

M.L. 2017 Project Abstract

For the Period Ending June 30, 2021

PROJECT TITLE: Invasive Bighead and Silver Carp and Native Fish Evaluation – Phase II

PROJECT MANAGER: Brian Nerbonne

AFFILIATION: Minnesota Department of Natural Resources

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FUNDING SOURCE: Environment and Natural Resources Trust Fund

LEGAL CITATION: M.L. 2017, Chp. 96, Sec. 2, Subd. 06c as extended by M.L. 2020, First Special Session, Chp. 4, Sec. 2

APPROPRIATION AMOUNT: \$500,000

AMOUNT SPENT: \$472,622

AMOUNT REMAINING: \$27,378

Sound bite of Project Outcomes and Results

Over the past four years, this project tested new capture methods, learned locations where invasive carp are vulnerable to capture, and removed over 150 fish. Our goal in learning how best to remove invasive carp is to disrupt the potential for spawning that could lead to their establishment in Minnesota waters.

Overall Project Outcome and Results

Invasive carp have caused severe ecological damage to the Illinois, Missouri, and lower Mississippi River ecosystems, and threaten to do the same if they become established in Minnesota. Increased monitoring by the Minnesota Department of Natural Resource (DNR), funded in part by ENRTF, has found invasive carp becoming more numerous and widespread in Minnesota in recent years. However, our multi-year monitoring of larval fish has not documented any reproduction in Minnesota waters to date, indicating they are not yet established. ENRT funding has led to significant gains in our understanding of where, when and how to capture and remove these fish and disrupt their establishment.

An array of receivers used in tracking tagged fish has been instrumental in identifying movement patterns and season habitat preferences of invasive carp and native species. We are learning the seasonal use of invasive carp habitats, which has proven useful in removal and management efforts. Tracking of a radio-tagged invasive carp allowed us to know when and where to target removal efforts, and has directly led to the capture of six invasive carp. Applying what we have learned to places where we don't have tagged fish, ENRTF funded staff conducted 364 days of field sampling, including over 139,000 feet of gill net deployed, over 7,300 minutes of electrofishing and over 134 days of monitored/contracted commercial fishing. This resulted in the removal of over 150 invasive carp during the grant period.

Our tracking tagged native fish assessing their habitat use through stable isotope analysis will be useful in the future to learn what effect invasive carp have on the native species.

Project Results Use and Dissemination

MN DNR invasive carp staff have provided a yearly [Invasive Carp Sampling Report](#) in which all sampling data is shared for anyone to view. MN DNR invasive carp staff also shares data with other state and federal agencies as well as Universities. In addition, numerous news outlets have covered the work done by the invasive carp crew over the last four years. Those articles and news stories can be located by doing a quick google search of [Invasive carp in Minnesota](#).



Environment and Natural Resources Trust Fund (ENRTF) M.L. 2017 LCCMR Work Plan Final Report

Date of Submission: August 18th, 2021

Final Report

Date of Work Plan Approval: 08/06/2018

Project Completion Date: June 30, 2021

PROJECT TITLE: Invasive Bighead and Silver Carp and Native Fish Evaluation – Phase II

Project Manager: Brian Nerbonne

Organization: Minnesota Department of Natural Resources

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Web Address: <http://www.dnr.state.mn.us/invasive-carp/index.html>

Location: Mississippi, St. Croix, and Minnesota Rivers and their tributaries, other bodies of water if needed

Total ENRTF Project Budget:	ENRTF Appropriation:	\$500,000
	Amount Spent:	\$
		\$472,622
	Balance:	\$
		\$27,378

Legal Citation: M.L. 2017, Chp. 96, Sec. 2, Subd. 06c as extended by M.L. 2020, First Special Session, Chp. 4, Sec. 2

Appropriation Language:

\$500,000 the first year is from the trust fund to the commissioner of natural resources to continue invasive bighead and silver carp monitoring in the Mississippi River and tributaries through advanced acoustic telemetry and assess food chains to determine how native species might prevent invasive bighead and silver carp establishment. This appropriation is available until June 30, 2020, by which time the project must be completed and final products delivered.

M.L. 2020 - Sec. 2. ENVIRONMENT AND NATURAL RESOURCES TRUST FUND; EXTENSIONS. [to June 30, 2021]

I. PROJECT TITLE: Continuation of Invasive Carp and Native Fish Evaluation

II. PROJECT STATEMENT: Invasive Carp, especially Bighead Carp and Silver Carp, pose an imminent and serious threat to Minnesota's aquatic ecosystems. The Minnesota Department of Natural Resources (MN DNR) will continue monitoring Invasive Carp in the Mississippi River and tributaries employing complex sampling protocols using traditional fisheries techniques and targeted commercial fishing. These efforts are used to determine the distribution and abundance of Invasive Carp in Minnesota waters, including the leading edge of Invasive Carp reproductive success, and this information will be used to inform rapid response efforts. Advanced acoustic telemetry will be used to determine habitat use and movement patterns of native species, and potentially Invasive Carp, including how they approach and pass locks and dams and occupy key locations in Minnesota rivers in three-dimensions. Diet and stable isotope samples will also be taken from native species to determine their position in the food chain and provide baseline data prior to Invasive Carp establishment to better inform managers regarding native species' resiliency and determine how native fish populations can be managed to prevent Invasive Carp establishment.

Invasive Carp have caused severe ecological damage to the Illinois, Missouri, and lower Mississippi River ecosystems. With increased monitoring, the MN DNR has found an increase in numbers and distribution of Invasive Carp in Minnesota. During 2014, two Silver Carp and one Bighead Carp were captured in Pool 2 of the Mississippi River, at that time that was the furthest upstream both species had been captured in Minnesota. In 2015, six Bighead Carp were captured further upstream in the St. Croix River than ever recorded. Most recently, during 2015 and 2016 the first Grass Carp and Bighead Carp ever were captured in the Minnesota River near New Ulm. Many of these fish were mature females carrying large numbers of eggs.

In the last three years, most of the Invasive Carp caught in Minnesota have been the direct result of work previously funded by the ENRTF (Legal Citation: M.L. 2013, Chp. 52, Sec. 2, Subd. 06b; and M.L. 2015, Chp. 76, Sec. 2, Subd. 19). The Minnesota DNR Division of Fish and Wildlife, Section of Fisheries continues to conduct surveys and sampling of our major rivers. However, enhancing this effort to detect Invasive Carp is impossible at current staffing and funding levels.

This continuation project will support the maintenance of the state's Invasive Carp monitoring, detection, and removal program including funding one full-time specialist and two student interns, funding standard fisheries monitoring and contracted commercial fishing, expert larval fish identification, and fleet and travel costs. The project will also expand an existing acoustic receiver array to determine how tagged fish approach and occupy critical locations in three-dimensions, including upstream and downstream of Lock and Dam 2 on the Mississippi River and the Allen S. King Plant on the St. Croix River where several Bighead Carp have been captured. Finally, the project will include a one year study to determine native species trophic niches to be compared with similar studies in areas where Invasive Carp are abundant to better understand the effects of Invasive Carp on native species and assess native species resiliency to Invasive Carp establishment. Outcomes will include increased numbers of Invasive Carp removed from Minnesota waters along with an increased understanding of their biology and populations, a better understanding of how fish occupy key locations and interact with locks and dams, and stable isotope data on Invasive Carp caught along with some of the Mississippi River's most abundant predatory fish, the prey they feed on, and the planktivorous fish whose diets are most likely to overlap with Invasive Carp.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of January 1, 2018:

Overall, the project is on track with the unclassified specialist hired, most of the VEMCO Positioning System (VPS) is in place and awaiting data for analysis, and the stable isotope samples have been collected and are awaiting results.

One Bighead Carp was caught in this reporting period and this fish was the first Invasive Carp to be tagged and tracked since Statute 84D.05, Subdivision 1a was changed on July 1, 2017. Tracking was effective and MN DNR crews were able to readily locate the fish and collected over 30,000 data points including depth and/or temperature data. This data is being analyzed and findings will be presented in the 2017 field sampling report and incorporated into 2018 field sampling plan to increase sampling efficiencies and ultimately re-capture this fish.

Using previous funding from the United States Fish and Wildlife Service, our contracted commercial fisherman was deployed seven times from July 1, 2017 to January 1, 2018, setting one seine and setting 45,600 feet of large mesh gill nets. Utilizing this funding will allow us to even more effectively utilize project funding budgeted for this purpose in the future. Directed sampling with traditional fisheries techniques were conducted a total of 49 days during this reporting period on the Mississippi and St. Croix rivers. Gear used included gill, trammel, and fyke nets, and electrofishing and larval trawls. MN

DNR staff are currently analyzing data from the acoustic tagged Bighead Carp to determine patterns in habitat use, increasing sampling efficiencies, and plan for re-capture in 2018. In addition, staff is analyzing native species age and growth to better understand the effects of Invasive Carp if they become established in Minnesota waters.

Project Status as of July 1, 2018:

Overall, the project is on track with the unclassified specialist providing additional field work and assistance with data management, the VEMCO Positioning System (VPS) is in place and awaiting additional data for analysis, and the stable isotope samples have been analyzed and a full report of the results will be completed in the winter of 2018/19.

Two Bighead Carp were caught in this reporting period. The fish were caught while MN DNR staff were tracking the tagged Bighead Carp that has been at liberty since July 2017. Staff had made several attempts before and after this to re-capture the tagged fish to no avail. The recapture attempts were unsuccessful due to sampling in flooded timber or within Lake St. Croix which is too deep and vast for conventional fisheries management techniques. On May 11, 2018 the tagged Bighead Carp was located using the active tracking devices in Andersen Bay on the St. Croix River, near the original capture location of the tagged Bighead Carp. The tagged Bighead Carp was detected within the bay and MN DNR staff blocked off the bay with large mesh gill nets producing a mature male and a mature female Bighead Carp. The tagged fish escaped and has since been tracked through Lake St. Croix. MN DNR staff continues to monitor the movements of the tagged fish and will continue to attempt recapture. This spring and summer we have experienced weeks of no wake on the lower St. Croix River due to high waters which limits our ability to travel the river in a timely manner and also raises water levels to the point where areas that are normally land are flooded, providing additional escape routes and habitats to occupy for the tagged Bighead Carp.

From January 1 to July 1, 2018 the MN DNR Invasive Carp field crew have contracted with our commercial fishermen, including five gill net days and three commercial seines. Further, MN DNR has collected 77 larval samples from Pool 2 and the St. Croix River, deployed large mesh gill nets (31,300 feet), electrofished (566 minutes), pulled six small seines, and fished trap or fyke nets for 39 fishing nights. Sampling this spring/summer has been difficult due to high water for most of May and June.

VEMCO Positioning System (VPS) telemetry equipment was purchased and deployed in the fall of 2017. The equipment was deployed at three locations: St Croix River near Bayport, Mississippi River above Lock & Dam #2 in Hastings, and Mississippi River below Lock & Dam #2 in Hastings. Data has been collected at all three sites. Preliminary data analysis was positive for the St. Croix River site, however the two sites above and below Lock & Dam #2 on the Mississippi River have some logistical problems that may require some modification to the locations and deployments. One receiver tethered to a cable was lost as a steel cable broke from wear and stress in high currents and probable log interference. Full data sets of late fall 2017 through spring 2018 will be submitted for analysis and 2D/3D fish positioning in mid-late summer of 2018. No problems are expected for the St. Croix River site. VEMCO will process the data for the Mississippi River sites to determine if the data is sufficient for fish positioning. Attempts will be made to recover the missing receiver in the Mississippi River. That receiver must be replaced if we are unable to recover it. It is unlikely we will be able to position the three fish that were detected above Lock & Dam #2 in the Mississippi River if we cannot recover the missing receiver as we will not have enough data from the remaining three receivers that were collecting data. The site below Lock & Dam #2 in the Mississippi River detected 20 fish transmitters in the spring of 2018. The noise from high flows, echoes off of hard surfaces, and logs interfering with receiver deployments may have impeded the communication between the receivers. Fish transmitters may still be able to be positioned in 2D/3D, however the error in those locations may be larger than anticipated. Further alteration may be needed to equipment deployed above and below Lock & Dam #2 in the Mississippi River to achieve better results.

