Aquatic Invasive Species Early Detection, Monitoring, and Control Annual Report

Abstract:
Aquatic invasive species (AIS) are non-native species that can degrade natural resources, damage water-based infrastructure or reduce recreational opportunities. Montana Fish, Wildlife & Parks AIS Bureau performs early detection surveys to identify new AIS populations and facilitate containment or possibly eradication. This report summarizes early detection and monitoring survey efforts for aquatic invasive species by Montana Fish, Wildlife & Parks and partners during the 2022 sampling season as well as control and eradication projects.

2022 Report Highlights

- Provide results of AIS early detection efforts
- Foster a greater understanding of the threats of AIS to Montana's waters
- Encourage partners and others to sample, report, and look for AIS invaders
- Highlight eradication and control projects

Early detection technicians take a moment to record their findings during a one-week training in northwest Montana to prepare for the 2022 field season.

The Montana Fish, Wildlife & Parks (FWP) Aquatic Invasive Species Bureau implements an AIS Management Plan, which includes coordination and collaboration, prevention of new AIS introductions, early detection and monitoring, control and eradication, and outreach and education. The goal of the AIS Management Plan is to minimize the harmful impacts of AIS through the prevention and management of AIS into, within, and from Montana.

Report Contents

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Early Detection and Monitoring – Background

AIS cause significant economic, ecologic, and recreational impacts when they invade a waterbody. Prevention efforts can preserve Montana's waters by keeping AIS from entering and spreading in the state. If prevention fails, early detection, monitoring, and control are the next essential lines of defense for any effective AIS program. FWP's first statewide AIS early detection and monitoring program began in 2004. Early detection allows FWP biologists to locate small or source AIS populations, while monitoring allows FWP to study existing population trends and investigate suspect findings. These efforts can lead to eradication efforts or long-term control and management strategies. FWP monitors for all AIS including zebra and quagga mussels, Corbicula clams, New Zealand mudsnails, faucet snails, Eurasian watermilfoil, flowering rush, curlyleaf pondweed, fragrant waterlily and others. All past reports, sampling standard operating procedures, and management plans can be found under the "Resources" and "Reports" sections at https://cleandraindry.mt.gov/.

News for 2022

The 2022 field season was a whirlwind of activity. A few notable activities across the state in 2022 included:

- Dive team joint training with Columbia River Basin states
- Completion of a revised dreissenid invasion risk assessment for Montana waters
- Conclusion of a statewide crayfish survey project

Dive Team Training with Washington

The FWP dive team participated in a one-week dive training (Figure 1) at Jones Island Marine State Park near Friday Harbor, WA in April 2022. The Washington Invasive Species Council received a grant to fund this joint training and was hosted by Washington Department of Fish and Wildlife. Agency staff from both states spent time responding to a simulated detection of dreissenid mussels. The teams practiced underwater grid surveys that would be used for AIS detection. The teams also deployed a containment boom (Figure 2), which could be used to contain and potentially treat an invasive mussel population. This training helped facilitate interstate communication and helped to lay the groundwork for long-term coordination between dive teams in Western states for work on AIS issues.

Figure 1. Some of the participants at the Columbia River Basin AIS dive training pose in front of the containment boom.

Figure 2. Shore support helps deploy the containment boom. A similar containment boom could be used in Montana in the event of a discovery of a dreissenid mussel population in order to contain and/or treat it.

Table 1. Results from the revised dreissenid invasion risk assessment.

Risk Rank	# of Lakes	# of Rivers/Streams
1	11	3
2	124	51
3	32	24
4	41	133
5	70	2
6	64	83
7	56	180
8	47	138
9	94	464
10	0	431

Revision of Dreissenid Invasion Risk Assessment for Montana Waters

Annual work plans developed by FWP are guided by an invasion risk assessment for dreissenid mussels. The last assessment was performed in 2017 and was driven heavily by the positive invasive mussel detection in Tiber Reservoir. Since that time, Tiber Reservoir was delisted as a positive water following five years of no additional detections. With not mussel positive waterbodies in the state, the waterbody risk assessment was revised to reflect those changes. Risk ranking categories were also revised from 5 levels to 10 to help prioritize sampling efforts (Table 1). A total of 2,048 waters were included in the assessment (Figure 3). Detailed results can be obtained by contacting Craig McLane, FWP's AIS early detection coordinator at cmclane@mt.gov.

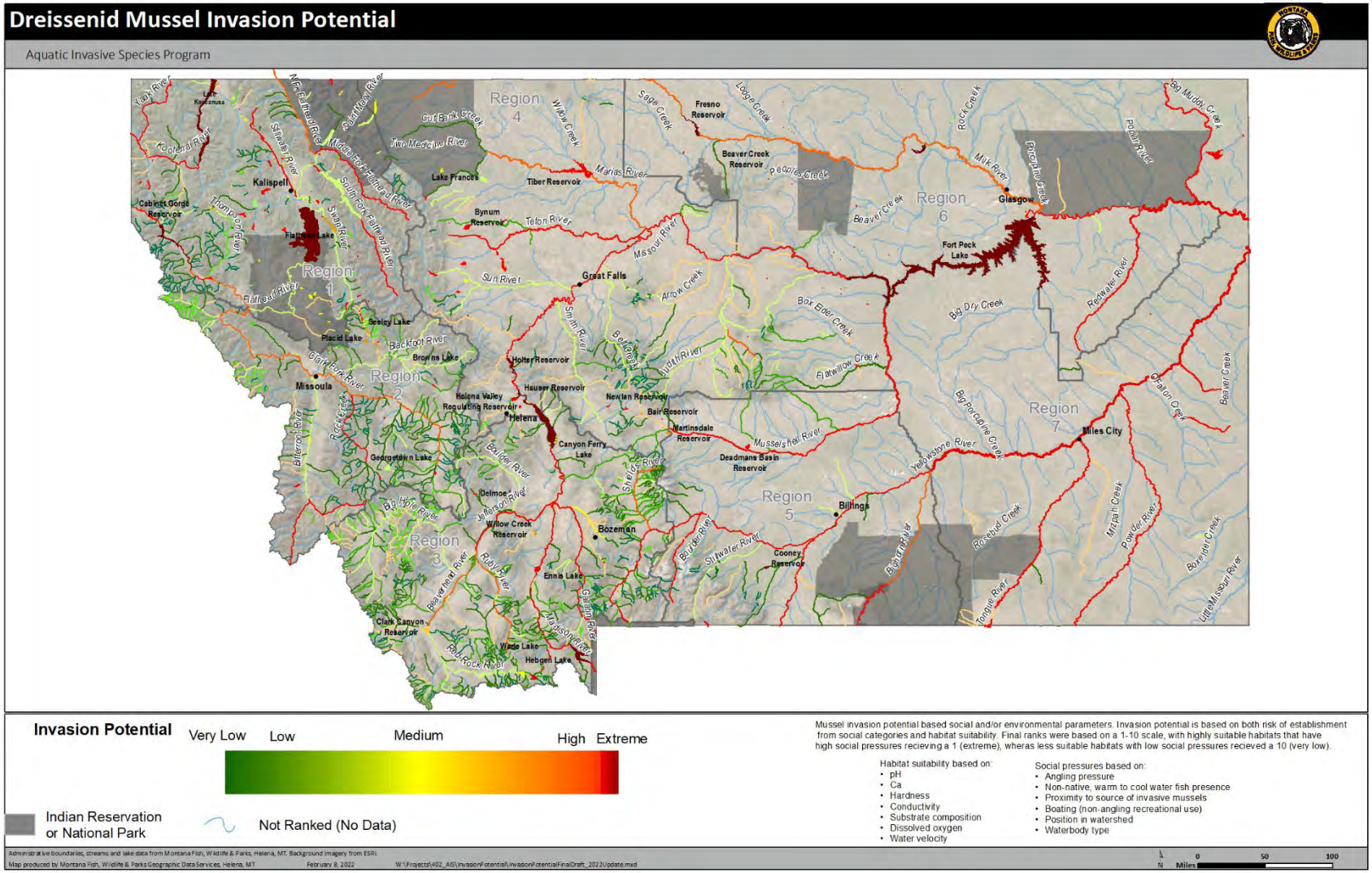


Figure 3. Map showing results from the 2022 dreissenid invasion risk assessment with waterbodies in red at highest risk of invasion.

