Final Abstract

Final Report Approved on August 21, 2026

M.L. 2020 Project Abstract

For the Period Ending June 30, 2027

Project Title: Increase Golden Shiner Production To Protect Aquatic Communities

Project Manager: Amy Schrank

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Funding Source:

Fiscal Year:

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 08k

Appropriation Amount: $188,000

Amount Spent: $188,000

Amount Remaining: -

Sound bite of Project Outcomes and Results

Minnesota Sea Grant and partners evaluated four aquaculture strategies to increase in-state production of Golden Shiner baitfish, successfully growing market-sized baitfish in less than nine months. Increasing local supply eliminates the need to import baitfish from outside Minnesota, reducing the risk of introducing invasive species and diseases into Minnesota waters.

Summary of Project and Outcomes

Minnesota's recreational fishing industry generates about $6 billion annually, with 70% of anglers using live minnows for bait. The preferred Golden Shiner (GOS) baitfish faces a 10,000 gallon (80,000 pound) annual in-state deficit. Importing baitfish is illegal due to risks of introducing aquatic invasive species and pathogens, therefore expanding in-state production is critical to address the supply-demand imbalance.

To address the GOS deficit, Minnesota Sea Grant and partners conducted a three-year demonstration project evaluating four aquaculture strategies to increase GOS production. All four strategies proved viable when properly managed, with GOS reaching market size (2.5-3.5 inches) in less than nine months.

Indoor Systems: In a recirculating aquaculture system, 75% of fish grew to market size in six to seven months. In an aquaponic system (integrating fish and plant production) the majority of GOS reached market size in nine months and almost 100% of GOS reached market size within 12 months.

Outdoor Systems: In a drainable pond stocked with hatchery-reared sac fry (fish retaining their yolk sac), about 90% of fish reached market size in under six months. Feed-trained fry (hatchery reared and supplementally fed for about 1 month) were stocked into a constructed pond and reached market-size in under six months, though pond harvesting proved difficult.

Project results are detailed in "A Guide for Increasing Production of Golden Shiner for Use as Bait in Minnesota" (Schreiner et al. 2026), providing operational protocols, production guidelines, and business planning information. This project delivers a blueprint for commercial-scale, in-state baitfish production. Increasing in-state GOS production helps alleviate the baitfish deficit, aligns with current environmental laws, and protects Minnesota's aquatic ecosystems against invasive species and pathogens while sustaining the critical recreational angling and baitfish industries.

Project Results Use and Dissemination

Minnesota Sea Grant (MNSG) compiled project results and recommendations into "A Guide for Increasing Production of Golden Shiner for Use as Bait in Minnesota" for use by current and potential baitfish producers and other interested communities. The guide is available on the MNSG website and University of Minnesota Digital Conservancy. MNSG created a dedicated project webpage including a video and project handout. Dissemination also included hosting three targeted workshops for baitfish producers, aquaculture farmers, legislative staff, and natural resource managers. Finally, outcomes were presented at state sponsored bait committee meetings, the Minnesota/Wisconsin Aquaculture Association Conference and Aquaculture America.

Environment and Natural Resources Trust Fund

M.L. 2020 Approved Final Report

General Information

Date: September 15, 2026

ID Number: 2020-033

Staff Lead: Lisa Bigaouette

Project Title: Increase Golden Shiner Production To Protect Aquatic Communities

Project Budget: $188,000

Project Manager Information

Name: Amy Schrank

Organization: U of MN - Duluth - Sea Grant

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Project Reporting

Final Report Approved: August 21, 2026

Reporting Status: Project Completed

Date of Last Action: August 21, 2026

Project Completion: July 31, 2026

Legal Information

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 08k

Appropriation Language: $188,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota for the Minnesota Sea Grant in Duluth to identify and demonstrate best methods for in-state production of golden shiners to address angler demand while reducing the risk of introducing and spreading invasive species and to communicate findings through reports, manuals, and workshops. Production of shiners in this project must not take place in wetlands.

Appropriation End Date: June 30, 2024

Narrative

Project Summary: We propose four strategies to increase in-state Golden Shiner (bait) production because angler demand exceeds production. Out-of-state importation creates a high risk of introducing aquatic invasive species and disease.

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

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.

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).

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.

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.

