procedures can make a world of difference in preventing the introduction and spread of pathogens. Photo by USFWS/J. Veilleux courtesy of Ouray NFH

The BFHC can conduct susceptibility tests on cultured bacteria from fish samples. Using antibiotic sensitivity discs, we can measure which drug will be most efficacious for each case. Photo by USFWS/J. Veilleux

- **Immune system functional status**: Fish have a series of immune system defenses to fight against infection. This includes a non-specific innate response and a specific, adaptive acquired response, which encapsulates everything from skin (a physical barrier) to lymphocytes. In times of stress, the immune system is not fully operational, and the fish is susceptible to invasion. When evaluating a case, think about whether there were any non-pathogenic causes of stress or injury to the fish. If so, then the pathogen may be secondary to the inciting cause.
- **Amount of pathogen present**: Even with a fully operational immune system, pathogens can still slip by and wreak havoc. If there's a high pathogen load in a system, it increases the probability of immune system evasion even with weaker infectious agents. Think about if someone with a cold sneezed in your face. Even if you're fit and healthy, your chances of getting sick have skyrocketed. The same holds true with fish. When considering this question, it is important to ponder where the pathogen came from, how did it spread, and what is its life cycle. Additionally, mortalities should be viewed as pathogen bombs and picked as frequently as possible. Certain bacteria can shed from carcasses for months!
- **Type of pathogen present**: Pathogens vary greatly in infectivity (ability to infect a host) and virulence (ability to cause damage to a host). Combined this is called pathogenicity (disease-causing capacity of a pathogen). Even the same species of pathogen can have dramatically different effects depending on its strain, the host species it's infecting, and environmental factors. This can be further exasperated by certain fish culture practices. All this is to say that with certain infectious agents, even if their numbers are low, they have evolved to evade the fish immune system much more efficiently.

5. Make a plan

- Based on the diagnosis(es), what needs to be done to fix the problem? This may include changes in areas such as preventative health and biosecurity, fish culture, hatchery infrastructure, and nutrition. Chemotherapeutics may be required depending on the cause. In some cases, culling of fish may be necessary. This plan should address the immediate problem AND long-term efforts to prevent it from happening again.
  - Though incredibly useful, chemotherapeutics are not a silver bullet. The presence of a pathogen is not necessarily reason enough to treat. Deciding to use drugs to treat a disease must be carefully considered based on the full clinical picture and facility capabilities.
    - Factors to consider include underlying non-infectious cause resulting in stress; severity of morbidity and mortality; fish welfare; the purpose of the fish (i.e., highly valuable broodstock); and number of fish in a system.
  - When using external chemical treatments, factors such as water quality, water temperature, negative effects on already stressed fish, type of system being treated, and amount of drug required must be assessed.
  - In aquaculture, we only have access to a few legal antibiotics. As a result, it is crucial we are judicious with our use to prevent antimicrobial resistance. For example, fish with a milder external bacterial infection could be treated with hydrogen peroxide before jumping to medicated feed. In cases where medicated feed is required, extra steps should be taken to prevent a future outbreak. This is because repeated use of an antibiotic at a facility greatly increases the probability that those bacteria will develop resistance. Once that happens, we lose that antibiotic as a weapon against infection in our arsenal. Even more alarming repercussions are that the resistant bacteria could spread to other facilities or the environment. Furthermore, those resistant genes could jump to other animal and human pathogens. This is possible through bacterial horizontal gene transfer and mobile genetic elements. To counteract this, after treatment, we must work with facilities to institute a strong biosecurity plan, alter fish culture practices, and consider other preventative health measures like vaccination.