Figure 4. Dr. Susie Adams (USDA Forest Service of Oxford, MS) and Jeremiah North Piegan (fisheries biologist with Blackfeet Nation Fish & Wildlife) sampling for crayfish on Blackfeet Reservation waters.

Statewide Crayfish Surveys

In 2021, Montana Fish, Wildlife & Parks, along with Dr. Susie Adams with the USDA Forest Service in Mississippi began a two-year collaborative statewide crayfish project to answer questions about crayfish, species distribution, and human consumption in Montana (Figure 4). Crayfish are important to the ecology of many Montana waters partly because of what they eat, what eats them and their interaction with the environment. Globally, crayfish are one of the most invasive species.

The project had multiple objectives including to:

- Provide guidance for human consumption (i.e., mercury levels, dioxins, furans, coplanar PCB's)
- Determine species distribution
- Locate and delineate non-native and invasive species
- Compare sampling techniques to provide recommendations for future monitoring
- Develop crayfish expertise within FWP and with partners

FWP and partners sampled nearly 2,800 sites and found crayfish in 550 locations (Figure 5). Partners included federal and state agencies, tribes, universities, counties, educators, and private citizens. No AIS-listed crayfish species were found, such as rusty crayfish (*Faxonius rusticus*) or red swamp crayfish (*Procambarus clarkii*). However, at the Miles City State Fish Hatchery, a non-native crayfish species, southern plains crayfish (*Procambarus simulans*) was identified in 2021 that was not previously documented in Montana. In 2022, a thorough survey was conducted of the Miles City hatchery and surrounding waters. *P. simulans* appeared to be limited to only two ponds on the hatchery property. Details of this discovery have been accepted for publication in the journal *Bioinvasions Records*.

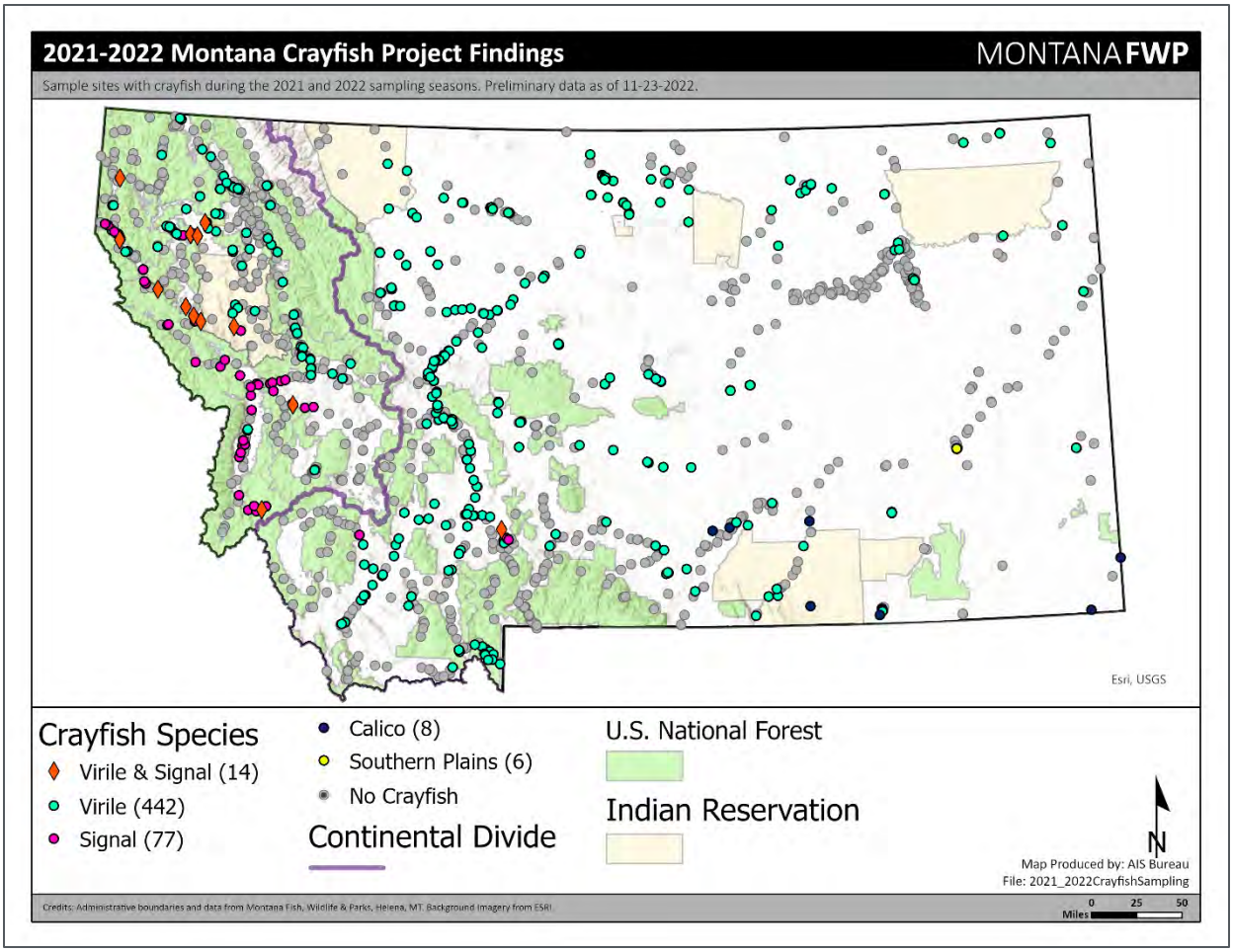


Figure 5. Results from the two-year (2021-2022) crayfish survey project. Results helped determine the distribution of three native species and one non-native species.

Several additional findings included mercury contaminant levels and reports of crayfish plague. Results of mercury contaminant testing were published in the fish consumption advisories on the FWP website (https://fwp.mt.gov/binaries/content/assets/fwp/fish/montanasportfishconsumptionguidelines.pdf). The survey efforts made the first report of crayfish displaying clinical signs (e.g., lesions) of crayfish plague (*Aphanomyces astaci*) in North America. Crayfish plague is endemic to crayfish in North America, although very little is known about the pathogen or disease in Montana. The pathogen was introduced to Europe and has spread throughout the continent, where the resulting disease has decimated native crayfish populations. Although common in North America, crayfish here do not typically exhibit clinical plague symptoms. The effects of the disease in Montana crayfish are unknown and further investigation will evaluate and monitor the disease. Montana crayfish and the pathogen that causes crayfish plague will be further evaluated by a Graduate Research Project scheduled to begin in 2023.