Our proposal will examine four in-state strategies to increase production of Golden Shiners using exclusively indoor production or indoor production in combination with dug 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 dug grow-out ponds.

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?

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.

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?

In the Future

Activities and Milestones

Activity 1: Indoor spawning and culture of Golden Shiner

Activity Budget: $48,406

Activity 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 dug ponds for grow-out (see Activity 2).

Activity Milestones:

	Description	Approximate Completion Date
1.	Collect Golden Shiners from Minnesota ponds	October 31, 2021
2.	Hatch eggs	May 31, 2022
3.	Transition fry to commercial feed	May 31, 2022

Activity 2: Four grow-out strategies for Golden Shiner

Activity Budget: $132,386

Activity Description:
Strategy 1. Grow fish indoors using a recirculating aquaculture system (RAS) and commercial feed. This system could provide disease free, market-size Golden Shiners to the bait industry year-round. Strategy 2. Feed-trained fry derived from Minnesota Golden Shiners will be taken from the indoor hatchery and introduced into aquaponics systems (i.e., growing fish and plants together). This would also supply a year-round source not presently available. Strategy 3. Obtain fry (~ 1/4 inch) from the indoor hatchery and stock them into outdoor dug ponds. This is similar to what MNDNR uses for Walleye fingerling production. This method may increase grow-out season length in ponds by 1– 2 months, allowing fish to reach market size in one summer. Strategy 4. Rear fish indoors to fryling size (~ ¾ - 2 inches), stock the dug 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 (dug pond) production of market-size Golden Shiner over one summer growing season.

Activity Milestones:

	Description	Approximate Completion Date
1.	Stock hatchery fry and fryling into different sets of outdoor dug ponds (2 years)	June 30, 2023
2.	Grow Golden shiners over the summer to market size and harvest in late fall (2 years)	October 31, 2023
3.	Golden Shiner production in RAS and aquaponics systems (Tye Fish solutions).	June 30, 2024

Activity 3: Monitor results and develop recommendations based on which strategies may best increase commercial production of Golden Shiner in Minnesota

Activity Budget: $7,208

Activity Description:
Monitor results by sampling Golden Shiners, water quality, disease, and environmental conditions in tanks and/or dug 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.

Activity Milestones:

Description		Approximate Completion Date
1.	Summarize project results in a final report.	June 30, 2024
2.	Publish a production (how-to) manual.	June 30, 2024
3.	Host three workshops for growers, bait dealers, and legislators	June 30, 2024

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Donald Schreiner	Minnesota Sea Grant	Schreiner will help oversee the project, communicate with project partners, analyze results, and develop outreach workshops.	Yes
Marc Tye	Tye Fish Solutions	Tye is a Golden Shiner indoor production specialist, he will supply and grow Golden Shiner for this project.	Yes
Barry Thoele	Lincoln Bait	Thoele will grow-out Golden Shiners in his dug ponds and tank facilities.	Yes
Aquaponics Grower (TBD)	TBD	This person/business will grow-out Golden Shiner in his/her aquaponics facility.	Yes
Sean Sisler	Minnesota DNR	Sisler will assist with required permits, regulation compliance and act as MNDNR liaison.	No

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.
We will summarize project results in a final report that will be shared among managers, bait growers, legislators and the public. We will also develop a production (how-to) manual to be made available to bait producers to allow them to repeat our results at their own farms. Both our project report material and the production manual will be made available through the Minnesota Sea Grant Golden Shiner project website. In addition to these outreach methods, we will host three workshops for growers, bait dealers, and legislators describing the results of our study and the implications for the MN bait industry in the future. In all of our materials, we will acknowledge the Environment and Natural Resources Trust Fund through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENTRF Acknowledgment Guidelines.

