

**Environment and Natural Resources Trust Fund**

# 2022 Request for Proposal

## **General Information**

**Proposal ID:** 2022-237

**Proposal Title:** Evaluating Bowfishing for Invasive Carp Control

## **Project Manager Information**

**Name:** Mark Clark

**Organization:** U of MN - Duluth

**Office Telephone:** (701) 552-2473

**Email:** meclark@d.umn.edu

## **Project Basic Information**

**Project Summary:** Invasive fish degrade freshwater ecosystems. Recreational bowfishing has the potential to reduce carp populations. We will evaluate whether educational workshops combined with regulated bowfishing can effectively reduce carp numbers.

**Funds Requested:** $519,000

**Proposed Project Completion:** June 30 2024

**LCCMR Funding Category:** Aquatic and Terrestrial Invasive Species (D)

## **Project Location**

**What is the best scale for describing where your work will take place?** Statewide

**What is the best scale to describe the area impacted by your work?** Statewide

**When will the work impact occur?** During the Project and In the Future

## **Narrative**

**Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.**

Common carp Cyprinus carpio is established throughout Minnesota (Eddy and Underhill 1974), where it continues to degrade aquatic ecosystems (Bajer and Sorensen 2010; Vilizzi 2018). Many control measures (e.g., constructed barriers) prevent carp from dispersing into waters where they have not yet established (Bajer and Sorensen 2010; Dauphinais et al. 2018). Methods to remove carp from infested waters are expensive, not species-specific and therefore not often effective. For example, in 2021 at Lake Ocheda (on the impaired waters list for high turbidity) a planned drawdown to winterkill common carp caused mortality in at least six native fish species, including bigmouth buffalo Ictiobus cyprinellus, a species likely declining in Minnesota (Eddy and Underhill 1974; Lackmann et al. 2019). In fact, bigmouth buffalo mortality due to the drawdown exceeded the mortality of all other species combined, including common carp (Fig. 1A; MPR 2021). Recreational bowfishing, promoted as a sport that targets invasive carp, has exponentially increased in popularity, and bowfishing tournaments in Midwestern lakes result in harvests comparable to commercial fishing harvests (Scarnecchia and Schooley 2020). However the use of recreational angling to reduce carp populations has not been evaluated.

**What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.**

We will assess the effectiveness of bowfishing as a targeted removal strategy of invasive carp by organizing workshop-centered, bowfishing carp-removal events in cooperation with watershed managers, Minnesota Department of Natural Resources, and local stakeholders. Unfortunately unregulated bowfishing tournaments can result in significant mortality of native species (Scarnecchia 1992). At the 2018 U.S. Open Bowfishing tournament, over 80% of fish harvested were native species (approximately 55% Ictiobus spp.) (Scarnecchia and Schooley 2020). Therefore training bowfishers to selectively target invasive species is critical for this to be a useful management tool. We will conduct workshop-centered, controlled removal events, in which anglers must attend an on-site training session designed to educate bowfishers on key identification features that distinguish invasive carp from native species. We will also collect data to quantify angling effort, catch (both target and non-target) and unharvested mortality. For comparison, we will collect the same information from standard bowfishing tournaments (See Fig. 1B for examples of bowfishing tournaments held in MN) that happen throughout the state to determine the potential effectiveness of recreational bowfishing and the education workshops in removing carp from Minnesota lakes.

**What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state’s natural resources?**

Outcome 1: Estimates of invasive carp removal, effort, native fish removal, unharvested mortality and carcass discard from directed bowfishing carp-removal events (June 2024).
Outcome 2 Educational workshops designed to improve bowfishing anglers’ ability to distinguish carp from native species, and identify ecosystem services provided by native species (June 2024).
Outcome 3: Estimates of invasive carp removal, effort, native fish removal, unharvested mortality and carcass discard from standard bowfishing tournaments (June 2024).