Early Detection and Monitoring Methods

FWP assesses risk for AIS introductions to waterbodies to maximize sampling efforts. Annual work plans are developed in the winter for the following season. Sampling plans are dynamic due to constantly evolving variables used in determining risk. Sites are prioritized based upon variables such as previous years sampling efforts and detections, water calcium levels, water quality data, angler pressure data, and survey conducted by other partners.

Sampling Methods

FWP routinely surveys for a variety of taxa while conducting standard dreissenid sampling. Since there are a variety of AIS, FWP uses different sampling techniques to increase the likelihood of early detection of each of these species. Sampling methods include the use of plankton nets, kick nets, dredges, benthic sleds, plant rakes, shoreline visual surveys, visual surveys, artificial substrate samplers, rock picking, mussel detection dogs, eDNA, snorkeling, and scuba diving. All of Montana's survey methods are described in the AIS Field Sampling and Lab Operating Procedures (Montana Fish, Widlife & Parks, 2019). Methods have been scientifically reviewed and are coordinated with partners and neighboring states. Seasonal AIS technicians spend a week training on sampling methods and species identification (Figure 6) prior to deployment for the sampling season.

Figure 6. Scott Freeman, FWP AIS early detection technician, examines a specimen during the 2022 training week in northwest Montana.

In 2022, FWP expanded its use of eDNA, in conjunction with other sampling, for early detection sampling of dreissenid mussels. FWP collected 70 eDNA samples in 2022 to work out logistical issues with incorporating it at the programmatic scale. FWP plans to continue its use and expand its use when available and appropriate. Positive eDNA results alone would not make a waterbody present for invasive mussels but would trigger more intensive sampling in that water. This additional tool will bolster the state's ability to detect a new population earlier and improve its control and containment.

AIS Sampling Prior to Fish Transfers

The movement of fish can be a vector for transferring AIS including invasive plants, snails, clams, mussels, and pathogens. FWP moves large numbers of fish through both its hatchery and wild fish transfer programs. Hatcheries cannot receive certification to sell or move fish without passing an AIS inspection and fish health inspection. To accomplish this, the FWP Fish Health Laboratory and the FWP AIS Bureau work closely together to inspect all federal, state, and commercial hatcheries annually as well as waterbodies that fish biologists use for wild fish stock transfers. AIS inspections include both on-site AIS surveys and fish disease/pathogen testing. AIS Program protocols include survey for all aquatic invasive species taxa whenever possible. Specifics about pathogen sampling protocols and findings can be obtained by contacting the fish health coordinator, Ken Staigmiller (kstaigmiller@mt.gov).

Figure 7. Dave Ellis stands next to biosecurity upgrades at FWP's Bluewater Fish Hatchery. Copper pipe lining prevent movement of macroinvertebrates, such as New Zealand mudsnails, into the hatchery as well as an extended effluent pipe that creates a higher drop to prevent animals from entering the pipe.

FWP AIS and fish health staff have been working for many years on the standards for hatchery inspections, both within Montana and for facilities importing fish into the state. Hatchery-specific standard operating procedures (SOPs) were developed and are utilized to ensure the highest probability of detection of new populations of invasive species. This effort began during the 2020 field season and was completed in 2021. This process identified strategies to improve biosecurity at hatchery facilities and those upgrades have been initiated (Figure 7).

Figure 8. Brian Hagan, one of FWP's AIS early detection technicians shows off a Eurasian watermilfoil plant he finds on Beaver Lake in May 2022.

2022 AIS Sampling Results

In 2022, FWP and partners cumulatively sampled nearly 400 waterbodies. Most of these waters received all taxa AIS surveys (Figure 8). Specific information on individual waters or areas can be download through FWP's GIS data page at http://gis-mtfwp.opendata.arcgis.com/datasets?q=AIS. No evidence of dreissenid mussels was detected in 2022.

New Detections in 2022

In 2022, new detections of AIS included the following locations:

- New Zealand mudsnails (*Potamopyrgus antipodarum*)
  - Red Rock River - Lima, MT
  - Wayne Edsall Pond - Bozeman, MT
- Eurasian watermilfoil (*Myriophyllum spicatum*) (Figure 9)
  - Pablo Reservoir - Pablo, MT
- Flowering rush (*Butomus umbellatus*)
  - Church Slough - Kalispell, MT
- Curlyleaf pondweed (*Potamogeton crispus*)
  - Haskill Creek - Whitefish, MT
  - Frog Pond - Trout Creek, MT
  - Mission Reservoir - Saint Ignatius, MT
  - Lower Crow Reservoir - Ronan, MT
  - Ninepipe Reservoir - Ronan, MT
- Fragrant waterlily (*Nymphaea odorata*)
  - Hidden Lake - Seeley Lake, MT

Figure 9. A young Eurasian watermilfoil (Myriophyllum spicatum) plant that sprouted from a plant fragment on Beaver Lake near Whitefish.

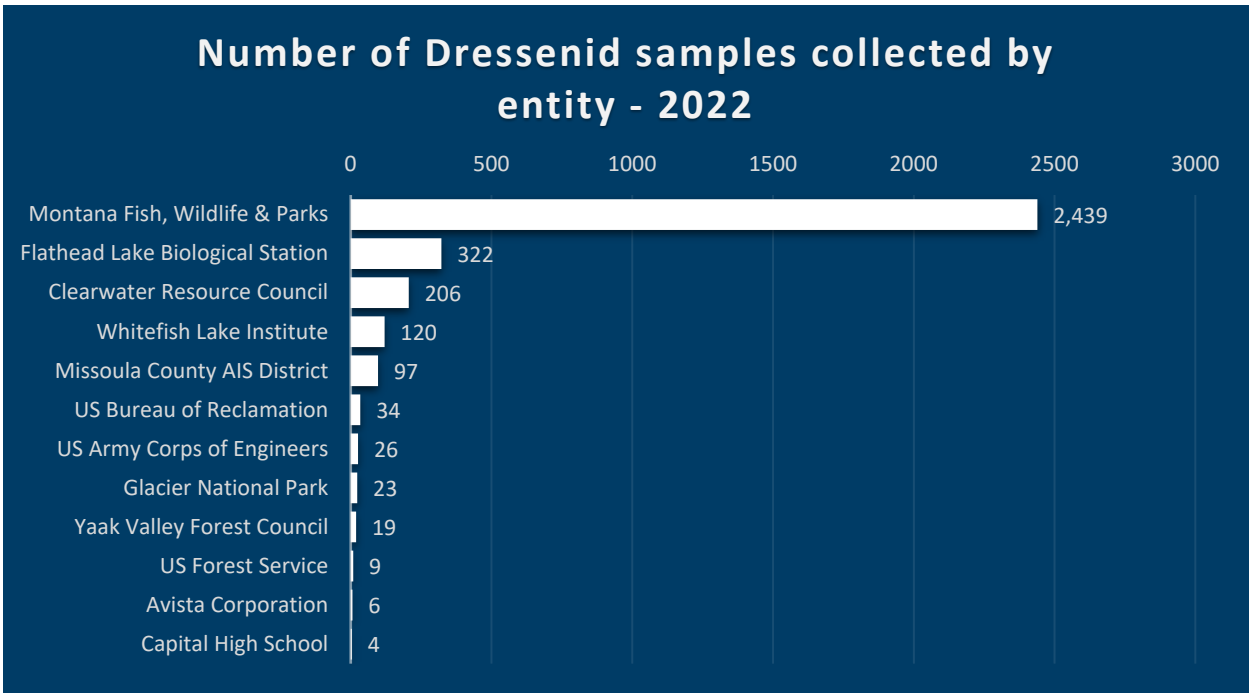


Figure 10. 2022 aquatic invasive species plankton sampling effort by all reported entities.