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?
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 and increase the annual supply to appreciative anglers.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount	$ Amount Spent	$ Amount Remaining
Personnel										
Project Co-manager		Help oversee the project, communicate with project partners, analyze results, and develop outreach workshops.			27%	0.45		$35,847	-	-
Project Manager		Oversee project components, coordinate with partners, oversee student workers, contribute to analysis and written reports and outreach products.			27%	0.45		$47,322	-	-
Field/lab staff		Assist with field and lab work.			0%	0.76		$18,700	-	-
							Sub Total	**$101,869**	**$101,869**	**-**
Contracts and Services										
Tye Fish Solutions	Professional or Technical Service Contract	Produce Golden shiners for grow-out and grow fish indoors for entire life-cycle. Tye Fish Solutions is the only business in Minnesota that produces Golden Shiner indoors with the capacity to produce different life stages. We compared pricing with Dr. Chris Hartleb at University of Wisconsin facility and pricing was competitive.		X		0.6		$30,000	$30,000	-
Lincoln Bait	Professional or Technical Service Contract	Provide grow-out facilities, both indoor tanks and outdoor ponds. Lincoln Bait has the required variety of pond sizes, has previous experience working with researchers, and a demonstrated ability to follow data collection and reporting protocols. Pricing was compared to University of Wisconsin lab and found to be competitive.		X		0.38		$25,000	$25,000	-

Aquaponics grower	Professional or Technical Service Contract	Grow out Golden Shiners in their aquaponics facilities.				0		$4,000	$4,000	-
							Sub Total	**$59,000**	**$59,000**	**-**
Equipment, Tools, and Supplies										
	Tools and Supplies	Fish feed, feeders and fry counter as well as other miscellaneous field supplies: measuring board, scale, sample containers, sample preservatives, water temperature loggers, dissolved oxygen measurement, etc.	These items will be used for field or lab work to feed/measure/weigh/assess health of fish during growing periods. Fry counter will ensure we have accurate survival estimates.					$18,168	$18,168	-
							Sub Total	**$18,168**	**$18,168**	**-**
Capital Equipment										
							Sub Total	**-**	**-**	**-**
Acquisitions and Stewardship										
							Sub Total	**-**	**-**	**-**
Travel In Minnesota										
	Miles/ Meals/ Lodging	Mileage to sample fish from ponds (Lincoln Bait in Staples area), hatchery (Tye Fish Solutions near Mankato) and aquaponics (Twin Cities area and TBD): 8 trips/yr for three years @ 300 miles/trip = 7200 miles @ 0.575/mile = $4140	Travel to sample fish and assess fish health at all field and lab sites.					$3,140	$3,140	-
	Miles/ Meals/ Lodging	Mileage to outreach meetings: travel to outreach groups (likely Twin Cities and Alexandria areas) for 7 trips @ 300 miles/trip = 2100 miles @ $0.575 per mile = $1208	Travel to provide outreach to stakeholders					$1,208	$1,208	-

	Miles/ Meals/ Lodging	Lodging for travel for field/lab work and outreach: 30 overnights @ $100 per night = $3000	Lodging for travel for field, lab, and outreach work					$2,000	$2,000	-
	Miles/ Meals/ Lodging	Meals for 124 days @ $45 per day	Meals for trips to complete field, lab, and outreach work.					$1,580	$1,580	-
	Miles/ Meals/ Lodging	Mileage for initial planning meetings and facility preparation (likely in Twin Cities are) 2 trips, 3 groups @ 300 miles/trip = 1800 miles @0.575/mi = 1035	Mileage for initial planning meetings and facility preparation					$1,035	$1,035	-
							Sub Total	**$8,963**	**$8,963**	**-**
Travel Outside Minnesota										
							Sub Total	**-**	**-**	**-**
Printing and Publication										
							Sub Total	**-**	**-**	**-**
Other Expenses										
							Sub Total	**-**	**-**	**-**
							Grand Total	**$188,000**	**$188,000**	**-**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Contracts and Services - Tye Fish Solutions	Professional or Technical Service Contract	Produce Golden shiners for grow-out and grow fish indoors for entire life-cycle. Tye Fish Solutions is the only business in Minnesota that produces Golden Shiner indoors with the capacity to produce different life stages. We compared pricing with Dr. Chris Hartleb at University of Wisconsin facility and pricing was competitive.	Tye Fish Solutions is the only business in Minnesota that produces Golden Shiner indoors with the capacity to produce different life stages. We compared pricing with Dr. Chris Hartleb at University of Wisconsin facility and pricing was competitive.
Contracts and Services - Lincoln Bait	Professional or Technical Service Contract	Provide grow-out facilities, both indoor tanks and outdoor ponds. Lincoln Bait has the required variety of pond sizes, has previous experience working with researchers, and a demonstrated ability to follow data collection and reporting protocols. Pricing was compared to University of Wisconsin lab and found to be competitive.	Lincoln Bait has the required variety of pond sizes, has previous experience working with researchers, and a demonstrated ability to follow data collection and reporting protocols. Pricing was compared to University of Wisconsin lab and found to be competitive.

