Environment and Natural Resources Trust Fund

2023 Request for Proposal

General Information

Proposal ID: 2023-104

Proposal Title: Understanding Native “Rough Fish” in the Bowfishing Era

Project Manager Information

Name: Mark Clark

Organization: U of MN - Duluth

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Project Basic Information

Project Summary: Quantify age, size and reproductive status of four fishes, classified as “rough fish” with minimal or no harvest limits in Minnesota, which now experience increasing, significant exploitation by recreational bowfishing.

Funds Requested: $382,000

Proposed Project Completion: June 30, 2026

LCCMR Funding Category: Foundational Natural Resource Data and Information (A)

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.

Problem: Minnesota currently uses a broad, non species-specific classification ("rough fish") to include many native fishes such as the Buffalofishes, Redhorses, Carpsuckers and Bowfin for management. While this categorization contributed to a lack of demographic information on these fishes (Rypel et al. 2021), it may have been adequate historically when these species were not subject to significant recreational harvest. However times are changing, and bowfishing has grown exponentially since 2000 (Scarnecchia and Schooley 2020). Recreational bowfishing of "rough fish" is effectively not limited, despite harvests that often exceed commercial harvest levels (Lackmann et al. 2019; Scarnecchia et al. 2021). Thus, updated information on the population demographics of these species is necessary for management to adapt to the evolving fishery. Indeed, HF 2764 is a broad-sweeping bill that calls for updated data and assessment of "rough fish" in Minnesota.

Opportunity: Analyzing specimens harvested by bowfishing provides a unique opportunity to provide such an assessment. We will collect fish and catch totals from bowfishing tournaments conducted throughout Minnesota to determine age and size structure, rates of maturation and harvest trends in at least four of the bowfishing-exploited native species to provide updates on life history and harvest trends.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

A potential solution to the lack of contemporary demographic information on the "rough fish" in Minnesota is to use bowfishing tournaments to provide catch statistics and fish samples to obtain information on the age, size and reproductive status of individuals harvested. We will focus analysis on four species/groups: Bigmouth buffalo (Ictiobus cyprinus), Quillback (Carpiodes cyprinus), Bowfin (Amia calva) and Redhorses (Moxostoma sp.), because these are all native species managed in the "rough fish" category and occur in significant numbers in recreational bowfishing harvests (A. Lackmann, peronal observations) (Figure 1). Catch statistics provided by bowfishing tournament organizers, angler groups and lake associations will be used to assess trends in catch-per-unit-effort in the four focus groups. Representative samples of fish from the four groups will be obtained on site during tournaments to determine individual size, dissect for gonad analysis and provide otoliths for age determination. We will develop size at age curves and maturation curves (Figure 1) along with distributional data specific to Minnesota populations. We will disseminate this information to the scientific community through peer-reviewed publications and to the general public through a website developed for highlighting Minnesota's lesser-known fishes.

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?

There are 3 project outcomes for disseminating updated information on the biology of Minnesota's "rough fish":
Outcome 1: A community-based, educational website to serve as a portal for distributing the scientific findings on demography and harvest trends of Minnesota's "rough fish".
Outcome 2: Presentation of findings at scientific meetings, including Annual Meetings of the Minnesota Chapter of the American Fisheries Society.
Outcome 3: Publication of findings in peer-reviewed, scientific journals.

Activities and Milestones

Activity 1: Updated demographic data and assessment of four groups of "rough fish" in Minnesota

Activity Budget: $372,339

Activity Description:
We will update life history trait information and harvest trends of four native fishes included in the "rough fish" management category. Specifically we will collect Bigmouth buffalo, Quillback, Bowfin and Redhorse suckers harvested in Minnesota bowfishing tournaments. We will measure, dissect reproductive tissue, extract and process otoliths from individual fish to determine the general rates of growth, sexual maturation and longevity for these species in Minnesota. Processing of otoliths will include independent, bomb-radiocarbon validation of ages for a subset of individuals. Contemporary information on the rate of growth, age at which individuals begin to reproduce and how long individuals can survive is necessary to develop management plans and sustainable harvest limits for fish stocks in the state as bowfishing participation continues to grow. We will also collect historical and current harvest and angler participation data from bowfishing tournament organizers to examine trends in catch-per-unit-effort (CPUE). Changes in CPUE can show trends in populations, and this information has not been assessed for native fishes managed in the "rough fish" category (for which harvest limits currently do not exist).