Analyses for the Pool 2 Stable Isotope study conducted in 2017 have been received from Cornell University; however, the results have yet to be analyzed. Analysis of the data is expected to be completed during the winter of 2018/19.

Amendment Request (07/01/2018):

A budgetary amendment is requested to move funds from the salary of the full-time NR Monitoring Fisheries Specialist position to off-set increased pay for Student Interns and add additional funds to Monitoring supplies and increase Commercial Fishing effort. Budgets for the specialist's salary, stable isotope analysis, stable isotope equipment, and acoustic telemetry equipment is proposed to be decreased and budgets for student interns, commercial fishing, and monitoring equipment will be increased. All other items will remain the same and the nature of the activities will remain the same.

Budgetary savings resulted from several unforeseen circumstances. First, the full-time specialist hired was able to accept a lower pay than expected. Stable Isotope Analysis was expected to be conducted by the University of Minnesota under the state's general contract; however, the University's equipment failed and the contract was dissolved. As a result, MN DNR solicited vendors and Cornell University was selected and completed the same analyses for a lower cost. The original plan was to employ four separate VEMCO Positioning Systems; however, after installing the first three systems we found that the fourth would not provide adequate data and the equipment for this system was not purchased.

Student interns received an increase in salary throughout all of the MN DNR between when our original proposal was accepted and when we received funding. Additional funds are needed to allow us to hire student interns to assist in field work. Commercial Fishing has been the most effective technique used in Minnesota and other states to capture Invasive Carp; however, commercial fishing activity in Minnesota has decreased in recent years and additional funds are needed to attain similar levels of activity from contract commercial fishermen to meet the lack of effort exerted by other commercial fishermen not under contract. Finally, additional supplies are requested for the monitoring efforts including additional sensors for water quality instrumentation, increased equipment repairs, and additional nets as well as adding funding to ship Invasive Carp samples to other laboratories able to complete the analyses in a more cost-effective manner.

Amendment Approved: (08/06/2018)

Project Status as of January 1, 2019:

Overall, the project is on track with the unclassified specialist providing additional field work and assistance with data management, the VEMCO Positioning System (VPS) is in place and awaiting additional data for analysis, and the stable isotope samples have been analyzed and a full report of the results will be completed in the winter/spring of 2018/2019.

One Bighead Carp were caught in this reporting period. The fish were caught while MN DNR Hutchinson staff were tracking tagged Paddlefish in an attempt to capture and tag additional Paddlefish. The Bighead was caught approximately 5 river miles downstream of the city of Granite Falls, MN in the Minnesota River, representing the furthest upstream a Bighead Carp or any Invasive Carp had been caught in the Minnesota River. Previously, in 2017 one Bighead Carp was caught by a bowfisherman in a floodplain lake off the Minnesota River upstream of Redwood Falls. The Bighead from 2017 was approximately 20 river miles downstream of the Bighead Carp caught this reporting period. Hutchinson office staff completed follow up sampling in the area and both Hutchinson and Invasive Carp field staff sampled the area on October 3rd, resulting in additional Paddlefish tagged and zero Invasive Carp.

From July 1 to December 31, 2018 the MN DNR Invasive Carp field crew have contracted with our commercial fishermen, including eight gill net days and five commercial seines. Further, MN DNR has collected 57 larval samples from Pool 2 and the St. Croix River, deployed large mesh gill nets (19,600 feet), electrofished (1489 minutes), and pulled thirteen small seines. Sampling this entire field season has been difficult due to high water.

VEMCO Positioning System (VPS) telemetry equipment has been collecting data since fall of 2017 at three locations: St Croix River near Bayport, Mississippi River above Lock & Dam #2 in Hastings, and Mississippi River below Lock & Dam #2 in Hastings. Full data sets of late fall 2017 through spring 2018 were analyzed for 2D/3D fish positioning at the St Croix River site. Twenty-one different fish transmitters were able to be positioned. Position locations for each transmitter ranged from 3 to 8,696. The one Bighead Carp implanted with a transmitter in the St Croix River was positioned 149 times from May 21, 2018 through June 1, 2018. Data is being compiled to be sent to VEMCO to process 2018 summer to early fall transmitter positions at the St Croix River location. Data is also being compiled for the Lock & Dam #2 sites from late fall 2017 through early fall 2018. However, limited detections above the dam and the loss of a receiver may preclude that analysis from being cost effective. Data below the dam will also be sent to VEMCO for processing, but a limited number of positions may be possible as the noisy environment and loss of a receiver may have restricted the number of times a transmitter was detected on three or more receivers allowing for triangulation of that fish. Alterations to the VPS networks at the two Lock & Dam #2 sites are being considered. One possible alteration may be moving receivers from above the dam to below the dam, which would cease fish positioning above the dam (few fish present above the dam) and expand the network below the dam, hopefully overcoming the noise issue and allow for more triangulation of fish below the dam. Twenty-seven transmitter fish representing seven different species were detected below Lock & Dam #2 in 2018, 18 of which were present during April/May 2018.

Analyses for the Pool 2 Stable Isotope study conducted in 2017 have been received and analysis of the data is expected to be completed during the winter of 2018/19 and submitted for peer-reviewed publication.

Project Status as of July 1, 2019:

Overall, the project is on track with the unclassified specialist providing additional field work and assistance with data management, the VEMCO Positioning System (VPS) is in place with the first results available and awaiting additional data for analysis this winter, and the stable isotope samples have been analyzed and a full report of the results will be completed soon. One of our fisheries specialists took a mobility position assisting the agency with legislative work but has since returned and will aid in the development of the stable isotope analysis and write up.

Two Bighead Carp, six Silver Carp, and two Grass Carp were caught in this reporting period. The first Silver Carp was caught April 4, 2019 in a monitored commercial seine haul on the St. Croix River at the confluence of Pool 3 of the Mississippi River. The first Bighead Carp was caught by DNR Invasive Carp staff in Anderson Bay on the St. Croix River on May 17, 2019 while attempting to re-capture the tagged Bighead Carp. On May 22, 2019 a Silver Carp was caught in a monitored commercial seine in Pool 9 of the Mississippi River. On May 24, 2019 another Silver Carp was snagged by an angler in Pool 4 of the Mississippi River near Red Wing, MN. On June 4, 2019 a Silver Carp was caught by Xcel Energy staff electrofishing in Lake Pepin in Pool 4 of the Mississippi River. On June 20, 2019 another Bighead Carp was caught by DNR Invasive Carp staff while attempting to re-capture the tagged Bighead Carp, this time at the Allen S. King Plant on the St. Croix River (just upstream of where the May 17 Bighead Carp was caught). The last two Silver Carp and two Grass Carp were caught during a bowfishing tournament. On June 25, 2019 a Silver Carp was shot by a bowfisherman pre-fishing for the tournament in Pool 6 of the Mississippi River. On June 26, 2019 a Silver Carp jumped into the boat of an angler scouting for the tournament in Pool 6 of the Mississippi River. During the tournament, two Grass Carp were shot by bowfishermen (one in Pool 6 and one in Pool 8 of the Mississippi River).

In addition, during this reporting period a Silver Carp originally tagged in Pool 16 of the Mississippi River in April 2017 was detected by MN DNR acoustic telemetry equipment in Pool 4 on May 28, 2019. The Silver Carp was last detected in Pool 17 in October of 2018 and then appears to have entered Pool 4 on May 28 and was detected as far upstream as Green Point (upper Lake Pepin). The last known location of this fish was outside of Minnesota waters in Pool 10 of the Mississippi River, near Prairie du Chien, Wisconsin.

From January 1 to June 30, 2019 the MN DNR Invasive Carp field crew have contracted with our commercial fishermen, including four gill net days and two commercial seines. Further, MN DNR has deployed large mesh gill nets (21,250 feet), electrofished (2567 minutes), and fished trap nets for a total of forty fishing days. Sampling this entire field season has been difficult due to high water.

VEMCO Positioning System (VPS) telemetry equipment has been collecting data since fall of 2017 at three locations: St Croix River near Bayport, Mississippi River above Lock & Dam #2 in Hastings, and Mississippi River below Lock & Dam #2 in Hastings. Two acoustic receivers at Lock & Dam #2 have been lost due to high flows, logs and ice. Data above Lock & Dam #2 is insufficient due to the loss of one of these receivers. As a result, receivers above the dam were planned to be re-purposed to add to the array below the dam to increase coverage and fish positioning. However, the prolonged flooding in 2019 has delayed that effort. Data has been analyzed below Lock & Dam #2 from November 13, 2017 through November 15, 2018. Data has been analyzed at the St. Croix River site from October 20, 2017 through October 30, 2018. The one Bighead Carp implanted with a transmitter in the St. Croix River in 2017 has been positioned by the VPS 2,033 times in the St. Croix River and 24 times below Lock & Dam #2. Data will continue to be collected at the 2 remaining VPS sites and submitted to VEMCO in the winter for analysis. Results are expected during the winter of 2019/2020.

Analyses for the Pool 2 Stable Isotope study conducted in 2017 have been received and a full report of the results will be completed soon. One of our specialists took a mobility position assisting the agency with legislative work but has since returned and will aid in the development of the stable isotope analysis and write up.

Project Status as of January 1, 2020:

Overall, the project is on track with the unclassified specialist performing field work and assisting with data management. The VEMCO Positioning System (VPS) is in place with the first results available and continuously collecting additional data

for analysis this winter, and the stable isotope samples have been analyzed and a full report of the results will be completed June 30, 2020. An additional unclassified specialist was hired for this winter to assist in analysis and winter field work operations.

One Bighead Carp (caught in tagged Bighead Carp recapture attempt), one Grass Carp, and six Silver Carp were caught during this reporting period. The MN DNR staff with aid from contracted commercial anglers caught two of the Silver Carp. One of those Silver Carp caught on 9/10/19 was tagged and released on the St Croix River but later was confirmed to be deceased from tagging surgery. Recovery of the tag is ongoing at this time.

From July 1 to December 31, 2019 the MN DNR Invasive Carp field crew have contracted with our commercial fishermen, including six gill net days and four commercial seines. Further, during this time period MN DNR has deployed large mesh gill nets (29,300 total feet of net), electro-fished (1,280 minutes), conducted 19 shore seine hauls, and collected 152 larval samples.

Amendment Request as of 01/01/2020:

1. Project Manager

- We are requesting an amendment to switch our project manager. Bradford Parsons was replaced by Brian Nerbonne as regional fisheries manager.

2. Salary

- Full-time employee salary would be reduced by \$36,600 to a revised budget of \$143,400.
- Part-time employee salary would increase by \$36,600 to a revised budget of \$71,600 to cover existing deficit and fund the temporary specialist for the remainder of the grant.
- These changes are being requested in order to help us accomplish our goals in activities 1 and 2 by paying one temporary fisheries specialist from these funds.

3. Professional/Technical/Service Contracts

- Larval Sampling would be reduced \$13,100 to a revised budget of \$21,900.
 - Commercial fishing budget would be increased \$12,600 to a revised budget of \$99,400
 - Vemco processing would be reduced \$9,000 to a revised budget of \$12,000.
- These changes are being requested in due to a surplus in larval sampling budget. Outside funding paid for the second round of larval samples. In order to increase commercial fishing we are requesting the majority be added to that budget line for activity 1.

4. Monitoring Equipment, Tools, and Supplies

- Monitoring equipment, tools, and supplies would be increased \$5,920 to a revised budget of \$31,798. These changes are being requested in order to cover replacement nets, and any equipment needs that may arise during the last 6 months of the grant.
- Acoustic Telemetry would be increased \$9,000 to a revised budget of \$64,025. These changes are being requested in order to buy four additional VPS receivers. Our cost for Vemco analysis has been much less than our original quotes had suggested. We feel that adding four VPS receivers will add value to our outcomes for activity 2

5. Travel Expenses in Minnesota

- In-state travel budget would be reduced \$5,420 to a revised budget of \$2,180.
- Our estimated in-state-travel costs are much less than we budgeted for. The majority of the work done was on the St. Croix and Pool 2 of the Mississippi River

Amendment Approved by LCCMR 2/27/2020

Project extended to June 30, 2021 by LCCMR 6/18/20 as a result of M.L. 2020, First Special Session, Chp. 4, Sec. 2, legislative extension criteria being met.