Non ENRTF Funds

Category	Specific Source	Use	Status	$ Amount	$ Amount Spent	$ Amount Remaining
State						
In-Kind	Minnesota DNR	Minnesota DNR will support Aquaculture Specialist Sean Sisler at 40 hrs/yr for 3 years @ $50 per hour.	Secured	$6,000	$6,000	-
In-Kind	University of Minnesota	Unrecovered indirect cost @ 55% MTDC	Secured	$106,700	$106,700	-
			State Sub Total	**$112,700**	**$112,700**	**-**
Non-State						
			Non State Sub Total	**-**	**-**	**-**
			Funds Total	**$112,700**	**$112,700**	**-**

Attachments

Required Attachments

Visual Component

File: 24de5ceb-7c0.pdf

Alternate Text for Visual Component

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....

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
Minnesota DNR letter of support (2019)	94363749-720.pdf
University of Minnesota Letter of Support	07d83dce-982.pdf
Minnesota DNR letter (updated - 2021)	8ec6bc1d-520.pdf
Background Check Certification	a599251d-a04.pdf
Golden Shiner Project handout	94a5a14c-450.pdf
A Guide for Increasing Production of Golden Shiner for Use as Bait in Minnesota	fb186647-24a.pdf

Media Links

Title	Link
Star Tribune article addressing bait shortage and mentioning the Golden Shiner project	https://www.startribune.com/mn-dnr-live-bait-minnow-shortage-fatheads-suckers/600293076/
Morning Ag Clips article describing outreach related to Golden Shiner project	1. https://www.morningagclips.com/minnesota-sea-grant-co-hosts-great-lakes-fish-farm-session/
Twin Cities.com article describing the Golden Shiner project for addressing bait fish shortages	https://www.twincities.com/2023/05/12/umn-golden-shiner-project-minnesota-baitfish-shortage/
AgWeek article describing the Golden Shiner project and potential economic benefits	https://www.agweek.com/business/minnesota-baitfish-farms-could-grow-with-help-of-golden-shiner-projec
Golden Shiner project video	https://www.youtube.com/watch?v=YxsKKo-R8bc&t=15s
Project website	https://seagrant.umn.edu/programs/fisheries-and-aquaculture-program/producing-golden-shiner-bait
Aquaculture Decision Maker Day video	https://www.youtube.com/watch?v=K9TEJ5hlGBM&t=212s

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

The changes from proposal to workplan stage include: 1) a change a principal investigator from John Downing to Amy Schrank (she was hired as a Fisheries and Aquaculture Extension Educator in March 2020), and 2) the addition of Golden Shiner disease testing as needed throughout the project through the University of Minnesota Veterinary Diagnostic Lab.

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

N/A

Do you understand that travel expenses are only approved if they follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Not acknowledged

Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?

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?

No

Work Plan Amendments

Amendment ID	Request Type	Changes made on the following pages	Justification For Amendment Request (word limit 75)	Date Submitted	Approved	Date of LCCMR Action
1	Amendment Request	• Budget - Personnel	We changed the title of "Undergraduate student worker" to "Field/lab staff" so that we are able to hire a broader range of staff to complete this work. This amendment will not change the scope or timing of our project.	August 15, 2022	Yes	August 16, 2022
2	Completion Date	Previous Completion Date: 06/30/2024 New Completion Date: 11/30/2025	The project officially ends on June 30, 2024, near the middle of the Golden Shiner growing season. We request project extension through the 2024-early 2025 growing season. This will provide another year of important data/information. During winter/spring of 2025, data will be analyzed, summarized and a production manual and presentations will be produced. The proposed workshops will be held in summer/fall of 2025 to transfer output to all interested parties.	November 30, 2023	Yes	December 15, 2023
3	Amendment Request	• Other • Budget - Professional / Technical Contracts • Budget - Printing and Publication • Budget - Capital, Equipment, Tools, and Supplies • Budget - Travel and Conferences	We are requesting redistribution of funds into supplies so we can increase the amount and quality of feed to increase growth rates of Golden Shiner, purchase three additional feeders to better distribute food (<$500 each), purchase additional fish so we can increase and test the effect of density on growth, and purchase a fry counter ($4,900 w/shipping) to get a more accurate count of fish stocked and more precise survival.	February 2, 2024	Yes	February 5, 2024
4	Completion Date	Previous Completion Date: 11/30/2025 New Completion Date: 07/31/2026	Because our last fish were harvested during September of 2025, this was not enough time to complete the data analysis and final report/guide by the end date. The analysis of all years of data were pending	March 20, 2026	Yes	March 20, 2026