## **Activities and Milestones**

### **Activity 1: Regulated Bowfishing Carp-Removal Events**

**Activity Budget:** $192,078

**Activity Description:**We will assess the effectiveness of carp removal through regulated bowfishing removal events. We will organize approximately five bowfishing carp-removal events each year for a 3-year period (15 total) in lakes selected in collaboration with the MN DNR, local watershed districts, lake property owners and local stakeholders. Participants will be required to register, attend an educational workshop (see Activity 2), return their catch prior to departure, and report their start & end times to personnel monitoring the event following established guidelines (Fig. 1C). From this information we will quantify the number of anglers, boats and hours fished, and the number and species of fish removed. We will also collect a subsample of the catch to quantify demographic characteristics (e.g., age & size structure) of some species affected to compare with any historical information on populations from the specific lakes. Finally, we will contract with local businesses to dispose of the catch, then survey the nearby area to estimate the quantity of catch discarded (e.g., carcasses left near lake access points). Within 48 hours of the completion of the removal event, we will survey the lakeshore to estimate mortality due to unharvested catch (see Fig. 1D), and remove any carcasses encountered.

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Complete 15 workshop-regulated, carp-removal bow fishing events | June 30 2024 |
| Analyze bow fishing catch & survey data from workshop regulated, carp removal events | June 30 2024 |
| Estimate unharvested mortality associated with workshop-regulated, carp-removal events | June 30 2024 |

### **Activity 2: Workshops for Improving Angler Differentiation of Carp from Native Fishes and Bowfishing Impacts on Native Fishes**

**Activity Budget:** $196,645

**Activity Description:**We will conduct educational workshops at each bowfishing carp-removal event so that shooters are exposed to the native species that are legal to shoot in MN waters vs. those that are invasive species. Workshops will include video and live demonstrations, along with pamphlets, to highlight identifiable characteristics that distinguish carp from native fishes following recommendations from Scarnecchia and Schooley (2020) for managing bowfishing tournaments. Workshops will also include demonstrations of appropriate landing technique using a net, because other methods (e.g., use of a gaff, by hand) can result in unharvested mortalities (a common complaint from landowners or other lake users) (Fig. 1D). We anticipate workshop demonstrations will require no more than 30 minutes, and all anglers will be required to complete the workshop to participate in the carp-removal event.

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Conduct 15 Workshops associated with Regulated Bowfishing Events | June 30 2024 |
| Compile Totals on Angler Workshop Attendance | June 30 2024 |

### **Activity 3: Monitoring Unregulated Bowfishing Tournaments at Minnesota Lakes**

**Activity Budget:** $130,277

**Activity Description:**In collaboration with the MN DNR and local stakeholders, we will monitor approximately five unregulated bowfishing tournaments (Fig. 1B) each year to collect comparative data to our carp-removal events. We will collect information on the number of participants and boats from the tournament organizers. We will collect catch, as well as information on participant start & end times and approximate locations where fish were taken following standard MNDNR fishing tournament guidelines (https://www.dnr.state.mn.us/fishing/tournaments/index.html, Fig. 1C). Data collected from these tournaments will then be used to estimate the number of anglers, boats and hours fished, and the number and species of fish removed. We will also collect a subsample of the catch to quantify demographic characteristics of species affected to compare with any historical information on populations from the specific lakes. Finally, we will contract with local businesses to dispose of the catch, then survey the nearby area to estimate the quantity of catch discarded (e.g., carcasses left near lake access points). Within 48 hours of the completion of the tournament, we will survey the lakeshore to estimate mortality due to unharvested bowfishing catch (Fig. 1D), and remove any carcasses encountered.

**Activity Milestones:**

|  |  |
| --- | --- |
| **Description** | **Completion Date** |
| Monitor 15 unregulated bow fishing tournaments in Minnesota | June 30 2024 |
| Analyze catch, effort & survey data collected from unregulated bowfishing tournaments | June 30 2024 |
| Estimate unharvested mortality from unregulated bow fishing tournaments | June 30 2024 |

## **Project Partners and Collaborators**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Organization** | **Role** | **Receiving Funds** |
| Dan Livdahl | Okabena-Ocheda Watershed District | Dan Livdahl is Administrator of the Okabena-Ocheda Watershed District, and will help coordinate areas in need of carp removal, communication with local stakeholders and outreach to other watershed districts interested in hosting a workshop, carp-removal event. | No |

