Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)

Project Title: **ENRTF ID: 255-FH**

Increase Golden Shiner Production to Protect Aquatic Communities

Category: H. Proposals seeking $200,000 or less in funding

Sub-Category: F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Total Project Budget: $ 188,161

Proposed Project Time Period for the Funding Requested: June 30, 2023 (3 yrs)

Summary:

We propose four strategies to increase Golden Shiner (bait) production in-state because angler demand exceeds production. Suggested importation from out-state creates high risk of introducing aquatic invasive species and disease.

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Sponsoring Organization: U of MN - Duluth

Job Title: MN Sea Grant Director

Department: Minnesota Sea Grant

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Location:

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Visual shows four strategies to increase in-state Golden Shiner production so importation is not required to meet angler demand. Importation has high risk of introducing aquatic invasive species and disease.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%

PROJECT TITLE: Increase Golden Shiner Production to Protect Aquatic Communities

I. PROJECT STATEMENT:

In Minnesota, demand for Golden Shiners (*Notemigonus crysoleucas*) used as bait exceeds in-state production. Recent projections by bait dealers estimate a deficit of approximately 10,000 gallons of Golden Shiners annually. There is pressure from anglers, bait dealers, and legislators to import them from Arkansas and other states. However, importation can introduce aquatic invasive species such as invasive carps and fish diseases, which can negatively impact state waters and jeopardize valuable native fish species. This proposal will explore strategies to provide a sustainable in-state supply of Golden Shiners that would negate the need for importation. A dependable in-state supply of Golden Shiner will reduce the risk of introducing invasive species and fish pathogens through importation and the inadvertent activity of anglers who illegally bring Golden Shiner into Minnesota. Expansion of in-state Golden Shiner production could increase jobs and commerce in rural Minnesota communities.

Present laws prohibit the importation of baitfish for resale in Minnesota to prevent importation of invasive species and fish diseases. The recent report to the Minnesota Legislature titled "Minnow Importation Risk Report: assessing the risk of importing Golden Shiners into Minnesota from Arkansas" (Gunderson 2018) identified several key vulnerabilities and risks associated with importing Golden Shiner. The report recommends increasing production of Golden Shiner in Minnesota as a preferred alternative to importation (Gunderson 2018 pg. 57). This conclusion was endorsed by Minnesota Department of Natural Resources Commissioner Tom Landwehr in a February 2018 letter to legislators (included in Gunderson 2018).

Our proposal will examine four in-state strategies to increase production of Golden Shiners using exclusively indoor production or indoor production in combination with grow-out ponds. The goal of moving production or partial production of Golden Shiner to indoor facilities is to extend the growing period and enable Golden Shiners to reach marketable size in 9 months or less. Indoor production prevents Golden Shiners from having to over-winter in natural ponds where mortality is high and growth very slow. Successful indoor production could provide Golden Shiners for bait year-round and be used to develop disease-free fish for grow-out ponds.

Project outcomes: 1) Identify and demonstrate best methods for in-state production of Golden Shiner that will address angler demand and reduce importation and 2) Communicate findings and recommendations to commercial producers by publishing a project report, a production (how-to) manual, and holding three workshops to transfer results of this project.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1 Title: Indoor spawning and culture of Golden Shiner

Description: Golden Shiners are an excellent candidate for indoor production because they are a hardy fish, spawn multiple times a year, and their spawning times can be manipulated by adjusting water temperature and lighting conditions. We propose to begin spawning Golden Shiners indoors and raising the juvenile fish to various sizes which will then be transferred to other facilities for grow-out with the goal of reaching marketable size in 9 months or less. To accomplish indoor production, we will start with mature Golden Shiners from Minnesota ponds. We will bring them into the hatchery, hatch the eggs, transition the newly hatched fry from yolk-sac stage to external feeding using small zooplankton and once the fry are eating the zooplankton, transition them to feed on a commercially available diet of dry food. This process has been researched and successfully implemented by Marc Tye (Tye 2012), a partner on this proposal. **Activity Outcome**: Provide year-round indoor production of Golden Shiner that will be transferred to aquaponics facilities or ponds for grow-out (see Activity 2).