			until the final fish were harvested as did the guide/report writeup, and guide/report review. This took longer than we estimated. A full draft of the report/guide is currently out to review to all partners.			

Status Update Reporting

Final Status Update September 14, 2026

Date Submitted: June 22, 2026

Date Approved: June 25, 2026

Overall Update
Minnesota Sea Grant (MNSG) and our project partners successfully met all project goals and completed all outcomes.

First, field projects and subsequent data analysis confirmed that the four distinct fish production strategies we implemented—recirculating aquaculture systems, aquaponics, pond-stocked sac fry, and pond-stocked feed-trained fry—all successfully produced market-sized Golden Shiners (2.5 to 3.5 inches) within 6 to 9 months or less.

Second, during the last reporting period, the team synthesized project findings into a combined final report and production manual titled A Guide for Increasing Production of Golden Shiner for Use as Bait in Minnesota. Combining these resources eliminated redundancy while providing technical, step-by-step guidance for potential producers interested in applying these strategies. In addition, the publication provides accessible introductory and summary sections for general audiences. The final document is available as a PDF on the MNSG website, via the University of Minnesota Digital Conservancy, or by request to MNSG.

Finally, project results were shared broadly through three workshops targeting aquaculture producers, natural resources staff, legislative personnel, and other communities to support a sustainable baitfish industry in Minnesota.

Activity 1
This activity was previously marked complete.
(This activity marked as complete as of this status update)

Activity 2
This activity was previously marked complete.
(This activity marked as complete as of this status update)

Activity 3
The final report/production manual on the Golden Shiner demonstration project titled A Guide for Increasing Production of Golden Shiner for Use as Bait in Minnesota was completed and includes results and recommendations aimed at current and potential baitfish producers as well as background and introductory information for others interested in the Minnesota baitfish industry. The report and manual were combined into one document to reduce redundancy.
(This activity marked as complete as of this status update)

Dissemination
A description of this Golden Shiner demonstration project is available on the MNSG website and is updated quarterly. A copy of A Guide for Increasing Production of Golden Shiner for Use as Bait in Minnesota is available as a PDF on the MNSG website, via the University of Minnesota Digital Conservancy, or by request to MNSG.

Status Update Reporting

Status Update April 1, 2026

Date Submitted: March 26, 2026

Date Approved: March 27, 2026

Overall Update
Minnesota Sea Grant (MNSG) and project partners completed the field portion the project. Over the three-year project all four strategies (recirculating aquaculture systems, aquaponics, pond stocked sac fry and pond stocked feed trained fry) produced some market size Golden Shiner (GOS, 2.5-3.5 in.) in approximately 6-9 months or less. Each strategy proved feasible.

Data analysis is complete. A draft combination final report/production manual with results and recommendations from the project is in review by project partners and MNSG staff. The report and manual were combined into one document to reduce redundancy. Potential producers can review the entire report which includes technical information about how to accomplish each of the four strategies. A more general audience can understand the purpose and results of the project by reviewing separate sections including the introduction, general strategies, contrasting strategies and the summary and recommendations sections.

We completed all three workshops. We hosted a fish health workshop featuring Golden Shiner in October 2022, a bait workshop featuring project team members in February 2023, and hosted Aquaculture Decision Maker Day where our project team was present and conveyed project information to legislative staff, natural resources managers and farmers in June 2025.

Activity 1
This activity is complete
(This activity marked as complete as of this status update)

Activity 2
This activity is complete
(This activity marked as complete as of this status update)

Activity 3
We combined the final report and production manual into “a guide” to reduce redundancy. The draft guide is under final review by the project team. In the guide, producers will find technical details/ results to understand how to undertake each strategy. A more general audience will be directed toward specific sections to understand project purpose, goals, and outcomes.