Project Status as of July 1, 2020:

Due to COVID 19, field work got off to a slow start this spring and summer. Our work was hampered by the governor's stay at home order, as well as not being able to refill one of our temporary specialist positions due to the state's hiring freeze. From January 1 to June 30, 2020 the MN DNR Invasive Carp field crew have contracted nine gill net days and three commercial seine hauls with our commercial fishermen. Further, during this time-period MN DNR has electro-fished (99 minutes), and monitored 2 seine hauls by other commercial anglers. The VEMCO Positioning System (VPS) is in place with the results available and continuously collecting additional data for analysis this fall and winter.

The MN DNR Invasive Carp field crew assisted a commercial angler in removing 51 invasive carp on March 9, 2020. On March 25th, 2020 a Bighead Carp was caught near the confluence of the St. Croix and Mississippi River during a monitored seine haul and one Silver Carp was caught near Bayport on May 26th, 2020 by contracted commercial fisherman.

Project Status as of January 1, 2021:

Due to COVID 19, field work continued to be hampered and more limited than in previous years. However, field staff were able to fulfill most of the target numbers for sampling effort. From July 1 to December 31st, 2020 the MN DNR Invasive Carp field crew contracted 12 gill net days and four commercial seine hauls with the contracted commercial fisherman. Further, the MN DNR set large mesh gill nets (12,550 feet), electro-fished (1,191 minutes) and pulled 20 small shore seines. Additional commercial fishing hauls were monitored through relationships established by the MN DNR.

The MN DNR Invasive Carp field crew assisted Windom Area Fisheries in removing 18 Invasive Carp (12 Bighead Carp, 1 Grass Carp, and 5 Silver Carp) from the Illinois Lake Drainage in Southwest Minnesota. On August 21, 2020 we collected a Silver Carp shot by a bow fisherman in Pool 5A, gathering standard size/sex/maturity information following our protocols. In October and November of 2020, six Silver Carp were captured by contracted commercial fisherman in Pool 8 of the Mississippi River. Five of those fish were tagged and released by the US Fish and Wildlife Service. Data will be collected on movement, habitat preference, and potential spawning activity in the coming months.

Amendment Request January 1, 2021:

We are requesting funds be shifted from the student intern budget line to fleet.

- Student Intern budget would be reduced \$9,000 to a revised budget of \$62,600.
- Fleet budget would increase \$9,000 to a revised budget of \$30,000.

These changes are being requested because we are unable to hire student interns or temporary specialists due to the COVID 19 hiring freeze. In addition, due to COVID 19 guidelines, our fleet charges have increased with only one person allowed per vehicle. This shifting of funds would allow us to the fleet dollars necessary to achieve our goals for activity 1.

Amendment Approved by LCCMR 2/05/2021

Overall Project Outcomes and Results:

Invasive carp have caused severe ecological damage to the Illinois, Missouri, and lower Mississippi River ecosystems, and threaten to do the same if they become established in Minnesota. Increased monitoring by the Minnesota Department of Natural Resource (DNR), funded in part by ENRTF, has found invasive carp becoming more numerous and widespread in Minnesota in recent years. However, our multi-year monitoring of larval fish has not documented any reproduction in Minnesota waters to date, indicating they are not yet established. ENRT funding has led to significant gains in our understanding of where, when and how to capture and remove these fish and disrupt their establishment.

An array of receivers used in tracking tagged fish has been instrumental in identifying movement patterns and season habitat preferences of invasive carp and native species. We are learning the seasonal use of invasive carp habitats, which has proven useful in removal and management efforts. Tracking of a radio-tagged invasive carp allowed us to know when and where to target removal efforts, and has directly led to the capture of six invasive carp. Applying what we have learned to places where we don't have tagged fish, ENTRF funded staff conducted 364 days of field sampling, including over 139,000 feet of gill net deployed, over 7,300 minutes of electrofishing and over 134 days of monitored/contracted commercial fishing. This resulted in the removal of over 150 invasive carp during the grant period.

Our tracking tagged native fish assessing their habitat use through stable isotope analysis will be useful in the future to learn what effect invasive carp have on the native species.

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Enhanced Invasive Carp Monitoring to Evaluate Abundance and Removal Efforts

Minnesota DNR will enhance monitoring efforts to estimate abundance and distribution, determine preferred habitats, and inform removal efforts in all Minnesota waters to minimize the risk of populations becoming established. MN DNR has established an extensive Invasive Carp sampling protocol including standard fisheries sampling and deployment of directed commercial fishing. Using these techniques, the MN DNR has increased efficiency of monitoring and removal efforts and is better able to inform managers regarding their distribution and spread. In addition, it is critical that we determine if and where Invasive Carp are spawning and successfully reproducing in Minnesota waters. Prior MN DNR research and information from other states has provided vital information regarding what gears and habitats are most likely to confirm the presence of viable eggs, larvae, and juveniles. Larval samples will be sent to an expert on larval fish identification for analysis. MN DNR experience collecting larval native fishes has informed the best timing and locations for sampling. This efficiency will allow this method to expand from current sampling locations to the Mississippi River from Minneapolis to the Iowa border and in the Minnesota River.

Experiences in Minnesota waters and other states indicate that commercial fishing gears are an effective means of capturing adult Invasive Carp. Nearly all Invasive Carp caught to date in Minnesota waters have been collected by commercial fishermen. Commercial fishermen possess the necessary gear and have the local knowledge to deploy it in an effective manner. Contracting with commercial fishermen is a cost effective method of collecting adult Invasive Carp if they are present. An existing commercial fishing operation will be selected through a competitive bid process to provide approximately 34 days of gill net fishing and 14 days of seine fishing over a 2.5 year period. Seining is only feasible in certain locations within the rivers that are free of obstruction, while gill nets can be deployed in other locations. Additionally, the personnel in this project will accompany and monitor the catch of other, non-contracted, commercial fishing operations to detect fishing patterns and trends in fish caught which will greatly inform future Invasive Carp directed sampling efforts.

Standard fisheries gears, including electrofishing, trap nets, gill nets, trammel nets, trawls, drift nets, and hoop nets will also be used to capture Invasive Carp in habitats not accessible to commercial gears. This directed effort would be above and beyond MN DNR normal fisheries management efforts. Normal efforts by DNR staff are effective in monitoring population trends of our native sportfish and panfish species. However, detection of Invasive Carp requires specialized, targeted sampling gears deployed in different manners at intense levels in all habitat types. Annual reports will be prepared summarizing sites sampled, effort expended with various gears, and biological data on fish captured.

This continuation project will support the maintenance of the state's Invasive Carp monitoring, detection, and removal program including funding one full-time specialist and two student interns, funding standard fisheries monitoring and contracted commercial fishing, expert larval fish identification, and fleet and travel costs. Outcomes will include increased numbers of Invasive Carp removed from Minnesota waters along with an increased understanding of Invasive Carp and native species' biology and populations.

Summary Budget Information for Activity 1:

ENRTF Budget:	\$ 416,882
Amount Spent:	\$389,539
Balance:	\$27,343

Outcome	Completion Date
1. Direct and monitor commercial fishermen in likely Invasive Carp habitats	June 30, 2020
2. Employ traditional fisheries sampling targeted to monitor Invasive Carp	June 30, 2020
3. Collect larval fish samples identified by larval fish experts	June 30, 2020

Activity 1 Status as of January 1, 2018:

In July 2017, MN DNR hired an unclassified Fisheries Specialist, Benjamin Larson, to assist in monitoring and removal efforts. As of January 2018, all funds spent for this activity were to pay his salary.

From July 1, 2017 to January 1, 2018 MN DNR staff caught one Bighead Carp at the Allen S. King Plant on the St. Croix River. This fish was successfully acoustically tagged using a VEMCO transmitter with temperature and depth sensors. This fish was tracked consistently until November 27, 2017. The fish’s last confirmed location was south of Hudson, WI and will be re-located when field conditions are safe to track and locate and attempts will be made to recapture this fish and euthanize the fish per standardized protocols.

Using previous funding from the United States Fish and Wildlife Service, our contracted commercial fisherman was deployed seven times from July 1, 2017 to January 1, 2018, setting one seine and setting 45,600 feet of large mesh gill nets. Utilizing this funding will allow us to even more effectively utilize project funding budgeted for this purpose in the future. From July 1, 2017 to January 1, 2018, directed sampling with traditional fisheries techniques were conducted a total of 49 days during this reporting period on the Mississippi and St. Croix rivers. Gear used included gill and trammel nets (24,650 feet set on 17 days), fyke nets (30 net nights over 4 days), and electrofishing (1,831 minutes non-standardized sampling over 20 days; 94 minutes standardized electrofishing over 4 days) and larval trawls (47 samples on 3 days). From 2017 sampling, 93 larval samples have been sent to our contractor at Colorado State University for expert analysis. Results are pending as of January 1, 2018. MN DNR staff are currently analyzing data from the acoustic tagged Bighead Carp to determine patterns in habitat use, increasing sampling efficiencies, and plan for re-capture in 2018. In addition, staff is analyzing native species age and growth to better understand the effects of Invasive Carp if they become established in Minnesota waters.

Activity 1 Status as of July 1, 2018:

Two Bighead Carp were caught in this reporting period. The fish were caught while MN DNR staff was tracking the tagged Bighead Carp that has been at liberty since July 2017. Staff had made several attempts before and after this to re-capture the tagged fish to no avail. The recapture attempts were unsuccessful due to sampling in flooded timber or within Lake St. Croix which is too deep and vast for conventional fisheries management techniques. On May 11, 2018 the tagged Bighead Carp was located using the active tracking devices in Andersen Bay on the St. Croix River, near the original capture location of the tagged Bighead Carp. The tagged Bighead Carp was detected within the bay and MN DNR staff blocked off the bay with large mesh gill nets producing a mature male and a mature female Bighead Carp. The tagged fish escaped and has since been tracked through Lake St. Croix. MN DNR staff continues to monitor the movements of the tagged fish and will continue to attempt recapture. This spring and summer we have experienced weeks of no wake on the lower St. Croix River due to high waters which limits our ability to travel the river in a timely manner and also raises water levels to the point where areas that are normally land are flooded, providing additional escape routes and habitats to occupy for the tagged Bighead.

Through this reporting period several large-scale directed efforts have been conducted. On April 9, 2018 MN DNR partnered with WI DNR and U.S. Fish and Wildlife Service to gill net and electrofish an area in Pool 8 near Onalaska where Bighead Carp had been caught in previous years. No Invasive Carp were caught. On May 15, 2018 U.S. Fish and Wildlife personnel assisted in gill netting and electrofishing, along with our contract commercial fishermen, to survey Andersen Bay on the St. Croix River where 2 Bighead Carp were caught on May 11th. No Invasive Carp were caught. On June 7, 2018 a resident sent a picture of a Grass Carp stating the fish was caught in an inland lake near Blaine, MN. MN DNR staff set over 2,000 feet of large mesh gill nets and electrofished over 2 hours but did not capture any Grass Carp, only Common Carp and native fish species.

From January 1 to July 1, 2018 the MN DNR Invasive Carp field crew have contracted with our commercial fishermen, including five gill net days and three commercial seines. Further, MN DNR has collected 77 larval samples from Pool 2 and the St. Croix River, deployed large mesh gill nets (31,300 feet), electrofished (566 minutes), pulled six small seines, and

fished trap or fyke nets for 39 fishing nights. Sampling this spring/summer has been difficult due to high water for most of May and June.