## **Long-Term Implementation and Funding**

**Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this be funded?**Our findings will be disseminated to managers and the scientific community through peer-reviewed publications. We will also prepare reports for cooperating partners (Minnesota DNR, Minnesota Watershed Districts, regional angler associations) detailing the efficacy of workshops to train bowfishers for invasive carp removal as well as best practices for conducting bowfishing events designed to reduce invasive species numbers. If this proves to be an effective mechanism for reducing carp population size, our designs will offer a blueprint for local stakeholders to coordinate with MN DNR in using recreational bowfishing as a carp management tool.

## **Project Manager and Organization Qualifications**

**Project Manager Name:** Mark Clark

**Job Title:** Professor

**Provide description of the project manager’s qualifications to manage the proposed project.**Mark Clark is a Professor in the Department of Biology at UMD, with research expertise in population biology. He has been a faculty member for over 18 years, advising 13 graduate students (3 Ph.D., 10 M.S.) and 1 postdoctoral fellow. His research projects have spanned a diverse array of vertebrates, including effects of timing of nesting on colonial waterbirds, life history variation in several fish species and waterborne parasite dynamics in small mammals. His work especially emphasizes the development of population models incorporating individual physiology and behavior (see https://sites.google.com/site/clarkreedecologylab/). Recent work from his lab highlights longevity in Bigmouth Buffalo, including changes in the immune function with age.

**Organization:** U of MN - Duluth

**Organization Description:**The University of Minnesota Duluth is a highly-ranked regional research and liberal arts university with a global reputation for freshwater research. UMD students can choose from more than 93 undergraduate and post-baccalaureate degrees, and from graduate programs in more than 20 different fields. The Department of Biology lies within the Swenson College of Science and Engineering (SCSE), the largest college at UMD and the third largest in the University of Minnesota System. It currently has an enrollment of over 3,200 undergraduate and 200 graduate students. This research fits in with one of the grand challenges of the college, i.e. developing an international reputation in the nascent areas of materials science, water, sustainable energy and mining innovation.

## **Budget Summary**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Category / Name** | **Subcategory or Type** | **Description** | **Purpose** | **Gen. Ineli gible** | **% Bene fits** | **# FTE** | **Class ified Staff?** | **$ Amount** |
| **Personnel** |  |  |  |  |  |  |  |  |
| Alec Lackmann |  | Co-PI |  |  | 20.2% | 3 |  | $199,126 |
| Undergraduate Research Assistants |  | Lab & Field Assistants |  |  | 0% | 2.61 |  | $71,612 |
| Mark Clark |  | PI |  |  | 26.7% | 0.24 |  | $22,626 |
|  |  |  |  |  |  |  | **Sub Total** | **$293,364** |
| **Contracts and Services** |  |  |  |  |  |  |  |  |
| TBD | Professional or Technical Service Contract | A subset of 10 otoliths will be prepared for bomb radiocarbon analysis for validation of age estimates (for age structure assessment). Preparation includes slide mount, micro milling and final radiocarbon analysis at Woods Hole Oceanographic Institute. Based on previous analysis we estimate the total cost of $812 per sample. |  |  |  | - |  | $8,120 |
|  |  |  |  |  |  |  | **Sub Total** | **$8,120** |
| **Equipment, Tools, and Supplies** |  |  |  |  |  |  |  |  |
|  | Tools and Supplies | Miscellaneous field supplies (e.g., waders, nets, scales, coolers, ice, projector, screen) | Various field supplies needed for surveys, collecting fish, dissection & transport, presentations at workshops. |  |  |  |  | $6,610 |
|  | Tools and Supplies | Miscellaneous lab supplies (e.g., storage vials, microscope slides, isomet blades, image analysis computer software) | Expendable items used to store samples in the lab, prepare samples for analysis and analyze otolith images for age determination. |  |  |  |  | $4,045 |
|  |  |  |  |  |  |  | **Sub Total** | **$10,655** |
| **Capital Expenditures** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Acquisitions and Stewardship** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Travel In Minnesota** |  |  |  |  |  |  |  |  |
|  | Miles/ Meals/ Lodging | Trip to field sites (30 total). We assume 400 miles per trip @ $0.56 per mile, 3 hotel rooms per trip @ $98 per room, $82.5 per diem overnight per person and 3 persons per trip. Thirty trips are estimated (10 per year), to conduct workshop & carp removal events and to survey standard Bowfishing tournaments. | Trips to organize/collect/survey workshops, fishing effort, etc. (Activities 1-3) |  |  |  |  | $23,861 |
|  |  |  |  |  |  |  | **Sub Total** | **$23,861** |
| **Travel Outside Minnesota** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | **Sub Total** | **-** |
| **Printing and Publication** |  |  |  |  |  |  |  |  |
|  | Publication | At least 2 manuscripts for scientific journals are anticipated from the study | Dissemination of findings through peer-reviewed scientific journals |  |  |  |  | $3,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$3,000** |
| **Other Expenses** |  |  |  |  |  |  |  |  |
|  |  | Workshop Participant Travel Defrayment | We will provide $200 to defray travel costs to attract participants for the workshop & carp-removal events. We anticipate 40-50 participants, per event, with approximately 5 events per year for 3 years (total of 15 events and 750 participants) |  |  |  |  | $150,000 |
|  |  | Harvested fish disposal & cleanup | We have budgeted $30000 to pay for clean up & disposal of harvested fish after carp-removal events and standard Bowfishing tournaments (anticipating 10 events per year, $1,000 per event). |  |  |  |  | $30,000 |
|  |  |  |  |  |  |  | **Sub Total** | **$180,000** |
|  |  |  |  |  |  |  | **Grand Total** | **$519,000** |