We hosted a fish health workshop on St. Paul campus, October 26, 2022 as part of a Great Lakes region-wide hybrid event, Great Lakes Aquaculture Days 2022 (https://greatlakesaquaculture.org/great-lakes-aquaculture-days-presentation-archive/). We convened project partners, farmers, fish health professionals, and extension staff to learn how to dissect GOS to identify signs of disease and prepare samples for fish health diagnosis.

We hosted a bait workshop at the joint Minnesota/Wisconsin Association conference in Eau Claire, WI, Feb.16, 2023. The workshop featured talks by GOS project participants and facilitated discussion of issues facing bait growers/dealers.

We hosted Aquaculture Decision Maker Day workshop on the St. Paul campus, June 24, 2025 to convene aquaculture producers, MN legislative staff, and natural resources managers. Project team members conveyed results through

conservations with attendees and hosting a table at the industry showcase.
(This activity marked as complete as of this status update)

Dissemination
As described in activity 3, our final report and manual have been combined into a guide that is currently in final review with the project team and partners. We have completed our three workshops as described above in Activity 3 and posted relevant links in Tab 7.

In addition, our project description on the MNSG website is updated quarterly. Don Schreiner presented on the project and led a discussion at the Minnesota DNR Bait Committee meeting on March 24, 2025, in Brainerd, MN. Amy Schrank presented a talk at Aquaculture America in Las Vegas, NV, entitled “Supporting a Sustainable Aquaculture Industry in Minnesota” in February of 2026 that included results of the GOS project.

Additional Status Update Reporting

Additional Status Update January 14, 2026

Date Submitted: December 20, 2025

Date Approved: March 20, 2026

Overall Update
Minnesota Sea Grant (MNSG) and project partners that include aquaculture producers (Tye Fish Solutions and Lincoln Bait), Central Lakes College (CLC) in Brainerd, MN and the Minnesota Department of Natural Resources (MNDNR) completed the demonstration project to increase Golden Shiner (GOS) production in MN. Over the three-year project all four strategies (recirculating aquaculture systems or RAS, aquaponics, pond stocked sac fry and pond stocked feed trained fry) produced some market size GOS (2.5-3.5 in) in approximately 9 months or less. Survival and growth varied among years (cohorts) and strategies. Growth trends, feed information, water quality and system type were summarized for each strategy and cohort.

Data analysis is complete and discussions continue with partners. A final report/guide with results and recommendations from the project will be distributed to potential producers upon completion. Three of the four project partners have continued rearing GOS after project completion and there has been keen interest in the project results from several potential producers. This project was not conducted on a commercial scale to maximize production or profit; it was designed as a demonstration project. We are optimistic that project results will be applied to increase GOS production in MN.

Activity 1
This activity was previously marked complete.
(This activity marked as complete as of this status update)

Activity 2
This activity was previously marked complete.
(This activity marked as complete as of this status update)

Activity 3
All data analysis is complete among all cohorts and strategies. This includes analyses that compare growth, survival and production, water quality, and the amount and cost of feed. Scale of operation among strategies varied significantly, but in general 1) sac fry stocked in a drainable one acre pond had the highest production at the least cost, 2) aquaponics produced the largest fish, but the length of the growing season was longest, 3) the RAS was the most consistent production system among and within cohorts, and 4) the pond stocked feed trained fry produced some of the largest fish in the least amount of time, but the size of the pond used was small and it was difficult to harvest so total annual production numbers are lacking.

Project results indicated a need for a controlled experiment to determine the most efficient feed type for feed training in RAS and aquaponics. In addition, for a commercial system to be successful/profitable in RAS and aquaponics the optimal density of GOS in rearing tanks must be determined. Based on the recommendations from this study, we applied for and were successful in acquiring funding to explore both initial feed training and tank density.
(This activity marked as complete as of this status update)

Dissemination
Project results and recommendations are summarized and are in final preparation for publication of a report/guide that will be distributed to potential producers and posted on the MNSG website and submitted to the University of

Minnesota Digital Conservancy. We will develop and distribute a news release to announce completion of the report/guide upon its release. We are planning a workshop to engage potential producers, bait dealers, resource managers and legislators. We also anticipate presenting our findings at a variety of local, regional and national aquaculture and fishery meetings. When these activities are completed, we will post the required information to the attachments page in the LCCMR portal.