2017-collected larval samples are currently being identified by Colorado State University's Larval Fish Laboratory. Publication of the results of larval samples collected from 2013-2017 is expected winter 2018/2019. Larval samples are sent to Colorado State University for expert identification. Minnesota Department of Natural Resources went through an extensive search for professionals able to provide expert larval fish identification to the lowest possible taxon and Colorado State University's larval fish lab was found to be the only lab in the country to offer this service to external agencies. In addition, Colorado State University has been a leader in the field of larval fish identification and has over 40 years of experience in the field. Samples collected in 2018 will be preserved in formalin and alcohol and the larval fish and eggs will be separated and will be sent to Colorado State University for identification during fall 2018.

Activity 1 Status as of January 1, 2019:

One Bighead Carp were caught in this reporting period. The fish were caught while MN DNR Hutchinson staff were tracking tagged Paddlefish in an attempt to capture and tag additional Paddlefish. The Bighead was caught approximately 5 river miles downstream of the city of Granite Falls, MN in the Minnesota River, representing the furthest upstream a Bighead Carp or any Invasive Carp had been caught in the Minnesota River. Previously, in 2017 one Bighead Carp was caught by a bowfisherman in a floodplain lake off the Minnesota River upstream of Redwood Falls. The Bighead from 2017 was approximately 20 river miles downstream of the Bighead Carp caught this reporting period. Hutchinson office staff completed follow up sampling in the area and both Hutchinson and Invasive Carp field staff sampled the area on October 3rd, resulting in additional Paddlefish tagged and zero Invasive Carp.

Staff have made several attempts to re-capture the tagged Bighead Carp on the St. Croix River and determine if this fish is schooling with other Invasive Carp using recently purchased 24 foot deep large mesh gill nets thanks to this Environment and Natural Resource Trust Fund grant. The tagged Bighead Carp has not been recaptured and no additional Invasive Carp have been caught while sampling near the tagged fish except the two Bighead Carp caught last reporting period. The recapture attempts have been unsuccessful due to sampling in flooded timber or within Lake St. Croix which is too deep and vast for conventional fisheries management techniques. For the 2019 field season, additional tools will be utilized to more effectively sample for this tagged Bighead Carp including a 2,000 foot long and 40 foot deep purse seine (purchased with a grant from the U.S. Fish and Wildlife Service) and a real-time receiver that will send emails/text messages when the tagged fish is in the area of the receiver (also purchased with a grant from the U.S. Fish and Wildlife Service).

Through this reporting period several large-scale directed efforts have been conducted on the St. Croix River in the vicinity of the tagged Bighead Carp. Over ten days, staff set over 19,000 feet of 24 feet deep gill nets and partnered with our contract commercial fishermen to include commercial seine hauls in areas where it was expected to have the highest likelihood of recapture. No Invasive Carp were caught.

From July 1 to December 31, 2018 the MN DNR Invasive Carp field crew have contracted with our commercial fishermen, including eight gill net days and five commercial seines. Further, MN DNR has collected 57 larval samples from Pool 2 and the St. Croix River, deployed large mesh gill nets (19,600 feet), electrofished (1489 minutes), and pulled thirteen small seines. Sampling this entire field season has been difficult due to high water.

After further review of the 2013-2017 collected larval samples, we are waiting for the results of the 2018 larval samples before preparing results for publication with Colorado State University's Larval Fish Laboratory. Publication of the results of larval samples collected is expected in 2019. Larval samples are sent to Colorado State University for expert identification. Minnesota Department of Natural Resources went through an extensive search for professionals able to provide expert larval fish identification to the lowest possible taxon and Colorado State University's larval fish lab was found to be the only lab in the country to offer this service to external agencies. In addition, Colorado State University has been a leader in the field of larval fish identification and has over 40 years of experience in the field. Samples collected in 2018 have been sent for identification and results are expected by May 2019.

Activity 1 Status as of July 1, 2019:

Two Bighead Carp, six Silver Carp, and two Grass Carp were caught in this reporting period. The first Silver Carp was caught April 4, 2019 in a monitored commercial seine haul on the St. Croix River at the confluence of Pool 3 of the Mississippi River. The first Bighead Carp was caught by DNR Invasive Carp staff in Anderson Bay on the St. Croix River on May 17, 2019 while attempting to re-capture the tagged Bighead Carp. On May 22, 2019 a Silver Carp was caught in a monitored commercial seine in Pool 9 of the Mississippi River. On May 24, 2019 another Silver Carp was snagged by an angler in Pool 4 of the Mississippi River near Red Wing, MN. On June 4, 2019 a Silver Carp was caught by Xcel Energy staff electrofishing in Lake Pepin in Pool 4 of the Mississippi River. On June 20, 2019 another Bighead Carp was caught by DNR Invasive Carp staff while attempting to re-capture the tagged Bighead Carp, this time at the Allen S. King Plant on the St. Croix River (just upstream of where the May 17 Bighead Carp was caught). The last two Silver Carp and two Grass Carp were caught during a bowfishing tournament. On June 25, 2019 a Silver Carp was shot by a bowfisherman pre-fishing for the tournament in Pool 6 of the Mississippi River. On June 26, 2019 a Silver Carp jumped into the boat of an angler scouting for the tournament in Pool 6 of the Mississippi River. During the tournament, two Grass Carp were shot by bowfishermen (one in Pool 6 and one in Pool 8 of the Mississippi River).

In addition, during this reporting period a Silver Carp originally tagged in Pool 16 of the Mississippi River in April 2017 was detected by MN DNR acoustic telemetry equipment in Pool 4 on May 28, 2019. The Silver Carp was last detected in Pool 17 in October of 2018 and then appears to have entered Pool 4 on May 28 and was detected as far upstream as Green Point (upper Pepin). The last known location of this fish was outside of Minnesota waters in Pool 10 of the Mississippi River, near Prairie du Chien, Wisconsin.

Staff have made several attempts to re-capture the tagged Bighead Carp on the St. Croix River and determine if this fish is schooling with other Invasive Carp. The tagged Bighead Carp has not been recaptured but two additional Bighead Carp have been caught while sampling near the tagged fish this reporting period. Two Bighead Carp were caught when netting near the tagged Bighead Carp in 2018, for a total of four Bighead Carp caught as a direct result of the tagging and release of one Bighead Carp in 2017. The recapture attempts have been unsuccessful due to sampling in flooded timber or within Lake St. Croix which is too deep and vast for conventional fisheries management techniques. During the 2019 field season, additional tools have been utilized to more effectively sample for this tagged Bighead Carp including a 2,000 foot long and 40 foot deep purse seine (purchased with a grant from the U.S. Fish and Wildlife Service) and a real-time receiver that sends emails and text messages when the tagged fish is in the area of the receiver (also purchased with a grant from the U.S. Fish and Wildlife Service).

From January 1 to June 30, 2019 the MN DNR Invasive Carp field crew have contracted with our commercial fishermen, including four gill net days and two commercial seines. Further, MN DNR has deployed large mesh gill nets (21,250 feet), electrofished (2567 minutes), and fished trap nets for a total of forty fishing days. Sampling this entire field season has been difficult due to high water.

Last reporting period it was decided after further review of the 2013-2017 collected larval samples that the results of the 2018 larval samples would be necessary before preparing results for publication with Colorado State University's Larval Fish Laboratory. The results of the 2018 larval samples have now been received and staff will begin working to publish these results with publication expected by the end of 2019. Larval samples are sent to Colorado State University for expert identification. Minnesota Department of Natural Resources went through an extensive search for professionals able to provide expert larval fish identification to the lowest possible taxon and Colorado State University's larval fish lab was found to be the only lab in the country to offer this service to external agencies. In addition, Colorado State University has been a leader in the field of larval fish identification and has over 40 years of experience in the field.

Activity 1 Status as of January 1, 2020:

During this reporting period, 152 larval samples were collected from six different sites on the St. Croix River, Pool 2 and Pool 3 of the Mississippi River. They were sorted and are being sent to CSU for expert identification. These six sites are different from previous years. These sites were selected by MN DNR Biologists to better coincide with the locations and timing when invasive carp would be spawning, based on tracking data collected from our tagged bighead carp.

Contracted commercial fishermen have been hired 10 times during this reporting period for invasive carp monitoring and Bighead Carp recapture events. Contracted commercial fishing included six gill net days and four commercial seines. Further, MN DNR has deployed large mesh gill nets (29,300 feet), electro fished (1,280 minutes), 19 shore seine hauls, and

collected 152 larval samples. Additional commercial fishermen hauls have been monitored and have provided more invasive carp captures that were turned over to the DNR for analysis.

Activity 1 Status as of July 1, 2020:

Due to COVID 19 and the governor's stay at home order this spring, field activities were limited. Larval samples were not collected this year as we planned for only 3 years of funding for that activity, and social distancing is not possible while collecting larval samples. Samples from the 2019 field season have been identified by CSU; results have shown no invasive carp present.

Contract commercial fisherman have been hired 12 days, including nine gill net days and three commercial seine hauls. One Silver Carp was captured during these contracted commercial fishing days. MN DNR has electro-fished (99 minutes), and monitored 2 seine hauls. In addition to monitoring hauls, MN DNR staff were in constant contact with commercial fisherman along the Minnesota-Wisconsin border to monitor for invasive carp captures without in-person contact. A total of 52 invasive carp were removed and data were collect from each fish in monitored seine hauls.

Activity 1 Status as of January 1, 2021:

The 2020 field season was impacted by the COVID-19 pandemic. Field work was not allowed for almost the entire first half of the normal field season. Protocols to accomplish social distancing during field work were developed and followed to keep staff and others safe and healthy. Despite limitations caused by the pandemic, most of the annual goals of the invasive carp crew to gather information and protect our resources were met.

Contracted commercial fisherman have been hired 16 days, including 12 gill net days (37,000 feet of net) and four seine days. Six Silver Carp were captured during these contracted commercial fishing days and five were tagged by the US Fish and Wildlife Service in Pool 8. Further, MN DNR staff deployed large mesh gill nets (12,550 feet), electro fished (1,191 minutes), and deployed 20 shallow water seine hauls. Additional commercial fishing hauls were monitored by MN DNR staff, and two additional Silver Carp caught by commercial anglers were removed and turned over to the USFWS for standard data collection on each fish.

Final Report Summary:

During this reporting period from January 1 to June 30th of 2021, the DNR invasive carp crew was busy doing standardized sampling as well as conducting new methods to remove invasive carp. The monitoring crew assisted in the Modified Unified Method (MUM) in Pool 8 of the Mississippi River. During this event, 34 Silver Carp were removed from the Mississippi River during a coordinated effort with the WI DNR, USGS, USFWS and other MN DNR FAW and EWR staff. The five-day event was used as a removal of invasive carp to help curb the potential of spawning and also to test the effectiveness of the MUM as a management tool going forward. Due to its success, a similar effort is being planned for October of 2021.

In addition to the MUM, MN DNR staff conducted 361 minutes of electrofishing, collected 48 larval samples over 4 days, monitored 35 contracted seine hauls and 9 non-contracted hauls, and contracted over 10,700 feet of gill net over 7 days. 56 invasive carp were removed from MN waters during this reporting period, which is in part a result of upstream movement, but also the invasive carp crew's increased knowledge and understanding of frequently used habitats by invasive carp. Over the life of this grant, great strides were made to understand and develop new methods to capture invasive carp that will be used for future management.

Contracted commercial fishing has increased due to an increase in funding from the USFWS. In 2021, we received a \$315,000 grant for increased commercial fishing and monitoring as well as the purchase of two additional real-time acoustic telemetry receivers and larval sample identification in Pool 8. This additional funding has helped to expand the program's work beyond what we could accomplish solely using ENRT funds.

Larval samples were collected in Pool 8 this year, a shift from the previous collection sites of Pools 2, 3, and the St. Croix River. The collecting of samples in Pool 8 correlates to the increase in invasive carp activity in that pool that makes it the most likely place where reproduction might occur. The collected samples will be processed this winter and results will be stored with other larval data from previous years.