Activity 2 Title: Grow-out strategies for Golden Shiner
Description: Four grow-out strategies for rearing Golden Shiner to market size in Minnesota will be implemented**. Strategy 1.** Grow fish completely indoors using a recirculating aquaculture system (RAS) and feeding commercial food. Fish are hatched, grown, and harvested indoors. This system could provide disease free market-size Golden Shiners to the bait industry year-round. **Strategy 2.** This strategy couples indoor Golden Shiner production with aquaponics (i.e., growing fish and plants together). Golden Shiners are tolerant of the high nutrient loads and warmer temperatures needed to grow plants. Feed-trained fry derived from Minnesota Golden Shiners will be taken from the indoor hatchery and introduced into aquaponics systems. Use of Golden Shiners in aquaponics would also supply a year-round source not presently available. **Strategy 3.** Obtain fry (~ 1/4 inch) from the indoor hatchery and stock them directly into outdoor ponds before the fry consume their yolk-sac. This is a relatively simple approach, similar to what is used by the MNDNR for Walleye fingerling production. This method may increase the length of the grow-out season in ponds by approximately 1– 2 months, thereby allowing fish to potentially reach market size in only one summer. **Strategy 4.** Rear fish indoors on commercial feed to fryling size (~ ¾ - 2 inches), stock the grow-out ponds in early spring, and harvest before freeze up. This could increase the length of the growing season by up to three months allowing harvest of market-size fish in one summer, without over wintering in ponds. **Activity Outcomes:** Indoor, year-round, production of market-size Golden Shiner within nine months or less using RAS and aquaponics. Outdoor (pond) production of market-size Golden Shiner over one summer growing season.

Activity 3 Title: Monitor results and develop recommendations based on which strategies may best increase commercial production of Golden Shiner in Minnesota
Description: Monitor results by sampling Golden Shiners, water quality, and environmental conditions in tanks and/or ponds for each strategy. Develop recommendations based on growth rates, food availability, survival of Golden Shiner, and estimated costs for each strategy. **Activity Outcomes:** Summarize project results in a final report, publish a production (how-to) manual, and host three workshops for growers, bait dealers, and legislators.

ENRTF BUDGET: Activity 1 – $30,000; Activity 2 – $122,161; Activity $36,000 Total = $188,161

Outcome	Completion Date
1. Refine indoor hatchery production of Golden Shiner eggs, fry, fryling, and adults	*May 1, 2023*
2. Determine which grow-out strategies are most productive for Golden Shiner in Minnesota	*Dec. 31, 2022*
3. Summarize project information and provide recommendations in a project report , publish a production (how-to) manual, and host three workshops at which we will distribute project information to growers, bait dealers, and legislators	*June 30, 2023*

III. PROJECT PARTNERS AND COLLABORATORS:
Don Schreiner - Minnesota Sea Grant, Fisheries and Aquaculture Specialist; **Marc Tye,** Owner, Tye Fish Solutions, Golden Shiner Indoor Production Specialist; **Barry Thoele,** Owner, Lincoln Bait, bait producer, aquaponics producer, facility owner/manager (ponds and tanks); **Sean Sisler** – MNDNR,Aquaculture Coordinator.

IV. LONG-TERM IMPLEMENTATION AND FUNDING: We anticipate that Golden Shiner growers and bait dealers will implement and fine-tune the results of this project. We predict growers will be better positioned to fund their businesses based on the profit gained through the increased production and sale of Golden Shiners to anglers. We expect increased in-state production to significantly reduce demand for Golden Shiner importation.