Statewide Sampling Efforts

The program goal is to comprehensively survey the state every year, which includes all types of waterbodies (lakes, reservoirs, ponds, creeks, rivers, etc.) for all AIS taxa. Montana FWP strives to provide statewide AIS sampling at major lakes and streams (Figure 12). Most sampling sites include plankton sampling as well as all taxa surveys looking for invasive plants, snails, crayfish, and other invertabrates. FWP surveys all high risk sites annually, with more frequent sampling at the highest risk sites. Lower risk sites are visited less frequently depending on risk of AIS introduction.

After plankton samples are collected, they are submitted to FWP's AIS lab for analysis. Figure 10 shows the breakdown of the plankton sampling effort by each entity in 2022. FWP and partners collected 3,271 plankton samples from Montana waters. While most samples are collected by FWP, efforts from partners have increased overtime (Figure 11). FWP is dedicated to working closely with partners to develop and train new partners to improve AIS sampling at the local level. Figure 13 shows mussel veliger sampling effort by Montana partners in 2022.

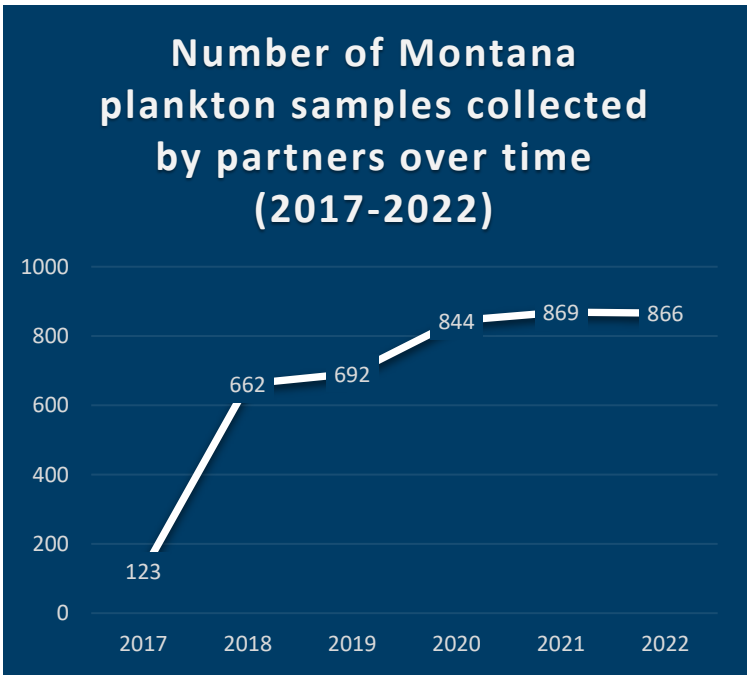


Figure 11. Montana plankton samples submitted to FWP's AIS lab during the last six years showing an increase over time.

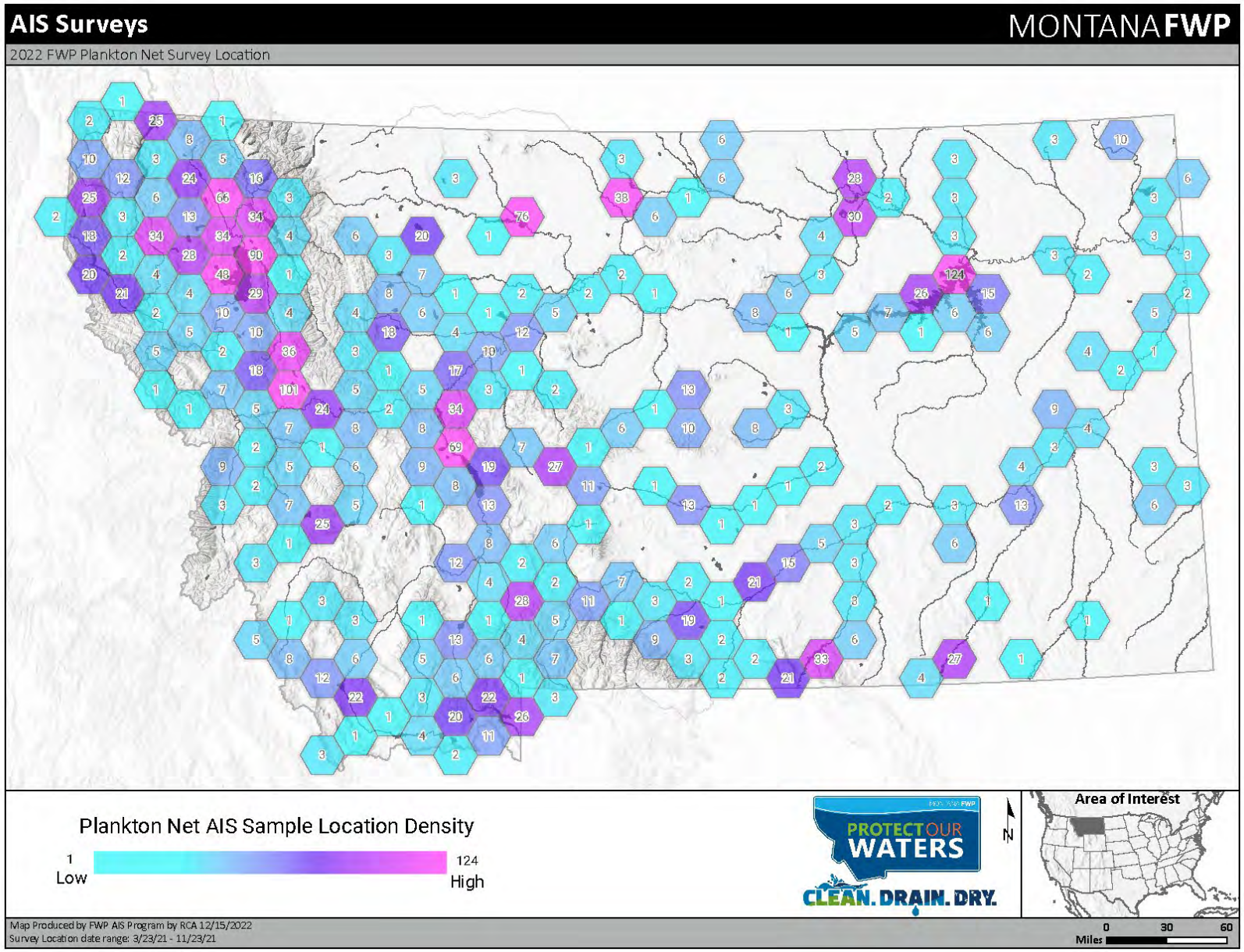


Figure 12. Map of AIS plankton sampling intensity, 2022.