Over the life of this grant the goals for Activity 1 have been met. ENTRF funded staff conducted 364 days of field sampling, including over 139,000 feet of gill net deployed, over 7,300 minutes of electrofishing, over 134 days of monitored/contracted commercial fishing and over 450 larval samples. This resulted in the removal of over 150 invasive carp during the grant period and countless others that have been reported to DNR staff as a result of media coverage, our presence on the water and in public and professional forums. We now have a greater understanding of invasive carp movement and habitats that will prove useful in future management. In addition, we learned about the effectiveness of different gears in capturing invasive carp at different life stages, in different habitats and in different seasons. We now also have a strong native species baseline from standardized electrofishing and the native fish that we've caught in larval samples year to year. This data can be compared to in years to come if invasive carp ever get a strong foothold in MN waters to better understand the effects they could have on native fish in those areas sampled. The information gained over the last four years will also be used to update and direct the invasive carp management plan that will be put forth by the MN DNR in the coming year.

ACTIVITY 2: 2D/3D Acoustic Monitoring of Lock and Dam Passage and Critical Locations

Description: Funding will supplement an existing VEMCO fish telemetry project, adding a three-dimensional component to better understand how tagged fish occupy important locations in the Mississippi River and tributaries. MN DNR currently maintains a network of 70 acoustic receivers, tracking a total of 201 tagged fish representing eleven species. Numerous fish have been observed passing locks and dams in the Mississippi River. Upgrading the acoustic receiver network to provide 2D and 3D location data will greatly enhance our knowledge of fish passage at locks and dams, how fish respond to commercial fishing and how the warm water discharge attracts fish at the Allen S. King Plant in Bayport, MN (a location where six Bighead Carp were captured in 2015). Data will be sent to VEMCO for processing, as they are the only company able to analyze these complex results. Silver Carp and Bighead Carp are already being implanted with transmitters outside of the state of Minnesota by other agencies and universities. Should a tagged Invasive Carp travel into Minnesota waters, it will be tracked and targeted to remove larger numbers of individuals.

Along with adding additional traditional acoustic receivers to the existing acoustic receiver array to fill in locations where fish may not be detected, MN DNR staff will install three networks of VEMCO VPS receivers to triangulate tagged fish locations to provide locations in three-dimensions. The VPS systems require the use of synch tags to synchronize receivers when receiving tag transmissions allowing for triangulation, along with batteries, and a permanent platform to hold the receivers in place. The first VPS network will be installed upstream of Lock and Dam 2, with five receivers added. The second VPS network will be installed downstream of Lock and Dam 2, with six receivers added. The third VPS network will be installed at the Allen S. King Plant on the St. Croix River in Bayport, MN, with four receivers added. Lastly, a VR100 and hydrophones will be purchased to assist researchers active track tagged fish to determine locations in real time. Acoustic receivers, including the VPS networks, will be downloaded to attain fish passage records twice per year and batteries will be changed once per year.

This Activity will expand an existing acoustic receiver array to determine how tagged fish approach and occupy critical locations in three-dimensions. Outcomes will include a better understanding of how fish occupy key locations and interact with locks and dams and the movement patterns of native riverine species. Results will be provided in high resolution locations of tagged fish and movement patterns that will be detailed in an annual MN DNR report.

Summary Budget Information for Activity 2:

ENRTF Budget: \$ 76,025
Amount Spent: \$ 75,990
Balance: \$ 35

Outcome	Completion Date
1. Deploy acoustic receivers around locks and dams and retrieve data	June 30, 2019
2. Contract VEMCO to analyze the 3D acoustic telemetry data	December 1, 2019
3. Analyze 2D and 3D data to determine how fish occupy these areas	June 30, 2020

Activity 2 Status as of January 1, 2018:

In 2017, equipment was purchased to deploy acoustic receivers in the St. Croix and Mississippi rivers. This equipment consists of acoustic receivers with overlapping detections ranges which allow for transmitter fish to be positioned in 2D/3D. This concept is termed a "VEMCO Positioning System" (VPS) by the manufacturer, VEMCO (Bedford, Nova Scotia, Canada). Data collected from three VPS receiver arrays have been sent in to VEMCO for preliminary processing and analysis.

Equipment purchased in 2017 consisted of 16 VEMCO VR2Tx receivers, four VEMCO transmitters to be used as reference sites within the VPS networks, and a VEMCO VR100 mobile receiver, directional hydrophone, and transponding hydrophone. Other equipment purchased was for materials needed (rebar, plastic tubs, buckets, concrete, and hardware) to deploy the acoustic receivers.

Deployment of receivers began on October 20, 2017 and was completed on November 13, 2017. Fifteen receivers were deployed as part of three separate VPS networks. The St. Croix River VPS network near Bayport, MN consists of five VR2Tx receivers and one reference transmitter. The Mississippi River has two VPS networks. One VPS network above Lock & Dam #2 in Hastings consists of four VR2Tx receivers and one reference transmitter. One VPS network below Lock & Dam #2 in Hastings consists of six VR2Tx receivers and two reference transmitters. The VPS network planned for Point Douglas on the St. Croix River has not been purchased yet. We are awaiting the results from the other networks before purchasing and installing another system.

Initial deployment and analysis of the VPS networks required data to be sent to VEMCO for analysis to determine if any adjustments were needed. Results were good at the St. Croix River location at Bayport. Some adjustments to deployment locations are needed at the two Mississippi River VPS sites. Adjustment to the Mississippi River VPS sites have not yet been completed as the results came back too late and ice formation on the river prevented winter adjustment. Given the timeframe of the deployment, no data was submitted for fish positioning as the cost outweighed the minimal amount of data that would have been analyzed over that short time period. The desire is to attempt to make minor adjustments to equipment as soon as possible in 2018 to ensure the Mississippi River VPS networks are operational come spring 2018.

Only one fish was present at the Mississippi River VPS sites during testing. Several fish were within range of the St Croix River VPS site during testing and VEMCO positioned one Lake Sturgeon free of charge as an example of the results we can expect.

Activity 2 Status as of July 1, 2018:

Data has been collected for all three VPS locations. Data is in the process of being compiled and processed to send to VEMCO for 2D/3D fish positioning. The St. Croix River network site did not experience any major problems and data analysis should provide good results. The two VPS network sites above and below Lock & Dam #2 experienced some problems after deployment. The environment is very noisy and receivers were having difficulty communicating with each other. Equipment was adjusted to improve line of sight and communication; however, ice cover, high flows, and logs created some problems maintaining receivers in the correct positions to maximize results.

One acoustic receiver above Lock & Dam #2 is currently missing. It is believed a large log caused a large amount of stress on the cable tethering the equipment and as a result the cable received many abrasions and stress causing the cable to snap. This receiver has been detected using an active receiver and transponder and it has passed the dam and is now in Pool 3 of the Mississippi River. High water has prevented a recovery effort for this receiver. If it is recovered, the data should be usable until the point at which the cable broke. If it is not recovered, fish transmitters detected above Lock & Dam #2 will not be able to be positioned. Only 179 detections were gathered from four transmitter fish above Lock & Dam #2. In order to position a transmitter fish in 2D/3D, the transmitter must be detected on at least three receivers to triangulate that fish's position. Very few detections occurred on three or more receivers, and detections on the third receiver appear to be detections of an echoing transmission and are not useful to position that fish. Recovering the missing receiver could fill in some detection gaps to allow for fish triangulation. Recovery efforts for this receiver will commence as soon as the flows recede to safe levels.

Twenty different fish transmitters were detected below Lock & Dam #2 totaling more than 180,000 detections. Seventeen of those fish were Paddlefish. The remaining three fish were a Blue Sucker, a Muskellunge, and a Smallmouth Buffalo. Most of the fish movement activity occurred in the spring, as expected. It remains to be seen if the VPS network communication will be sufficient to place those fish transmitters in 2D/3D during the time period when fish were within the receiver array.

No problems are anticipated with the St. Croix River VPS site near Bayport, MN. One receiver was out of position during retrieval this spring as an angler or boat anchor likely snagged the equipment and moved it about 250 feet east. This movement should not inhibit data processing as coordinates were obtained for this new position. Over 366,000 detections were recorded for 26 different fish transmitters at the St. Croix River VPS site. Species detected include Bighead Carp, Bigmouth Buffalo, Lake Sturgeon, Muskellunge, Paddlefish, and Walleye. Data analysis from this location will be beneficial to determine how fish utilize (or avoid) the warm-water effluent from the Allen S. King Plant throughout the year.

Activity 2 Status as of January 1, 2019:

Data has been collected for all three VPS locations. Data is in the process of being compiled and processed to send to VEMCO for 2D/3D fish positioning. The St. Croix River network site did not experience any major problems and data analysis should continue to provide good results. The two VPS network sites above and below Lock & Dam #2 experienced some problems after deployment. The environment is very noisy and receivers were having difficulty communicating with each other. Equipment was adjusted to improve line of sight and communication; however, ice cover, high flows, and logs created some problems maintaining receivers in the correct positions and two receivers were lost due to cable failure.

Data at the St Croix River network provided positions on 21 fish transmitters from November, 2017 through June, 2018. Species positioned were Bighead Carp (1), Lake Sturgeon (7), Muskellunge (4), Paddlefish (6), and Walleye (3). Analysis of fish positions in the area is ongoing. Data is being compiled for transmitter positioning for June 2018 through October 2018 and will be submitted to VEMCO during the winter of 2018/2019.

One acoustic receiver above Lock & Dam #2 is currently missing. It is believed a log and swift currents caused a large amount of stress on the cable tethering the equipment and as a result the cable received many abrasions and stress causing the cable to snap. This receiver has been detected using an active receiver and transponder and it has passed the dam and is now in Pool 3 of the Mississippi River. Attempts were made to recover the receiver but its final resting place could not be located and the receiver has been lost. A replacement receiver was purchased but has yet to be deployed. Fish transmitters detected above Lock & Dam #2 will not be able to be positioned after the receiver was lost. Prior to the receiver being lost, only four fish were detected above Lock & Dam #2 from November, 2017 through June, 2018. In order to position a transmitter fish in 2D/3D, a single transmission must be detected on at least three receivers to triangulate that fish's position. Of the 179 detections, only one fish was detected on three or more receivers six times. The cost of analyzing those six positions is not viewed as an efficient use of funds and data will not be submitted to VEMCO for processing the location data for that one fish.

One acoustic receiver below Lock & Dam #2 was lost due to cable failure. The deployment area was subject to eddy currents and had been experiencing problems with moving ice flows and logs. A replacement receiver was purchased and will be deployed after ice-out using a different method to prevent damage to the cable by ice and logs. Twenty-nine different fish transmitters were detected below Lock & Dam #2 totaling more than 292,000 detections. Eighteen of those fish were Paddlefish. The remaining fish were Bighead Carp, Blue Sucker, Flathead Catfish, Lake Sturgeon, Muskellunge, and Smallmouth Buffalo. It remains to be seen if the VPS network communication will be sufficient to place those fish transmitters in 2D/3D during the time period when fish were within the receiver array. As expected, most of the fish movement activity occurred in the spring, which is when the VPS network is most hindered by background noise from high water. Data from November 2017 through November 2018 will be compiled and sent to VEMCO for processing.

Given the problems with noise, current, echoes, and debris (e.g. logs), it is recommended to expand the VPS array below Lock & Dam #2 by removing the receivers deployed above the dam to ensure the large numbers of fish present below the dam in the spring are able to be triangulated. The VPS array above the dam is currently providing little insight to fish movement as the number of fish above the dam is minimal and replacing the lost receiver has logistical constraints. If the network below the dam is improved, it should provide enough information to determine if fish are passing through the dam gates or through the lock chamber. It should also provide insight as to where fish spend their time below the dam, whether they are immediately below the dam attempting to pass or if they are residing in other predictable areas. The final decision on moving VPS receivers will be made after data below Lock & Dam #2 is analyzed by VEMCO. No changes are needed at the St Croix River VPS site.