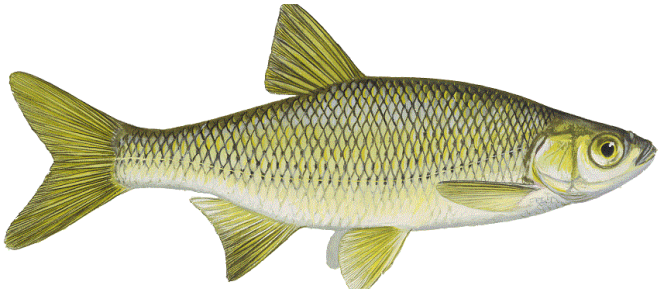
Attachment A: Project Budget Spreadsheet
Environment and Natural Resources Trust Fund
M.L. 2020 Budget Spreadsheet
Legal Citation:
Project Manager: Dr. John Downing
Project Title: Increase Golden Shiner Production to Protect Aquatic Communities
Organization: University of Minnesota Duluth (for MN Sea Grant)
Project Budget: $188,161
Project Length and Completion Date: 3 years - June 30, 2023
Today's Date: April 12, 2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 104,165	$ -	
John Downing- Project Direction and Administration $33,076 (74% Salary, 26% Fringe) 4% FTE for each of 3 yrs			
Don Schreiner and/or TBD Fisheries/Aquaculture Specialist $52,389 (74% Salary, 26% Fringe) 25% FTE for each of 3 yrs			
Undergraduate Student Worker - TBD - Field and lab assistance $18,700 (100% salary) 37.5% FTE for each of 2 yrs			
	$ -		
Professional/Technical/Service Contracts			
Tye Fish Solutions - Marc Tye, owner - Single Source - Produce Golden Shiners for grow-out and grow fish indoors for entire life-cycle. $10 K/yr for 3 yrs **Justification**-Tye Fish Solutions is the only business in Minnesota that we are aware of that produces Golden Shiner (a highly sought after bait fish) indoors and has the capacity to produce a variety of different life stages (eggs, fry, fryling, fingerling and adults). The results of Marc Tye's work has been published in the peer-reviewed literature (Tye 2012), and he has agreed to work with our group to supply Golden Shiner for this project. Based on internet searches and inquiries with other growers in the Minnesota bait and/or aquaculture industry we have found no other businesses that grow the different life stages of Golden Shiner indoors, that are required for this study. It is illegal to import Golden Shiner from other states. **Competitive Pricing**- We discussed our project requirements with Dr. Chris Hartleb, University of WI– Stevens Point, and Director of the Northern Wisconsin Demonstration Facility in Bayfield WI and asked him to estimate project costs if we were to do this work in his facility. Tye Fish Solutions: The estimated facility cost to grow Golden Shiner indoors with a recirculating aquaculture system (RAS) for 1 year would be approximately $5,000. Personnel or consultant cost ranges from $50-$100/hr. At 20% FTE @ $50/hr personnel cost would be $20,800/yr. Total estimate for work performed by Tye Fish Solutions is **$25,800/yr.**	$ 30,000		
Lincoln Bait - Barry Thoele, owner - Single Source - Provides grow out faciities, both indoor tanks and outdoor ponds. $10K/yr for 2.5 yrs. **Justification** - Lincoln Bait has the required facilities and knowledge to carry out the experimental work necessary for this project. Once fry and frylings are hatched and grown indoors they will be transferred from Tye Fish Solutions to Lincoln Bait indoor tanks and grow-out ponds. Lincoln Bait has the variety of pond sizes required for this work. Barry Thoele has worked with aquatic researchers to conduct various experiments on rearing bait (Gunderson et al. 2008) and has demonstrated his ability to follow data collection protocols in an appropriate manner so rearing conditions are documented and useful results are reported. **Competitive Pricing** - See above for source of competitive pricing - Lincoln Bait – The estimated facility cost to grow Golden Shiner in experimental ponds is approximately $10,000/yr. Personnel or consultant cost ranges from $50-$100/hr. At 15% FTE for 7 months @ $50/hr personnel cost would be $9,048/yr. Total estimate for work performed by Lincoln bait is **$19,048/yr.**	$ 25,000		
2 Aquaponics Growers TBD - $2,000K/yr for 2 years - Contracts will be detrmined through a competive selection process - Aquaponics growers will be recruited to participate in this project by email or letter notification. We will seek interested growers who have the required facilities, are willing and able to follow appropriate scientific protocols, and will provide their services within our budget.	$ 8,000	$ -	
Supplies - Measuring boards, scale, sample containers, sample preservatives, etc.	$ 3,500	$ -	
Printing - Handouts for outreach meetings and manual for growers	$ 3,000	$ -	
Travel expenses in Minnesota			
Mileage for initial planning meetings and facility preparation (likely in Twin Cities area) 2 trips to 3 groups @ 200 miles/trip = 1200 mi@0.58/mi = 696	$ 696		
Mileage for sampling fish from ponds (Lincoln Bait in Staples area), hatchery (Tye Fish solutions near Mankato) and aquaponics (in Twin Cities area and TBD) 8 trips/yr for 3 yrs @ 300 miles/trip=7200 mi@0.58/mi = 4176	$ 4,176		
Mileage for Outreach Meetings 3 trips (likely Twin Cities and Alexandria areas) each to 2 groups @ 300 mi/trip=1800 mi @0.58/mi=1,044	$ 1,044		
Est. lodging ~ 30 overnights@$100	$ 3,000		
Est. meals/per-diem for each trip above (some overnight) ~124 /days @$45/day=$5,580	$ 5,580	$ -	
COLUMN TOTAL	$ 188,161	$ -	$ -

SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:			$ -	
State: MN DNR Aquaculture specialist Sean Sisler 40 hrs/year for 3 years, $50/hr	secured	$ 6,000	$ -	
In-Kind: University of MN unrecovered Indirect Cost at 54% MTDC	secured	$ 101,607	$ -	$ 101,607

Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget	Spent	Balance
		$ -	$ -	$ -

Increase Golden Shiner Production to Protect Aquatic Communities



Demand for Golden Shiners used as bait exceeds in-state production and there is pressure from anglers to import them.

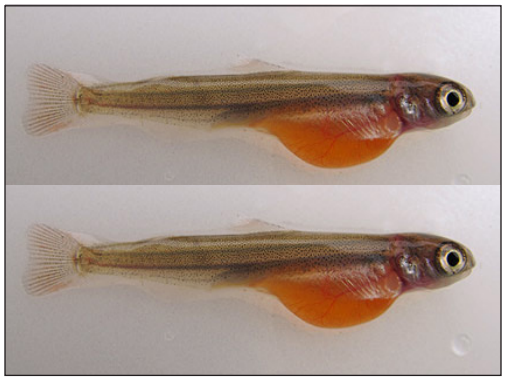
However, importation can introduce aquatic invasive species and carry disease, which can negatively impact our state waters and jeopardize valuable native fish species.