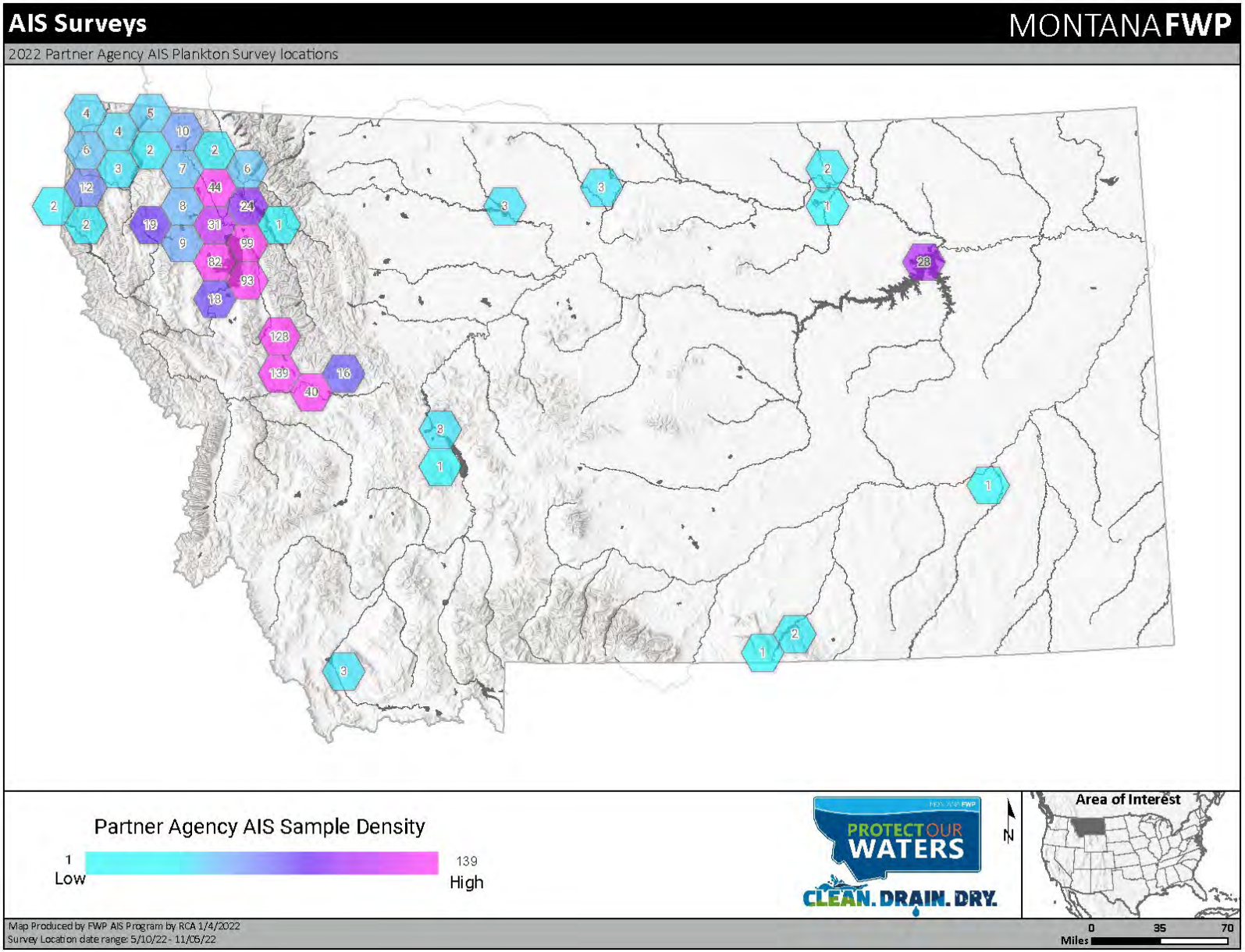


Figure 13. Mussel veliger sampling effort by partners in 2022.

The following tables show the locations of known AIS and the results from monitoring of those waters in 2022. Waters listed with no observations for a species in 2022 does not indicate that the species is no longer there, only that the species was not collected during 2022 sampling efforts. The lack of observations could indicate reduced species abundance, the species was missed by sampling crews, or samplers focused on a different area of the waterbody where the species was not present. Map depictions of AIS locations in Montana can be found in Appendix A and Appendix B.

Animals

Corbicula clam (*Corbicula fluminea*)

Waterbody where previously found	Observed during 2022 sampling efforts	Corbicula clam larvae (plankton sampling)
Lake Elmo	NO	NO

New Zealand mudsnails (*Potamopyrgus antipodarum*)

Waterbody where previously found	Observed during 2022 sampling efforts
Beaverhead River	YES
Beavertail Pond	YES
Big Sheep Creek	Not Sampled
Bighorn River	YES
Bitterroot Fish Hatchery	NO
Bluewater Creek	YES
Bozeman Creek	Not Sampled
Clark Canyon Reservoir	NO
Darlington Ditch 1	YES
Ennis Lake	NO
Gardner River	YES
Hauser Reservoir	NO
Jefferson River	NO
Madison River	YES

Waterbody where previously found	Observed during 2022 sampling efforts
Marias River (below Tiber Dam)	YES
Missouri River (below Holter Dam)	YES
Mitchell Slough	NO
Nelson Spring Creek	Not Sampled
Odell Creek	YES
Poindexter Slough	NO
Quake Lake	YES
Rainbow Dam Reservoir	YES
Red Rock River*	YES
Ruby River	NO
Spring Meadow Lake	YES
Upper Holter Lake	YES
Wayne Edsall Pond*	YES
Yellowstone River	YES

* = New find in 2022

Mud Bithynia/Faucet snail *(Bithynia tentaculata)*

Waterbody where previously found	Observed during 2022 sampling efforts
Browns Lake	YES
Flathead Lake	NO
Georgetown Lake	NO
Lake Frances	NO
Lost Loon Lake (Lost Coon Lake)	YES

Waterbody where previously found	Observed during 2022 sampling efforts
McWennegar Slough	NO
Smith Lake	YES
Upsata Lake	YES
Whitefish Lake	NO

Red-rim melania snail (*Melanoides tuberculatus*)

Waterbody where previously found	Observed during 2022 sampling efforts
Beaverhead River	NO
Gardner River	NO

Waterbody where previously found	Observed during 2022 sampling efforts
Powder River	NO
Warm Spring Ditch adjacent to Beaverhead River	Not Sampled

Big-eared radix (*Radix auricularia*)

Waterbody where previously found	Observed during 2022 sampling efforts
Bitterroot River	YES
Ennis Lake	NO

Waterbody where previously found	Observed during 2022 sampling efforts
Harpers Lake	NO
Pond 1 (Canyon Ferry Wildlife Management Area)	NO

Southern plains crayfish (*Procambarus simulans*)

Waterbody where previously found	Observed during 2022 sampling efforts
Miles City Fish Hatchery	YES

Plants

Eurasian watermilfoil (*Myriophyllum spicatum*)