Activity 2 Status as of July 1, 2019:

VEMCO Positioning System (VPS) telemetry equipment has been collecting data since fall of 2017 at three locations: St Croix River near Bayport, Mississippi River above Lock & Dam #2 in Hastings, and Mississippi River below Lock & Dam #2 in Hastings. Two acoustic receivers have been lost due to high flows, logs and ice in the vicinity of Lock & Dam #2.

Data above Lock & Dam #2 is insufficient due to the loss of one receiver. The cost of analyzing data above the dam was not viewed as cost effective due to the limited number of fish detections and the large amount of error that would occur with data from only three receivers. Data has been analyzed below Lock & Dam #2 from November 13, 2017 through November 15, 2018. Due to the high levels of ambient noise below the dam and the loss of one receiver, only 10.9% of the

fish transmitter detections were detected on three or more receivers. However, 23 fish transmitters (representing five different fish species) were able to be positioned below the dam (ranging from 1 to 7,516 positions per tagged fish). Acoustic receivers above the dam were to be re-purposed to add to the array below the dam to increase coverage and fish positioning but the prolonged flooding in 2019 has delayed that effort.

Data has been analyzed at the St. Croix River site from October 20, 2017 through October 30, 2018. There are times of high levels of ambient noise but the St. Croix River site performs much better than the site below Lock & Dam #2. Data has been analyzed twice for the St. Croix River site. Detected fish transmitters were detected on three or more receivers 20.5% and 21% of the time for each analysis respectively. Detections on three or more receivers on the St. Croix River is almost double the triangulation rate of transmitters below Lock & Dam #2. A total of 32 fish transmitters (representing six different fish species) have been positioned (ranging from 3 to 9,836 positions per tagged fish).

The one Bighead Carp implanted with a transmitter in the St. Croix River in 2017 has been positioned 2,033 times in the St. Croix River and 24 times below Lock & Dam #2. The positions from the St. Croix River array has shown this fish is attracted to the warmwater discharge at the Allen S. King Plant in mid-summer whereas most native fish tend to avoid the warmwater discharge in the summer. Fisheries staff are reviewing options to best exploit this information to aid in capture of this and other invasive Bighead Carp and Silver Carp in the future.

Data will continue to be collected at the VPS sites and submitted to VEMCO in the winter for analysis. Results are expected during the winter of 2019/2020.

Activity 2 Status as of January 1, 2020:

Telemetry receivers below Lock & Dam #2 (LD2) were downloaded in the fall of 2019 and will be submitted for VPS 2D/3D fish positioning in the winter of 2020. VPS receivers were unable to be downloaded before ice cover formed over the St Croix River near the King Plant. Those receivers will be downloaded after ice-out in 2020 and data will be compiled and sent to VEMCO for processing.

VPS receivers and reference transmitters above LD2 were removed and are planned to be deployed below LD2 to improve the efficiency of that array. However, depth and strong flows in 2019 are proving to be very problematic for equipment deployment below the dam.

Preliminary analysis of the VPS array below LD2 shows 29 individual fish transmitters were within the array in 2019, including the tagged Bighead Carp. MNDNR Invasive Carp personnel were sampling for invasive carp during a high water event in July, 2019, when the tagged Bighead Carp was in the area. We are hopeful VPS data will reveal movement and behavior information of the tagged Bighead Carp and how close the tagged fish was to our deployed gill nets, which netted a large female Bighead Carp that day.

Activity 2 Status as of July 1, 2020:

Telemetry receivers in the St Croix River that we were unable to be downloaded in the fall of 2019 were downloaded in June, 2020. Receivers below Lock & Dam #2 (LD2) on the Mississippi River were also downloaded in June, 2020. Data has been sent to VEMCO for processing.

Receivers below LD2 have been removed and will be deployed in the fall of 2020 to a new location. Equipment was being moved and lost in the strong currents below the dam. In addition, the noisy environment was decreasing the ability to triangulate fish. The tagged Bighead Carp was below LD2 for eight days in 2019. Only 211 triangulated positions were able to be calculated. Under normal conditions, we should have triangulated significantly more data points. The new location in Lake St Croix will provide favorable conditions in the area where the tagged Bighead Carp has been located on a regular basis over the winter months. Winter movement and behavior will be monitored if the tagged Bighead Carp remains at large.

Thirty noninvasive fish were able to be positioned below LD2 in 2019. The most recent data submitted for processing will potentially position 36 in the St Croix River (20 months of data), and 28 fish below LD2 (7 months of data).

Activity 2 Status as of January 1, 2021:

Data for the 20 month study period at the St Croix River VPS array positioned 35 fish transmitters, one of which was the tagged Bighead Carp. Only 242 positions were achieved for the tagged Bighead Carp over the 12 month period. While this was disappointing, it is an artifact of the fish's habits as it was only well positioned within the array for one day in 2020 before the data was retrieved in June, 2020. Seven months of data for the VPS array below Lock & Dam #2 (LD2) positioned 27 fish transmitters. The tagged Bighead Carp was not detected below LD2 during that timeframe.

Receivers from the VPS arrays above and below LD2 were removed from that location and re-deployed utilizing a new method. The location, between Hudson, WI and Afton, MN, is where the tagged Bighead Carp has overwintered every year since 2017. The goal is to gain a better understanding of where that fish is positioned in the roughly 2,400 acre stretch of water it over-winters in for 6 months every year. This new VPS deployment system will only be deployed from late fall to early spring to avoid being snagged and moved by open water anglers.

Final Report Summary:

The Mississippi River has been a challenging environment to fully utilize the capabilities of this equipment. Ambient noise at LD 2 and flood waters/debris moving equipment caused challenges in accurately positioning detected fish. However, 44 individual fish transmitters of various species were detected below LD2 nearly 117,000 times from November, 2017 through June, 2020. The tagged Bighead Carp was located within the array below LD2 in 2018 and 2019, but because of challenges at that site, we were only able to triangulate that fish's exact position 235 times. The tagged Bighead Carp was only present below LD2 for 14 days total in 2018 and 2019, and not at all in 2020. We were not able to get many instances of the exact movement of native fish through the lock and dam, but we did see some hotspots of use by both the tagged Bighead Carp and Paddlefish. The Bighead Carp data showed seasonal use of the auxiliary lock chamber that led us to target that area for removal, resulting in the capture of a large female Bighead Carp.

Due to challenges with collecting quality data, some detection equipment from below LD2 was eventually relocated to the St. Croix River to aid in manual tracking efforts of the tagged Bighead Carp and a seasonal VPS array was established near Lakeland, MN. This new location is intended to capture positions of the tagged Bighead Carp at its over-wintering site. That data will be analyzed in the near future to learn about behavior and habitat use during that time of year.

Data is still being collected at one of the three original VPS sites and one new seasonal site. We will continue to send the data to InnovaSea (formerly VEMCO) to process the data to allow for triangulated positioning of detected fish. The loss of a receiver and minimal data collected at the site above LD2 did not lend itself to the expense of processing the limited fish positioning data within that array. However, the detections of fish at this location tell us about general fish movement through the lock and dam, indicating the seasons or flows where movement of different fish species occurs through the lock, or more commonly, through the dam gates.

Data collected near Bayport on the St. Croix River has been abundant, with 42 individual fish transmitters of various species detected 186,000 times from October, 2017 to June, 2020. This site provided 2,275 positions of the tagged Bighead Carp and will be a useful site moving forward as experimental tactics evolve on how to better target and capture invasive carp in different habitats.

These data will be valuable in understanding invasive carp movements in order to better direct management of these species if they become established in MN waters. In addition to gaining information on Bighead Carp movement, we have also been able to collect thousands of data points showing native fish movement up and down the Mississippi, St. Croix and parts of the Minnesota Rivers over the last four years. That information is extremely important to our management of not only invasive carp, but also native fish species. This data further suggests that native fish move with ease through the locks and dams during high water events and show significant seasonal movement patterns which would be disrupted if any permanent structures were put in place. Conversely, LD2 in particular can be a considerable barrier to native fish movement when flows are less than 61,000 cubic feet per second. This science is important and will aid in decision making when it comes to invasive carp deterrents and dams alike.

Data analysis of fish positions within the VPS arrays is ongoing and evolving. New tools and code will be used to assess fish locations to better quantify how fish use these areas at certain times of the year as well as how they position themselves in the water column (for those equipped with depth sensor transmitters).

ACTIVITY 3: Native Fish Diet and Food Web Analysis

Description: One of the best options to prevent the expansion of Invasive Carp populations in the Mississippi River and its tributaries is to support healthy native fish communities. This project will collect stable isotope samples from native fish species collected using standard fish sampling techniques. Three native predators (Flathead Catfish, *Pylodictis olivaris*; Channel Catfish, *Ictalurus punctatus*; and Walleye, *Sander vitreus*), their main prey species, the Mississippi River’s most important planktivores (Bigmouth Buffalo, *Ictiobus cyprinellus*; Paddlefish, *Polyodon spathula*), and Silver (Hypophthalmichthys molitrix) and Bighead Carp (*Hypophthalmichthys nobilis*) will be sampled for isotope analysis. Stable isotope signatures will be used to determine their position in the food chain and provide baseline data on our native species prior to Invasive Carp establishment to better understand native species resiliency. Non-lethal fin clips from these species will be collected, with thirty individuals of each species sampled for 1 year. Fin clip samples will be dehydrated and vacuum sealed until the samples can be ground and sent for analysis. Stable isotope samples will be sent to an experienced stable isotope analysis laboratory at the end of each field season. From this project, MN DNR can better evaluate and make recommendations on how native aquatic communities can be used to slow the expansion and growth of Invasive Carp populations in Minnesota’s unique riverine habitats. Data will be reported in a MN DNR annual report with analyses of isotope overlap among species and which species exhibit the greatest overlap with Invasive Carp.

This Activity will be a one year study to determine native species feeding habits and niche to be compared with similar studies in areas where Invasive Carp are abundant to better understand the effects of Invasive Carp on native species and assess native species resiliency to Invasive Carp establishment in Minnesota. Outcomes will include stable isotope data on Invasive Carp caught in monitoring efforts along with some of the Mississippi River’s most abundant predatory fish, the prey they feed on, and the planktivorous fish whose diets are most likely to overlap with Invasive Carp. This information will provide a first look at how diverse our native species are ecologically and also the ecological effects of Invasive Carp establishment on native species.

Summary Budget Information for Activity 3:

ENRTF Budget: \$ 7,093
Amount Spent: \$ 7,093
Balance: \$ 0

Outcome	Completion Date
1. Collect stable isotope samples of native fish species	October 31, 2017
2. Contract to analyze stable isotope data	January 1, 2018
3. Compile results and analyze stable isotope data	June 30, 2018

Activity 3 Status as of January 1, 2018:

During May, June, and July of 2017 baseline samples were collected in Pool 2 of the Mississippi River to determine the bottom of the food chain and what important fish species consumed over the course of the summer. Baseline samples included algae, vegetation, detritus, phytoplankton, zooplankton, micro- and macro-invertebrates, crayfish, snails and zebra mussels. In addition, a few opportunistic samples of larval fish, fly larvae, and water scorpions were also collected. Overall, most species were collected as planned with several species absent from collection sites despite intense sampling.

During August and September of 2017 fish were collected and pelvic fin samples were collected to determine higher trophic levels. For all primary species, 30 samples were collected for each species (6 samples for each of 5 locations within lower Pool 2) to allow for comparison. Similar to baseline samples, most species were collected as planned with several species absent from collection sites despite intense sampling. As expected Bighead Carp, Silver Carp, Grass Carp, and Paddlefish were rare though several individuals were collected outside the study area and samples were taken for analysis.

Overall, we met our sampling objectives, collecting 283 baseline samples and 474 fish samples including all species and size groups.

Mass spectrometry was contracted with the University of Minnesota for Carbon (C¹³) and Nitrogen (N¹⁵) stable isotope analysis. Due to problems with the mass spectrometer, the results are still pending.

Activity 3 Status as of July 1, 2018:

The original plan was to collect samples over two field seasons; however, after extensive discussions with experts in the field it was determined that the effort would be better spent collecting all samples in one field season. This provides us with more extensive data on a complex system and mitigated the need to limit the study to a select few species.