We have developed and posted a project description on the MNSG website that is updated quarterly. It includes a YouTube video and a "rack card" with information about the project that can be viewed and downloaded. A summary of the project results was presented to three different sub-groups that attended the MNSG sponsored Aquaculture Decision Maker Day event held in St. Paul on June 24, 2025. Aquaculture producers, state and federal legislators, staff from both the MNDNR and MNDOA along with participants from academia attended the event.

Status Update Reporting

Status Update October 1, 2025

Date Submitted: September 21, 2025

Date Approved: November 25, 2025

Overall Update
Minnesota Sea Grant (MNSG) continues to work with partners that include aquaculture producers (Tye Fish Solutions and Lincoln Bait), Central Lakes College (CLC) in Brainerd, MN and the Minnesota Department of Natural Resources (MNDNR). The four strategies to increase Golden Shiner production completed its third and final growing season on September 5, 2025 when the last group of fish (cohort 3) were harvested from the aquaponics facility at CLC. LCCMR funding ended on June 30, 2024 so MNSG is self-funding the remainder of the project. Producers are committed to the project and also self-funded portions of the final growing season. Monthly meetings with partners continue.

Much of the Golden Shiner growth data from the first and second cohorts (2022 and 2023) was summarized during the last reporting period and analysis continues. Growth data for the third cohort (2024-25) was collected and is now being entered and analyzed. Feed data for all cohorts continues to be entered and analyzed. Preliminary work on temperature and water quality data was started. The data collected and analyzed to date continues to be discussed with partners. A description of the project is posted on the MNSG website, with quarterly updates.

Activity 1
No spawning or fry produced for this project occurred at the Tye Fish Solutions hatchery during this reporting period since the three growing seasons for all strategies were either completed or already in progress. However, some partners continued rearing Golden Shiner so Tye Fish Solutions did supply them with sac and feed trained fry. In addition to partners from this project, Tye Fish Solutions has received several requests for Golden Shiner sac and feed trained fry from other producers interested in this project.
(This activity marked as complete as of this status update)

Activity 2
Three of the four grow-out strategies were completed during the last reporting period (April 1, 2025). The last group of fish, cohort 3 that were stocked in late September 2024, remained in the aquaponics facility at CLC and were harvested on September 5, 2025.

Data from cohort 3 grown and harvested from the aquaponics system was collected and is being entered and error checked. Survival and growth of aquaponics cohort 3 will be determined over the next few months along with analysis of feed data.

Data on fish growth and feed continued to be entered, error checked and analyzed from all cohorts that had been harvested. Preliminary work on temperature and water quality data for all cohorts was started.
(This activity marked as complete as of this status update)

Activity 3
All data collection and monitoring were completed among all cohorts in all strategies before this reporting period, except for the cohort 3 fish reared in the CLC aquaponics facility. Cohort 3 fish from aquaponics were monitored daily and sampled about every 2-3 weeks during this reporting period and were harvested with final sampling on September 5, 2025.

Most of this reporting period was spent entering, error checking and analyzing data from all strategies and cohorts

collected since 2022. Analyses that compare growth, survival and production have and continue to be made both among strategies and cohorts. Amount and cost of feed used for each cohort in each strategy is also being analyzed. When available and appropriate, temperature and water quality data is being analyzed and reported.

Cohort 3 data from the aquaponics system will be added to the entire data set so each strategy will have three cohorts for comparison within and among cohorts (years) and strategies. This information will be summarized in a guide for potential producers and in a final report to LCCMR. Work has begun on both documents and since the field portion of the project has been completed good progress is being made.

Dissemination

We have developed and posted a project description on the MNSG website (https://seagrant.umn.edu/programs/fisheries-and-aquaculture-program/producing-golden-shiner-bait) that is updated quarterly. It includes a YouTube video and a "rack card" with project information. Project rack cards were distributed at a large statewide FFA event in June, at the Great Lakes Aquarium over the summer, and at the State Fair in August during MNDNR Water Day. We continue to provide information to the media describing the project and its potential to address bait shortages in Minnesota. The project continues to draw high interest from the bait industry and the MNDNR.