Waterbody where previously found	Observed during 2022 sampling efforts
Beaver Lake	YES
Cabinet Gorge Reservoir	YES
Clark Fork River (below Thompson Falls Reservoir)	NO
Fort Peck Dredge Cuts	YES
Fort Peck Lake	YES
Fort Peck Powerhouse Tailrace	YES
Fort Peck Trout Pond	YES
Jefferson River	NO
Jefferson Slough	YES

Waterbody where previously found	Observed during 2022 sampling efforts
Madison River (downstream of I-90)	YES
Missouri River (upstream of Canyon Ferry Reservoir, includes Toston Dam)	YES
Missouri River (downstream of Fort Peck Dam)	YES
Nelson Dredge	YES
Nilan Reservoir	YES
Noxon Rapids Reservoir	YES
Pablo Reservoir*	YES
Pond 4 - Canyon Ferry	YES

* = New find in 2021

Flowering rush (*Butomus umbellatus*)

Waterbody where previously found	Observed during 2022 sampling efforts
Cabinet Gorge Reservoir	YES
Church Slough*	YES
Clark Fork River	YES
Flathead Lake	YES

Waterbody where previously found	Observed during 2022 sampling efforts
Flathead River	YES
Noxon Rapids Reservoir	YES
Thompson Falls Reservoir	YES

* = New find in 2022

Fragrant waterlily (*Nymphaea odorata*)

Waterbody where previously found	Observed during 2022 sampling efforts
Beaver Lake	NO
Blanchard Lake (near Whitefish)	YES
Blanchard Lake (Clearwater River)	NO
Browns Lake	NO
Clearwater River	YES
Duck Lake (NW MT)	Not Sampled
Elbow Lake	Not Sampled
Harpers Lake	NO
Hidden Lake*	YES
Holland Creek	YES
Holland Lake	YES

Waterbody where previously found	Observed during 2022 sampling efforts
Lake Alva	NO
Lake Inez	YES
Lake Mary Ronan	NO
Lindbergh Lake	YES
Loon Lake	YES
Placid Lake	YES
Salmon Lake	YES
Savage Lake	YES
Seeley Lake	YES
Swan Lake	NO
Upsata Lake	YES

* = New find in 2022

Curlyleaf pondweed (*Potamogeton crispus*)

Waterbody where previously found	Observed during 2022 sampling efforts
Beaverhead River	NO
Big Elk Creek	Not Sampled
Bitterroot River	YES
Blackfoot River	NO
Bozeman Creek	Not Sampled
Cabinet Gorge Reservoir	YES
Canyon Ferry Reservoir	YES
Clark Canyon Reservoir	NO
Clark Fork River	YES
Darlington Ditch	YES
Deadman's Basin	YES
East Gallatin River	YES
Ennis Lake	YES
Ester Lake	YES
Fifth Street Pond (Libby)	Not Sampled
Flathead Lake	YES
Flathead River	YES
Fort Peck Lake	YES
Frog Pond*	YES
Gallatin River	YES
Haskill Creek*	YES
Hauser Reservoir	YES
Hebgen Lake	YES
Helena Valley Regulating Reservoir	YES
Holter Reservoir	YES
Jefferson River	NO
Judith River	YES
Kicking Horse Reservoir	YES
Kootenai River	YES
Lower Crow Reservoir*	YES

Waterbody where previously found	Observed during 2022 sampling efforts
Lake Helena	YES
Lower Glaston Lake	Not Sampled
Madison River	YES
Marias River	NO
Mission Reservoir*	YES
Missouri River	YES
Mitchell Slough – East Canal	YES
Musselshell River	YES
Newlan Creek	Not Sampled
Newlan Reservoir	YES
Ninepipe Reservoir*	YES
Noxon Rapids Reservoir	YES
Pablo Reservoir	NO
Pond 1 – Canyon Ferry	Not Sampled
Pond 2 – Canyon Ferry	Not Sampled
Pond 3 – Canyon Ferry	Not Sampled
Pond 4 - Canyon Ferry	NO
Post Creek	YES
Quake Lake	YES
Rainbow Dam Reservoir	NO
Sheep Creek	Not Sampled
Shields River	YES
Slip and Slide Creek (Ponds)	YES
Smith River	YES
Thompson Falls Reservoir	YES
Tiber Reservoir	YES
Triangle Pond	YES
Upper Holter Lake	YES
Wayne Edsall Pond	YES

* = New find in 2022

Aquatic Invasive Species Laboratory

FWP operates an AIS laboratory in Helena, MT (Figure 14) with a satellite lab in Kalispell, MT. These labs process plankton samples for FWP crews and partners from Montana and in Missouri River Basin (MRB) states. The labs also process samples from outside the basin as a confirmatory service for other labs. Figure 15 illustrates the volume of samples handled by the labs each year since 2005. The labs have discovered new populations of dreissenid mussel veligers (larvae) as well as invasive Corbicula clam veligers for multiple downstream states. To ensure the highest level of confidence of results, the labs undergo routine internal and external quality control testing.

Figure 14. Keegan Effertz, lead lab technician and Katie Richter, lab technician in the main FWP AIS lab in Helena, MT. The FWP AIS lab looks for the larval stages of invasive dreissenid (zebra & quagga mussels) and Corbicula clam species.

Sample Prioritization and Lab Process Turnaround Time

Due to a slowing turnaround processing time, the labs implemented a new risk categorization system in 2019. Risk categorization improved turnaround time on high priority samples and ensured rapid analysis. In 2022, the labs received a record number of 3,273 samples (3,273 MT, 552 MRB). Turnaround times average four days for the highest priority samples and seven days for an overall (Table 2).

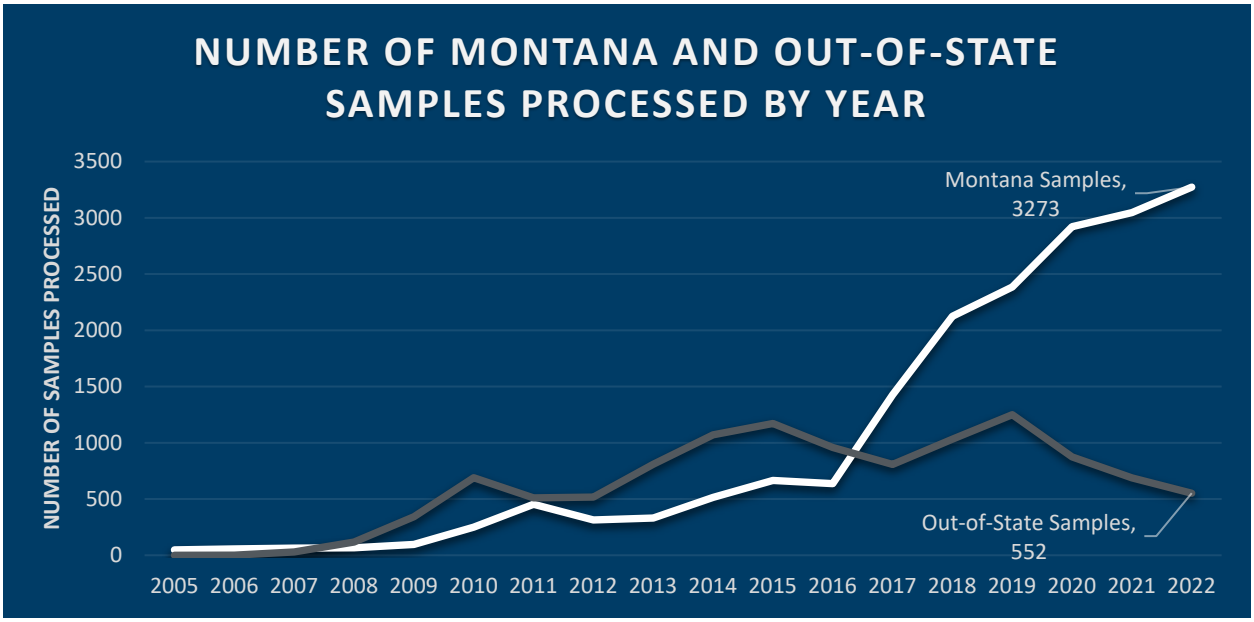


Figure 15. Number of plankton samples processed by year: in-state (FWP and partners) vs. out-of-state.