### **Classified Staff or Generally Ineligible Expenses**

|  |  |  |  |
| --- | --- | --- | --- |
| **Category/Name** | **Subcategory or Type** | **Description** | **Justification Ineligible Expense or Classified Staff Request** |

### **Non ENRTF Funds**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Category** | **Specific Source** | **Use** | **Status** | **Amount** |
| **State** |  |  |  |  |
|  |  |  | **State Sub Total** | **-** |
| **Non-State** |  |  |  |  |
| In-Kind | Unrecovered F & A at federally negotiated 55% |  | Pending | $285,450 |
|  |  |  | **Non State Sub Total** | **$285,450** |
|  |  |  | **Funds Total** | **$285,450** |

## **Attachments**

### **Required Attachments**

#### ***Visual Component***

File: [7b5148ee-a2e.pdf](https://lccmrprojectmgmt.leg.mn/media/map/7b5148ee-a2e.pdf)

#### ***Alternate Text for Visual Component***

Species-specific bowfishing could be a cost-effective, efficient, and widespread means of removing invasive carp from MN waters, which would enhance aquatic ecosystems statewide. A) Winterkill at Lake Ocheda, MN in March 2021 resulting from a planned water drawdown. Native bigmouth buffalo was the primary species affected despite the intended target being invasive carp. Catfish, bullhead, crappie, walleye, and freshwater drum were also significantly affected. B) Examples of bowfishing tournam...

### **Optional Attachments**

#### ***Support Letter or Other***

|  |  |
| --- | --- |
| **Title** | **File** |
| UMD SPA Proposal Approval Letter | [5093ecc5-e21.pdf](https://lccmrprojectmgmt.leg.mn/media/attachments/5093ecc5-e21.pdf) |
| Literature Cited | [5f4d90de-6f8.pdf](https://lccmrprojectmgmt.leg.mn/media/attachments/5f4d90de-6f8.pdf) |

## **Administrative Use**

**Does your project include restoration or acquisition of land rights?**
 No

**Does your project have potential for royalties, copyrights, patents, or sale of products and assets?**
 No

**Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?**
 N/A

**Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?**
 N/A

**Does your project include original, hypothesis-driven research?**
 Yes

**Does the organization have a fiscal agent for this project?**
 Yes, Sponsored Projects Administration