Activity Milestones:

Description	Completion Date
Collect 30-200 individuals from 4 members of "rough fish" at MN Bowfishing Tournaments	June 30, 2024
Complete lab work & develop size-at-age curves & maturation rates	June 30, 2025
Collect & analyze trends in Bowfishing Tournament CPUE	June 30, 2025
Age-validation via Bomb-rarbon analysis at Woods Hole Oceanographic Institute	June 30, 2026

Activity 2: Presentation of findings to natural resource management professionals

Activity Budget: $8,661

Activity Description:
We will disseminate updated information on the life history and harvest trends in "rough fish" groups through presentations at professional society meetings and peer-reviewed publications in fisheries science journals. We will begin informing natural resource managers and other scientists of results as soon as possible by attending and presenting preliminary findings at society meetings (e.g., Minnesota Chapter of the American Fisheries Society Annual Meetings) each year. We will also provide regular updates through the Otolith Lab Website (maintained by A. Lackmann). The final stage of sharing the updated understanding of the biology will be through publication in scientific journals through the peer-review process, assuring that the findings meet the highest standards. We anticipate at least three peer-reviewed publications will result from the proposed work.

Activity Milestones:

Description	Completion Date
Presentation of preliminary findings at 2023 Professional Fisheries Society Meeting(s)	June 30, 2024
Presentation of preliminary findings at 2024 Professional Fisheries Society Meeting(s)	June 30, 2025
Presentation of findings at 2025 Professional Fisheries Society Meeting(s)	June 30, 2026
Submission of at least 3 manuscripts to scientific journals associated with fisheries science	June 30, 2026

Activity 3: Develop an educational website in collaboration with local stakeholders that profiles up-to-date scientific findings on Minnesota's "rough fish"

Activity Budget: $1,000

Activity Description:

In collaboration with local stakeholders, we will develop an educational website, Minnesota's Lesser-known Sport Fishes, to disseminate updated information on native species. This website is intended for the public, and therefore will be developed in non-technical format using guidance from local stakeholders. Through previous studies with Bigmouth Buffalo from Minnesota (Lackmann et al. 2019), we have established multiple contacts (e.g., The Izaak Walton League, The Nature Conservancy, MNDNR, Roughfish.com, MN Lakes and Rivers, the Bowfishing Association of America) throughout the state who will help promote the website and the research findings. An additional emphasis of the website will be education regarding misconceptions arising from the term "rough fish" itself (Rypel et al. 2021). An informed public is necessary for successful conservation. Publicizing updated information on the biology in conjunction with how public view of sport fish can change over time will increase our appreciation of native species and ensure that natural resource managers can effectively maintain these fish for future generations of Minnesotans.

Activity Milestones:

Description	Completion Date
Develop "Minnesota's Lesser-known Sport Fishes" educational website	June 30, 2025
Publicize website to stakeholders and across social media platforms	June 30, 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Allen Andrews, Ph.D.	Age and Longevity Research	Dr. Andrews area of expertise is bomb-radiocarbon age validation of fish otoliths. He has collaborated with us previously, and will provide assistance in the micromilling of otolith subsamples for bomb-radiocarbon validation.	No
Tyler Winter	Roughfish.com	Tyler is an avid angler of historically non-sport native fish species in MN, and maintains active social media regarding these species. He will provide feedback on website design as well as assist dissemination of new scientific findings across social media channels.	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 work be funded?