Table 2. FWP AIS lab waterbody priority ranking system with 2022 average turnaround times. Overall average turnaround time in the lab was one week, like 2021 and the fastest turnaround times to date.

Priority (1- high; 10- low)	Turnaround Time (Average Days)	Total # Samples
Risk 1	4	987
Risk 2	6	938
Risk 3	5	493
Risk 4	6	337
Risk 5	1	163
Risk 6	2	227
Risk 7	14	82
Risk 8	14	6
Risk 9	4	38
Risk 10	7	1
Out-of-state	7	552
Totals	**6.7**	**3,824**

AIS Control Efforts

Beaver Lake Eurasian Watermilfoil Eradication

In 2022, FWP continued control efforts at Beaver Lake in northwest Montana to eradicate Eurasian watermilfoil (EWM). Since its detection in 2011, FWP, the City of Whitefish, and the Whitefish Lake Institute worked to eradicate this invasive plant and prevent further spread within the lake and adjacent waters. This year, the FWP dive team worked on the lake three different times during the summer to hand remove plants (Figure 16, Figure 17) and suppressed larger beds with benthic barriers. All EWM identified in the lake in 2022 was removed or covered treatment will continue in 2023. FWP will continue treatment efforts with the goal of eradicating Eurasian watermilfoil from the lake as quickly as possible.

Figure 16. Craig McLane, FWP dive team member, removes scattered Eurasian watermilfoil from Beaver Lake.

Figure 17. The FWP dive team prepares equipment before a dive on Beaver Lake. The dive team hand-pulled Eurasian watermilfoil plants and covered large patches with benthic barriers.

Holland Lake Fragrant Waterlily Control

Montana Fish, Wildlife & Parks assisted the USDA Forest Service (USFS) conducted fragrant waterlily removal in September at Holland Lake (Figure 18). Fragrant waterlily is an invasive rooted aquatic perennial lily with large floating leaves and showy flowers. Due to the depth of scattered plants on the lake, the use of scuba diving was the most effective way to target these plants for removal. Due to the widespread growth throughout the lake, this will be an ongoing project to contain this population until eradication or management plans are completed with partners.

Figure 18. Stacy Schmidt (right) and Jayden Duckworth (left) work to remove some fragrant waterlily plants in Holland Lake, MT.

Figure 19. Middle Slip and Slide Creek Pond on USFS land near Gardnier, MT. It was drained in 2021 to remove the high-hazard dam status and to eradicate curlyleaf pondweed.

Slip and Slide Creek Ponds Curlyleaf Pondweed Eradication

The US Forest Service acquired property with three small reservoirs located in the Slip and Slide Creek drainage, a tributary of the Yellowstone River near Gardiner, MT. The USFS was concerned that some of the plants might be invasive species, so FWP surveyed the reservoirs in 2019. Well established curlyleaf pondweed populations were subsequently identified in all three of the ponds. The dams were classified high risk for dam failure and in 2020 and 2021, the USFS drained the three ponds to mitigate the dam risk and to eradicate the curlyleaf pondweed populations (Figure 19). Sampling of the area in 2022 identified curlyleaf pondweed only in remaining pools of water in the upper pond.

The Forest Service has plans to perform herbicide treatments on the remaining plants to reduce the risk of curlyleaf pondweed from spreading downstream into the Yellowstone River and eradicate it from this site.

Nilan Reservoir Eurasian Watermilfoil Eradication

FWP identified a small population of EWM in Nilan Reservoir in October 2021. Nilan Reservoir is located about 15 miles west of Augusta, MT along the Rocky Mountain Front. FWP initiated a rapid response eradication treatment on this population, in coordination with Montana Department of Natural Resources and Conservation (DNRC) (dam owner), and the Nilan Water Users Association (landowners and irrigators that use the water) applied fluridone, in November 2021. The bay was curtained off from the rest of the reservoir to reduce water exchange and dilution of the herbicide.

Figure 20. The bay during the 2022 treatment of Eurasian watermilfoil on Nilan Reservoir.

FWP retreated the bay in August 2022 (Figure 20) and removed additional plants that were identified outside the bay adjacent to the boat ramp (Figure 21). Crews conducted surveys along the entirety of the shoreline and removed isolated plants along the east and north outlets. FWP will conduct follow-up survey and removal in 2023.

Figure 21. The new isolated area treated in August 2022 for Eurasian watermilfoil on Nilan Reservoir.

Lake Elmo Corbicula Clam Eradication

There were no confirmed populations of Corbicula clams (*Corbicula fluminea*) in Montana until FWP staff identified them in Lake Elmo during an AIS monitoring workshop in June 2019 (Figure 22). To address this issue and conduct site improvements, FWP dewatered the lake in 2021 (Figure 23). While it was dewatered, FWP performed habitat improvements to improve fisheries and improved the park with new fishing jetties, a new outlet control structure, and new walking paths. In April 2022, water was diverted back into the lake to fill it (Figure 24). FWP staff will begin intense sampling for clams in summer/fall of 2023, but FWP is optimistic that the eradication effort was successful.

Figure 22. Live, adult Corbicula found in Lake Elmo, MT during surveys in 2021.