Stable isotope sample analysis was originally contracted to the University of Minnesota and all samples were sent to the Stable Isotope Laboratory in November 2017. However, after two months the MN DNR and University of Minnesota agreed to dissolve this agreement due to the mass spectrometer failing and a timeline not being able to be set for repairs. As a result, MN DNR went through a bidding process and contracted Cornell University to complete stable isotope analysis for samples collected in 2017.

Samples were sent to Cornell University and the results have been received by MN DNR. Due to the timing results were received, analysis of the results will not be able to be conducted until the winter of 2018/19. Results are expected to be completed and submitted for peer-reviewed publication by spring 2019.

Activity 3 Status as of January 1, 2019:

Samples were sent to Cornell University and the results have been received by MN DNR. Due to the timing results were received, analysis of the results will not be able to be conducted until the winter of 2018/19. Results are still expected to be completed and submitted for peer-reviewed publication by spring 2019.

Activity 3 Status as of July 1, 2019:

Samples were sent to Cornell University and the results have been received by MN DNR. Due to the timing results were received, analysis of the results were expected to be completed during the winter of 2018/19. However, one of the specialists on this project was working in a mobility position with the agency over the winter and was not able to complete the report. A full write up of the results are expected to be completed and submitted for peer-reviewed publication by spring 2020.

Activity 3 Status as of January 1, 2020:

Samples were sent from the 2017 field season to Cornell University and the results have been received in 2018 by MN DNR. Analysis of the results were expected to be completed during the winter of 2018/19, but one of specialists on this project was working in a mobility position with the agency over the winter of 2018-2019 and was not able to complete the report. A full write up of the results are expected to be completed and submitted for peer-reviewed publication by spring 2020.

Activity 3 Status as of July 1, 2020:

Samples from the 2017 field season were sent to Cornell University and the results were summarized in 2018. Analysis of the results were to be completed during the winter of 2018/19, but one of specialists on this project was working in a mobility position with the agency over the winter of 2018-2019 and was not able to complete the report. At this time, results are drafted and peer-review is ongoing.

Activity 3 Status as of January 1, 2021:

Samples were sent to Cornell University and the MN DNR received the results. Analysis of the results were to be completed during the winter of 2018/19, but one of specialists on this project assigned this task was working in a mobility position with the agency over the winter of 2018-2019 and was not able to complete the report. We have since reassigned this task to other staff. At this time, results are drafted and peer-review is ongoing.

Final Report Summary:

During May, June, and July of 2017, baseline samples were collected in Pool 2 of the Mississippi River to better understand the main food sources consumed by important fish species over the course of the summer. Baseline samples included algae, vegetation, detritus, phytoplankton, zooplankton, micro- and macro-invertebrates, crayfish, snails and zebra mussels. In addition, a few opportunistic samples of larval fish, aquatic insects, and water scorpions were also collected. Overall, most species were collected as planned, but some targeted species were absent from collection sites despite intense sampling.

During August and September of 2017, targeted fish species were collected and tissue samples were taken to test at which trophic level they were feeding. For all primary species, 30 samples were collected per species (6 fish per species at 5 locations within lower Pool 2) to allow for comparison. Similar to baseline samples, most species were collected as planned, but some species were absent from collection sites despite intense sampling. As expected Bighead Carp, Silver Carp, Grass Carp, and Paddlefish were rare to non-existent, and in some cases individuals had to be collected outside the study area to allow for their analysis.

Overall, we met our sampling objectives, collecting 283 baseline samples of potential food sources and tissue samples from 474 fish, including all targeted species and size groups. The samples were originally to be sent to the University of Minnesota but due to issues at their laboratory, the samples had to be sent to Cornell University for analysis.

The stable isotope results have been received by the MN DNR and is stored in a shared drive for future use. The information from the results provides us with baseline data to be compared in years to come if invasive carp ever reach higher densities in this part of the Mississippi River. They may also be useful in comparison to similar analysis at other locations where invasive carp have become established, so that we can better understand how our rivers may be similar or different in how they respond to invasion.

V. DISSEMINATION:

Description: Information regarding sites sampled, effort expended, Invasive Carp caught, and native species associated with sampling sites will be compiled. This information will also be shared with other state and federal agencies including the University of Minnesota, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey, U.S. Army Corps of Engineers, Upper Mississippi River Conservation Committee, and others. Results will be presented at appropriate conferences, and, if appropriate, compiled and written for publication in peer reviewed journals. In addition, MN DNR annual reports will be written synthesizing the year's sampling activities and results and updates will be provided on the MN DNR website's Invasive Carp webpage.

Invasive Carp collected will be processed by MN DNR staff, information will be relayed to the U.S. Geological Survey's Nonindigenous Aquatic Species online database (<http://nas.er.usgs.gov/>) and representatives from other state and federal agencies. Samples from Invasive Carp will be sent to collaborating agencies for age validation, determination of sex and reproductive maturity, microchemistry, genetics, and other purposes as they arise following established protocols.

Status as of January 1, 2018:

MN DNR staff is currently preparing an annual report of effort and findings for Activity 1 and 3 which will be posted on the MN DNR Invasive Carp webpage. Activity 2 will be reported in an internal MN DNR report including other acoustic tagging activities from the East Metro Fisheries office.

Activity 1 received extensive media coverage this term due to the Bighead Carp tagging, including articles by the Pioneer Press, Outdoor News, Mankato Times, Star Tribune, MN DNR press release, MN DNR social media coverage, and the local news (KCCO, WCCO, MPR, Kare 11, Fox 21, Channel 5).

Status as of July 1, 2018:

MN DNR staff is currently focused on field work. The 2017 Invasive Carp Report is now available on the MN DNR Invasive Carp webpage. Activity 2 results are reported in an internal MN DNR report including other acoustic tagging activities from the East Metro Fisheries office.

Activity 1 received extensive media coverage this term due to the tagged Bighead Carp and the capture of two Bighead Carp caught while tracking the fish, providing further evidence for the "Judas fish" technique. Articles included by Outdoor News, MN DNR press release, MN DNR social media coverage, and the local news (KCCO, WCCO, MPR, Kare 11, Fox 21, Channel 5).

Status as of January 1, 2019:

MN DNR staff is currently preparing an annual report of effort and findings for Activity 1 and 3 which will be posted on the MN DNR Invasive Carp webpage spring of 2019. Activity 2 will be reported in an internal MN DNR report including other acoustic tagging activities from the East Metro Fisheries office.

Activity 1 received minimal media coverage this term due to few Invasive Carp captured and the inability to recapture the tagged Bighead Carp on the St. Croix River.

Status as of July 1, 2019:

MN DNR staff has finalized an annual report of effort and findings for Activity 1 and 3 which are posted on the MN DNR Invasive Carp webpage. Activity 2 is reported in an internal MN DNR report including other acoustic tagging activities from the East Metro Fisheries office.

Activity 1 received extensive media coverage this term due to the tagged Bighead Carp and the capture of ten Invasive Carp in this reporting period. In addition, a Bighead Carp was caught while tracking the tagged Bighead Carp, providing further evidence for the "Judas fish" technique. Articles included by Outdoor News, MN DNR press release, MN DNR social media coverage, and the local news (KCCO, WCCO, MPR, Kare 11, Fox 21, Channel 5).

Status as of January 1, 2020:

MN DNR staff is currently preparing an annual report of effort and findings for Activity 1 and 3 which will be posted on the MN DNR Invasive Carp webpage by spring of 2020. Activity 2 will be summarized in an internal MN DNR report, including other acoustic tagging activities from the East Metro Fisheries office.

Activity 1 received extensive media coverage this reporting period due to the tagging of a Silver Carp in the St. Croix River and the finding of a Silver Carp in a Southwestern MN river. Articles and press releases from MN DNR, Outdoor News, Yahoo News, Minneapolis Star Tribune, St. Paul Pioneer Press, Duluth News Tribune, The Globe, St. Croix 360, MPR, KARE 11, WCCO, Channel 5, and The Weather Channel.

Status as of July 1, 2020:

MN DNR staff are currently focused on field work. MN DNR staff have finalized an annual report of effort and findings for Activity 1 and 3, which is posted on the MN DNR Invasive Carp webpage. Activity 2 is summarized in an internal MN DNR report including other acoustic tagging activities from the East Metro Fisheries office.

Activity 1 received media coverage due to the large number of fish caught in Minnesota/Wisconsin waters. The capture was published in a DNR based news release as well as other media outlets such as Outdoor News, Duluth News Tribune, MPR, Star Tribune, Fox 9, JSOnline, Bring Me The News, WDIO, Pioneer Press, Albert Lea Tribune, Green Bay Press Gazette, as well as many other web-based media outlets throughout the country.

Status as of January 1, 2021:

MN DNR staff is currently preparing an annual report of effort and findings for Activity 1 which will be posted on the MN DNR Invasive Carp webpage by spring of 2021. Activity 2 will be summarized in an internal MN DNR report, including other acoustic tagging activities from the East Metro Fisheries office.

Activity 1 has continued to receive media coverage due to large numbers of fish sampled in Southwestern Minnesota and the capture, tagging, and releasing of fish in Pool 8 during October and November of 2020. Press releases from the MN DNR as well as articles from multiple media outlets have been published regarding activities done by the funded staff.

Final Report Summary:

MN DNR staff has put together the 2020 annual report illustrating effort and findings for Activity 1. Activity 2 will be summarized in an internal MN DNR report, including other acoustic tagging activities from the East Metro Fisheries Office.

During this reporting period, there was significant coverage of the Modified Unified Method in Pool 8. Several articles were published by news stations, newspapers, and magazines. Some of which include The Star Tribune, Big River Magazine, Outdoor News, KARE 11, and numerous others that will be on an attached sheet.

Throughout the last four years the MN DNR has worked in close partnership with the WI DNR, USGS, and USFWS in sharing data, management ideas, and other resources. MN DNR staff funded by ENTRF presented at the annual WI/MN border waters meeting and at an Aquatic Invasive Species seminar put on by the WI DNR, where they were asked to share their findings and ideas regarding an invasion scenario. On a yearly basis, staff funded by this ENTRF project have also presented to students at the University of Minnesota in person or online.

In addition, crews have been working with the USFWS out of La Crosse to process and collect data from captured invasive carp and also led a joint effort to capture and tag five Silver Carp in Pool 8 during the fall of 2020. The fish were then

released and tracked by MN DNR crews, WI DNR, and the USFWS through passive and active tracking. The USFWS maintains the acoustic telemetry network downstream of LD 5 and we maintain the upstream portions. Data is often shared and a great working relationship has been maintained in order to keep that sharing of data possible. The USGS has played a more prominent role in the invasive carp monitoring program as well by bringing their innovative Modified Unified Method to Pool 8 in spring of 2021. The five day event brought together multiple state and federal agencies as well as commercial fishermen to work towards one common goal of removing as many invasive carp as possible. The results were then shared with other agencies, universities, and the general public through a Stop-Carp-Coalition led Invasive Carp Forum held in June of 2021. MN DNR crews have also presented to the UMRCC (Upper Mississippi River Conservation Committee) and the UMRCT (Upper Mississippi River Asian Carp Team) showing their field work and findings on a yearly basis.