Our findings will be disseminated to managers and the scientific community through 1) peer-reviewed publications, 2) presentations at scientific meetings, 3) the Otolith Lab Website and 4) the Minnesota's Lesser-Known Fishes website. We will provide copies of all publications to cooperating partners (Minnesota DNR, Minnesota Watershed Districts, regional angler associations), and in the past have made scientific presentations to cooperators upon their request. These efforts will be funded through the current project. Upon project completion, peer-reviewed publications can continue to be disseminated and websites will be actively maintained by our university affiliation.

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. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Alec Lackmann		Co-PI			17.3%	3		$194,850
Undergraduate Research Assistants		Field and Lab assistants			0%	2.61		$71,612
Mark Clark		PI			25.1%	0.24		$44,871
							Sub Total	**$311,333**
Contracts and Services								
TBD	Professional or Technical Service Contract	A subset of approximately 10 otoliths from each of 4 species (n = 40 samples total) will be prepared for bomb radiocarbon analysis for validation of ages (where applicable). Preparation includes slide mount, micromilling and final radiocarbon analysis at Woods Hole Oceanographic Institute. Based on previous analysis we estimate $500/sample.				0		$20,000
							Sub Total	**$20,000**
Equipment, Tools, and Supplies								
	Tools and Supplies	Miscellaneous field supplies (e.g., waders, nets, scales, coolers, ice)	Various field supplies needed for surveys, collecting fish, dissection & transport from tournaments.					$2,500
	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.					$4,777
							Sub Total	**$7,277**
Capital Expenditures								
		Isomet saw	An additional isomet saw for thin-sectioning otoliths is budgeted to					$10,000

			decrease laboratory processing time for otoliths.					
							Sub Total	**$10,000**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Trips to field sites (210 total, 70 per year) to collect fish. We assume 150 miles per day trip @ $0.585 per mile. We assume 630 meals across all day trips at $10 per meal. We assume hotel rooms for annual conferences (n = 6 days) @ $98 per room (n = 2 total rooms), $82.5 per diem overnight per person and 3 persons per hotel trip. ($18,429 + $6,300+ $2,661 = $27,390)	Trips to collect samples organize/collect/conferences, etc. (Activities 1-2)					$27,390
							Sub Total	**$27,390**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	At least 3 manuscripts for scientific journals are anticipated from the study	Dissemination of findings through peer-reviewed scientific journals					$6,000
							Sub Total	**$6,000**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$382,000**

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%	NA	Pending	$204,600
			Non State Sub Total	**$204,600**
			Funds Total	**$204,600**

Attachments

Required Attachments

Visual Component

File: ca9db07f-f7e.pdf

Alternate Text for Visual Component

There are 20 native fish species commonly targeted by sport bowfishing in Minnesota. The ecology of these species is not well understood, and harvest is effectively unlimited. We will develop size at age and maturation curves for four of these species, providing foundational natural resource data for management plans....

Optional Attachments

Support Letter or Other

Title	File
Literature Cited	3882868e-2fe.docx

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 (UMD)

Native species commonly targeted by bowfishing (**A**) in Minnesota. Images show portions of bowfishing end-product in the state. None of these species is well understood.

1. Bowfin (**B**)
2. Freshwater Drum (**C**)
3. White Sucker (**D**)
4. Longnose Gar (**E**)
5. Shortnose Gar
6. Quillback (**F**)
7. River Carpsucker
8. Highfin Carpsucker
9. Greater Redhorse (**G**)
10. Silver Redhorse (**G**)
11. Shorthead Redhorse (**G**)
12. Golden Redhorse (**G**)
13. River Redhorse
14. Black Redhorse
15. Yellow Bullhead (**G**)
16. Brown Bullhead (**G**)
17. Black Bullhead (**G**)
18. Bigmouth Buffalo (**H**)
19. Smallmouth Buffalo
20. Black Buffalo