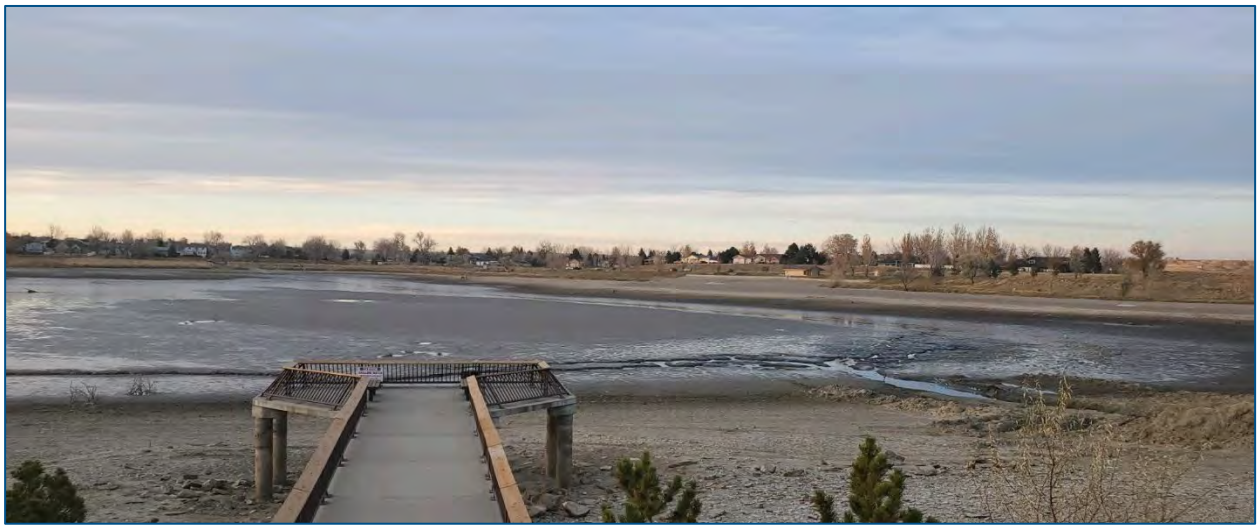


Figure 23. A view of the dewatered Lake Elmo in the fall of 2021 with the goal of eradicating established Corbicula.

Figure 24. A view of Lake Elmo refilled with the new shoreline and walking path. Additional surveys in 2023 and beyond will show if this project eradicated the only population of invasive clams in Montana.

Looking Forward

Fish, Wildlife & Parks consistently evaluates the AIS early detection and monitoring program to identify opportunities to improve efficacy and efficiency. These improvements lead to more reliable sampling efforts, data collection, sampling handling, and AIS eradication and control efforts.

Plans to Improve FWP's Early Detection Program in 2023:

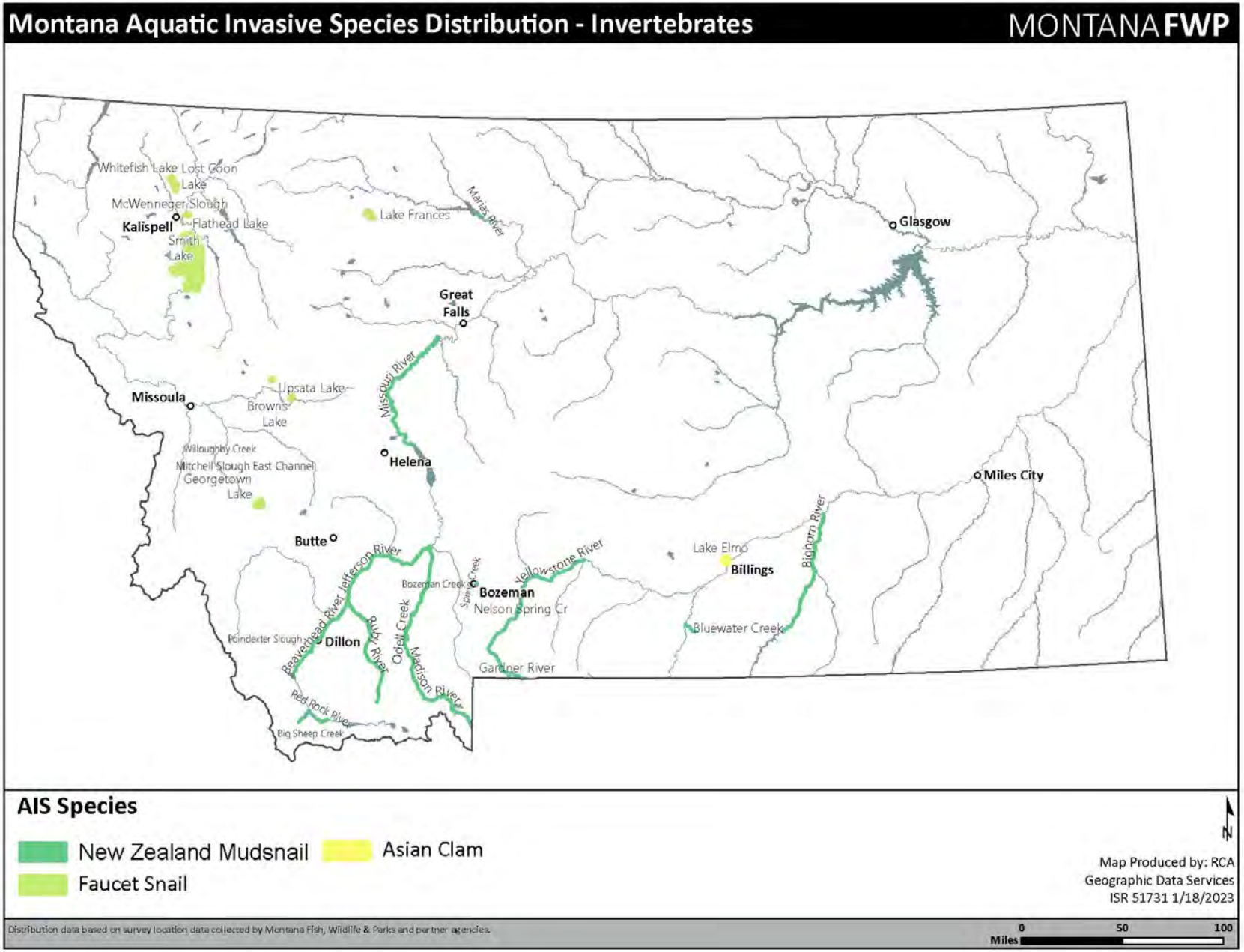
- Increase training workshops to expand partner all-taxa AIS monitoring efforts.
- Provided mid-season quality assurance / quality control (QA/QC) training for seasonal staff including cross-partner trainings.
- Survey for AIS in known geothermal areas.
- Increase FWP's use of environmental DNA (eDNA) for early detection sampling.
- Update FWP's early detection and sampling protocol.
- Update FWP's AIS laboratory protocols to be up-to-date and reflect current best practices .
- Continue to lead state and regional AIS monitoring coordination with state and regional partners.
- Finalize standardized hatchery AIS inspection protocols with regional state partners to ensure inspections at the regional scale are effective and consistent.
- Continue to evaluate and improve biosecurity at hatchery facilities in the state.
- Advertise and increase use of the "Reporting AIS Sightings" efforts through public events and workshops. AIS sightings can also be reported online at http://cleandraindry.mt.gov/reportais

Statewide survey efforts by FWP and partners continue to become more effective and expand capacity to detect new AIS populations, slow the spread of existing populations, and eradicate populations where feasible. These efforts are critical to the early detection of invasive species and are an important aspect of the AIS program and the statewide AIS Management Plan. While these efforts do not guarantee discovery of all AIS species when they are introduced, they significantly increase the potential to discover new populations before they become established or spread beyond their current boundaries. Limiting the establishment or spread of AIS allows for containment and possible eradication. Vigilance surveying for AIS ultimately saves the State of Montana time and money while protecting its aquatic resources and infrastructure from the impacts of AIS.

Literature Cited

Montana Fish, Wildlife & Parks. (2019). *Aquatic Invasive Species Management Program Field Sampling and Laboratory Standard Operating Procedures.* Fish, Wildlife, & Parks, Aquatic Invasive Species Bureau, Helena.

Appendix A. Map of Invasive Snails and Clams in Montana



Appendix B. Map of Invasive Aquatic Plants in Montana