4 Strategies to Increase In-State Golden Shiner Production

Raise indoors for their entire lifecycle

Couple production with aquaponics

Grow indoors to fry size (1") , then transfer to ponds



Grow indoors to fryling size (2"), then transfer to ponds

Outcomes and Products

Increase in-state production of Golden Shiner to meet angler demand and eliminate need to import	Document results, determine best strategies, and produce a report. Develop systems for commercial production	Host 3 workshops for growers, bait dealers and legislators to transfer project information

Vitae for Dr. John A Downing

Director, Minnesota Sea Grant College Program; Professor, University of Minnesota Duluth

Education

Hamline University, St. Paul, MN	Biology	B.S. with Honors 1973
North Dakota State Univ., Fargo, ND	Zoology	M.S. 1975
McGill University, Montréal, Can.	Biology	Ph.D. with Honors 1979
McGill Univ, Montréal, Can., Biology	Postdoc	1980-1981
Univ de Montréal, Montréal, Can., Biol	Postdoc	1981-1982

Professional Preparation

2015+, U of MN-Duluth, Director, Sea Grant College Program, Professor, Large Lakes Observatory and Dept. of Biology
2010-2015, Iowa State University, Chair, Environmental Science Graduate Program
2007+, Adjunct Professor, Science, Itasca Community College
1995 to 2016, Iowa State University, Professor, Ecology, Evolution, and Organismal Biology; Agricultural & Biosystems Engineering; Natural Res Ecol. & Management; Animal Ecology
1994-1996, University of Minnesota, Research Associate, Ecology, Evolution & Behavior
1981-1995, Université de Montréal, Director, Biological Science: Laurentian Biological Station, (1990-1995), Professor (1993-1995), Assoc. Prof. (1988-1993), Assist Prof. (1987-1988), Research Fellow (1982-1987), Postdoctoral Fellow (1981-1982)
1979-1995, McGill University, Biology, Adjunct Prof. (1981+), Postdoc Fellow (1980-1981)

Recent Major Publications

Keeler, B.L., S.A. Wood, S. Polasky, C. Kling, C.T. Filstrup, and **J.A. Downing**. 2015. Recreational demand for clean water: evidence from geotagged photographs by visitors to lakes. Frontiers in Ecology and the Environment 10.1890/140124

Downing, J.A. 2014. Productivity of freshwater ecosystems and climate change. Chapter 127 In: Freedman, W. (ed.) *Handbook of Global Environmental Change*. Springer.

Egan, K.J., J.A. Herriges, C.L. Kling, and **J.A. Downing**. 2011. The value of lake water quality improvements: qualitative information from quantitative studies. In: Wheeler, W. and C. Griffiths, eds., *Using Qualitative Methods to Understand Economic Valuation for Water Quality*. Edgar Elgar.

Downing, J.A. 2009. Global limnology: up-scaling aquatic services and processes to the planet Earth. *Verhand der Int Vereinigung für Theoretische und Angewandte Limnologie* 30: 1149-1166.

Downing, J.A., and 10 others. 2006. The global abundance and size distribution of lakes, ponds, and impoundments. *Limnology and Oceanography* 51(5): 2388-2397

Appointments

President of the Association for the Sciences of Limnology and Oceanography - 2012-2014
Chair of the Council of Scientific Society Presidents - 2015

PI and Organizational Qualifications

Dr. Downing is the Director of the Minnesota Sea Grant (MNSG) Program at the University of Minnesota Duluth. In this capacity he has an excellent staff at his disposal to undertake this project, both scientifically and administratively. He has an extensive background in limnology and has worked on lakes and ponds throughout the world. While at Iowa State University he worked closely with the Iowa Department of Natural Resources and Iowa Legislature to address critical water quality issues in lakes and ponds throughout Iowa. His Master's Degree focused on fisheries and water quality in small lakes and ponds in North Dakota. In addition to Dr. Downing's fisheries and water quality background, MNSG Fisheries/Aquaculture Specialist Don Schreiner has over 34 years of experience working for the Minnesota Department of Natural Resources and Minnesota anglers on a variety of fisheries management issues including Walleye production, invasive species, bait production and aquaculture. MNSG program staff routinely administer grants, track funding, and develop outside contracts with relevant experts for various projects. Outreach, or the transfer of aquatic science information between researchers, targeted user groups, and the public is a key mission of the MNSG program which will be instrumental in applying the results of the proposed project. Dr. Downing, as PI and Director of MNSG, will coordinate the activities of a well-qualified science and administrative staff to complete this project.