VI. PROJECT BUDGET SUMMARY:

A. Preliminary ENRTF Budget Overview:

***This section represents an overview of the preliminary budget at the start of the project. It will be reconciled with actual expenditures at the time of the final report.**

Budget Category	\$ Amount	Overview Explanation
Personnel:	\$206,000	NR Monitoring Fisheries Specialist (1 Unclassified position) (70% salary 30% benefits); 100% FTE for 3 years. Student Interns (2 positions) (100% salary) 25% FTE for 2 years.
Professional/Technical/Service Contracts:	\$140,393	Commercial Fishing: Contract 10 commercial seines and 22 large mesh gill nets over 2 years. Larval Fish Identification: Expert identification of larval fish samples for 2 years. Stable Isotope Analysis: Dual 13C and 15N natural abundance sample processing. Acoustic 3D Analysis: VEMCO Data Processing Fee for 2 years.
Equipment/Tools/Supplies:	\$95,823	Monitoring equipment to catch and process native species and Invasive Carp. Stable Isotope Analysis processing and tags to mark sampled fish. Acoustic Telemetry equipment including receivers, batteries, cages, and necessary equipment.
Travel Expenses in MN:	\$32,180	Fleet transportation expenses for 2 years and in-state travel expenses for distance and overnight status.
Other: Direct and Necessary Costs	\$25,604	*Direct and Necessary expenses: HR Support (~\$6,620), Safety Support (~\$1,854), Financial Support (~\$5,795), Communication Support (~\$1,316), IT Support (~\$8,910), Planning Support (~\$912), and Procurement Support (~\$197) necessary to accomplishing funded programs/projects.
TOTAL ENRTF BUDGET:	\$500,000	

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than \$5,000: N/A

Total Number of Full-time Equivalent (FTE) Directly Funded with this ENRTF Appropriation: 4.5 FTE

Total Number of Full-time Equivalent (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 2.0 FTE

*Direct and Necessary expenses include both Department Support Services (Human Resources, IT Support, Safety, Financial Support, Communications Support, Planning Support, and Procurement Support) and Division Support Services. Department Support Services are described in the agency Service Level Agreement, and billed internally to divisions based on rates that have been developed for each area of service. These services are directly related to and necessary for the appropriation. Department leadership services (Commissioner’s Office and Regional Directors) are not assessed. Division Support Services include costs associated with Division business offices and clerical support. Those elements of individual projects that put little or no demand on support services such as large single-source contracts, large land acquisitions, and funds that are passed-thru to other entities are not assessed Direct and Necessary costs for those activities.

B. Other Funds:

Source of Funds	\$ Amount Proposed	\$ Amount Spent	Use of Other Funds
Non-state			
United States Fish and Wildlife Service grant	\$200,696	\$200,696	Funding to support and maintain field work for detection and monitoring of Invasive Carp populations July 1, 2016- June 30, 2017.
United States Fish and Wildlife Service grant	\$70,350	\$70,350	Funding to support and maintain field work for detection and monitoring of Invasive Carp populations November 1, 2017-November 30, 2018.
United States Fish and Wildlife Service grant	\$88,429	\$65,326	Funding to support and maintain field work for detection and monitoring of Invasive Carp populations November 30, 2018-November 30, 2019. Also includes \$10,000 for a purse seine and \$10,000 for a real-time receiver.
State			
DNR Division of Fish and Wildlife in-kind match	\$132,000	\$132,000	Funding Fisheries Section employees assisting with field work and project oversight (\$40,000). Existing DNR equipment: trucks, boats, sampling equipment (fyke nets, gill nets, trawls, seines), acoustic receivers, microscopes, lab supplies, etc. (\$12,000). DNR facilities & services (office space, office overhead, technical & field support), existing DNR equipment (boats, sampling equipment, lab supplies, etc.), DNR fisheries staff (70% salary, 30% fringe) for John Waters (Invasive Carp Fisheries Specialist) and Joel Stiras (Fisheries Specialist).
TOTAL OTHER FUNDS:	\$491,475	\$468,372	

*NOTE: Additional funding was received by the U.S. Fish and Wildlife Service for John Waters' salary and travel costs for November 2018-November 2019, as well as funds for a commercial purse seine and a real-time acoustic receiver. Amount spent as of January 1, 2019.

VII. PROJECT STRATEGY:

A. Project Partners: Several state and federal agencies, including the National Park Service, Wisconsin DNR, U.S. Fish and Wildlife Service, U.S. Fish and Wildlife Service Refuge Staff, Iowa DNR, U.S. Geological Survey, U.S. Army Corps of Engineers will provide assistance including sharing research findings, access to sampling areas, and logistical support.

Partners receiving ENRTF funding

- None

Partners NOT receiving ENRTF funding

- United States Fish and Wildlife Service
- United States Geological Survey
- Wisconsin Department of Natural Resources
- Iowa Department of Natural Resources
- National Park Service
- Stop-Carp-Coalition
- United States Army Corps of Engineers

B. Project Impact and Long-term Strategy: The Minnesota DNR Division of Fish and Wildlife, Section of Fisheries continues to do surveys and sampling of our major rivers. However, enhancing this effort to detect Invasive Carp is impossible at current staffing levels. Furthermore Invasive Carp appear to be surprisingly hard to catch when they are at low numbers, apparently caused by better gear avoidance than many of our native fishes. This means that our traditional fisheries management and research activities on the rivers, although they are many, varied, and very effective for monitoring our native fish populations, are likely insufficient to understand what stage in the invasion we are facing. This project will determine the distribution and abundance of Invasive Carp in Minnesota waters and use this information to inform rapid response efforts. It will also delineate the leading edge of Invasive Carp reproductive success. Locating the areas and habitats these fish are using when they appear to be in very low numbers and have not yet established spawning populations is vital to targeting removal or other control efforts.

This proposal will enhance Minnesota waters by removing highly invasive species and will further the state's knowledge of native fish populations. Through sampling, MN DNR is increasing effectiveness to successfully capture these species and is providing vital information regarding these species' invasion and populations. This proposal will coordinate and enhance all current efforts that are available to monitor the invasion front and inform the state's response to it into the future to ensure populations do not become established. From this project, MN DNR staff will be able to increase sampling efficiencies for Invasive Carp by better understanding associations with native species and increased captures of Invasive Carp and associated biological information from captured individuals. By increasing efficiencies and removing more Invasive Carp, the state will be better able to combat the spread and establishment of these species and protect that state's natural resources and aquatic recreational opportunities. While operating under this grant and after completion, MN DNR will continue to seek additional funds to sustain efforts from the state's Game and Fish Fund and general operating budget as well as federal grants, including grants from the U.S. Fish and Wildlife Service. This program is an evolving management strategy and as such will adapt as needed to best protect the state's resources.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	\$ Amount
M.L. 2013, Chp. 52, Sec. 2, Subd. 06b M.L. 2015, Chp. 76, Sec. 2, Subd. 19 Detection and Monitoring of Asian Carp Populations and Movements	July 1, 2013 – June 30, 2016	\$540,000
U.S. Fish and Wildlife Service	July 1, 2015 – June 30, 2016	\$60,000
U.S. Fish and Wildlife Service	July 1, 2016 – June 30, 2017	\$140,696
MN Game and Fish Funds	January 1, 2014 – April 30, 2016	\$29,694
MN DNR Invasive Species funds	June 1, 2015 – July 1, 2017	\$20,000

VIII. REPORTING REQUIREMENTS:

- **The project is for 4 years, will begin on July 1, 2017, and end on June 30, 2021.**
- **Periodic project status update reports will be submitted *January 1* and *July 1* of each year.**
- **A final report and associated products will be submitted between June 30 and August 15, 2021.**

IX. VISUAL COMPONENT or MAP(S): See attached visual.

Environment and Natural Resources Trust Fund
M.L. 2017 Final Project Budget

Project Title: Invasive Bighead and Silver Carp and Native Fish Evaluation – Phase II

Legal Citation: M.L. 2017, Chp. 96, Sec. 2, Subd. 06c

Project Manager: Brian Nerbonne

Organization: Minnesota Department of Natural Resources

M.L. 2017 ENRTF Appropriation: \$500,000.00

Project Length and Completion Date: 4 years, June 2021

Date of Report: August 18, 2021



ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Revised Activity 1 Budget 2/5/21	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	Activity 3 Budget	Amount Spent	Activity 3 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM											
							Native Fish Diet and Food Web Analysis				
Personnel (Wages and Benefits)											
NR Monitoring Fisheries Specialist (1 Unclassified position) - to conduct at least 200 field sampling days annually, oversee commercial fishing operations, and compile, analyze, and report findings (70% salary 30% benefits); 100% FTE for 3 years.	\$143,400	\$143,400	\$0							\$143,400	\$0
Student Interns (2 positions) - field data collection activities in support of project objectives 25% FTE for 2 years. January 1, 2020- (back dating to Dec. 1, 2019) One Temporary Fisheries Specialist to assist with winter field work and data analysis. (1 Unclassified position- 7 months)	\$62,600	\$62,329	\$271							\$62,600	\$271
Professional/Technical/Service Contracts											
Commercial Fishing: Contracted directed commercial seines and large mesh gill nets. Licensed commercial fishermen will be hired to set 34 gill net days total and 14 seine days total over 2.5 years.	\$99,400	\$99,400	\$0							\$99,400	\$0
Larval Fish Identification: Technical contract to provide expert identification of up to 200 larval fish samples per year for 2 years by an expert in the field.	\$21,900	\$17,948	\$3,952							\$21,900	\$3,952
Stable Isotope Analysis: Dual 13C and 15N natural abundance sample processing. 15 species will be sampled with a total of 900 samples analyzed over 1 year at approximately \$11 per sample.							\$7,093	\$7,093	\$0	\$7,093	\$0
Acoustic 3D Analysis: VEMCO Data Processing Fee for 3 locations for 2 years. VEMCO is the only company able to analyze this data due to the VEMCO acoustic array already in place. No other company is able to analyze this data.				\$12,000	\$12,000	\$0				\$12,000	\$0
Equipment/Tools/Supplies											
Monitoring: Replacement nets, preservatives, sample bottles to support capture and collection of fishes, tags to track fish movement. Specialized nets including large mesh gill nets (4 @ \$300 = \$1,200), trammel nets (4 @ \$400 = \$1,600), and mini-lyke nets (6 @ \$600 = \$3,600), necessary to capture Invasive Carp at various life stages and in various habitats; associated supplies to deploy nets such as rope, anchors, floats (\$2,500); 500 mL bottles (120 bottles @ \$1.75 each = \$210) and preservative for larval samples (alcohol 48 L @ \$150 per 4 L = \$1,800; formalin 35 gallons @ \$110 per 5 gallons = \$770); external tags to track fish movements (6,000 @ \$0.70 each = \$4,200); tagging needles (8 @ \$10 each = \$80); tagging guns (2 @ \$55 each = \$110); miscellaneous supplies such as personal protective equipment, repairs, replacements, etc. (\$6,308). Costs are based on expected bids and may vary. Shipping costs to send Invasive Carp samples to external laboratories (\$3,000), sensors for water quality sonde (\$500).	\$31,798	\$29,722	\$2,076							\$31,798	\$2,076
Acoustic Telemetry: 21 VPS receivers (17 @ \$2,070 each = \$35,190), 25 deployment cages (25 @ \$50 each = \$1,250), 4 sync tags (4 @ \$380 each = \$1,520), 80 batteries (80 @ \$30 each = \$2,400), 1 VR100 (\$5,870), 1 Omnidirectional hydrophone (\$2,165), 1 Directional hydrophone (\$1,575), sales tax (\$4,455). Boat mounted crane to lift receivers with installation (\$2,500).				\$64,025	\$63,990	\$35				\$64,025	\$35
Travel expenses in Minnesota											
Fleet transportation expenses for 2 years; base of operation will be the Warner Road, St. Paul Fisheries office.	\$30,000	\$19,874	\$10,126							\$30,000	\$10,126
In-state Travel Expenses: Meals (\$3,100) and lodging (\$4,500) for distant and overnight status up to 25 nights per year for 2 years.	\$2,180	\$1,810	\$371							\$2,180	\$371
Other											
*Direct and Necessary expenses: HR Support (~\$6,620), Safety Support (~\$1,854), Financial Support (~\$5,795), Communication Support (~\$1,316), IT Support (~\$8,910), Planning Support (~\$912), and Procurement Support (~\$197) necessary to accomplishing funded programs/projects.	\$25,604	\$15,057	\$10,548							\$25,604	\$10,548
COLUMN TOTAL	\$416,882	\$389,539	\$27,343	\$76,025	\$75,990	\$35	\$7,093	\$7,093	\$0	\$500,000	\$27,378