A summary of the project results was presented to three different sub-groups that attended the MNSG sponsored Aquaculture Decision Maker Day (https://www.youtube.com/watch?v=K9TEJ5hlGBM) event held in St. Paul on June 24, 2025. Aquaculture producers, state and federal legislators, staff from both the MNDNR and MNDOA along with a few folks from academia attended the event. We have again been invited to provide a project update at the MNDNR Bait Committee Meeting on October 24, 2025. A final project report and Golden Shiner production guide, and we plan to hold workshops in winter 2025.

Status Update Reporting

Status Update April 1, 2025

Date Submitted: April 1, 2025

Date Approved: May 27, 2025

Overall Update

Minnesota Sea Grant (MNSG) continues to work with partners that include aquaculture producers (Tye Fish Solutions and Lincoln Bait), Central Lakes College (CLC) in Brainerd, MN and the Minnesota Department of Natural Resources (MNDNR). The four strategies to increase Golden Shiner production using exclusively indoor production or indoor production in combination with constructed grow-out ponds completed its third and final growing season, except for the third cohort in the aquaponics strategy. LCCMR funding ended on June 30, 2024 so MNSG is self-funding the remainder of the project. Producers are committed to the project and are also self-funding portions of the final growing season. Monthly meetings with partners continue.

Golden Shiner grown in all four strategies were harvested during this last reporting period. Much of the Golden Shiner growth data from the first and second years has been summarized. Data for the third year was collected and is now being analyzed. The data collected to date has been discussed with partners and has been summarized for presentations at local, regional and national meetings. A description of the project is posted on the MNSG website, with quarterly updates.

Activity 1

Successful spawning occurred at the Tye Fish Solutions hatchery in 2024 and all facilities were stocked with sac fry or feed trained fry as dictated by the project protocols. Because the grow out portion of the “official” project has ended there will be no fry produced for the project in 2025. However, some of the partners plan to continue rearing Golden Shiner so Tye Fish Solutions will maintain their broodstock and produce fry for stocking this spring, which will be starting soon. In addition to partners from this project, there have been several requests for Golden Shiner sac and feed trained fry from other producers interested in this project and are presently rearing or are planning to rear Golden Shiner on their own in 2025.

Activity 2

All strategies in year three produced market sized fish. Golden Shiner from cohort 3 in RAS (strategy 1) were harvested on March 22, 2025. This will be the final cohort grown in the RAS system. Feed trained fry stocked on January 15, 2024 (cohort 2) at the CLC aquaponics facility (strategy 2) were harvested on March 25, 2025. Cohort 3, stocked in late September 2024, remains in the aquaponics facility at CLC and is scheduled to be harvested near July 1, 2025.

Survival and growth of both sac fry (strategy 3) and feed trained fry (strategy 4) stocked into constructed ponds and tanks in late May-early June 2024 were harvested on November 1, 2024 (strategies 3 & 4) and November 5-6, 2024 (strategy 3). This was the third cohort for each strategy.

Non-drainable Golden Shiner ponds stocked in 2023 overwintered fish and were not stocked in 2024. Rather than stock feed trained fry (strategy 4) on top of overwintered fish, two stream-side tanks were set up and water from the pond was pumped into the tanks. Data collected from these cohorts and all strategies will be analyzed over the spring/summer of 2025.

Activity 3

Sampling protocols were developed in 2022 and implemented again in 2023 and 2024 with some minor modifications. Fish were collected about every two-three weeks for growth analysis once they reached about 1.5 inches (growth trend

through time). Water quality data was collected about every two-three weeks in addition to when/if fish appeared stressed. Temperature loggers were used to monitor temps hourly for each strategy. As mentioned above, data were collected from partners and is being entered into electronic spreadsheets for analysis in spring/summer 2025. Frozen fish samples from the 2023/2024 and most of the 2025 growing season have been processed to determine growth trends for each strategy and data are presently being summarized. Comparisons will be made both among strategies and years to determine the best recommendations. Data from cohort 3 in the aquaponics system continues to be collected and will be completed upon harvest in summer of 2025. This data will be added to the entire data set so each strategy will have three cohorts for comparison within and among years and strategies.

Dissemination

We have developed and posted a project description on the MNSG website (https://seagrant.umn.edu/programs/fisheries-and-aquaculture-program/producing-golden-shiner-bait) that is updated quarterly. It includes a YouTube video and a “rack card” with information about the project. When requested, we continue to provide information to the media describing the project and its potential to address bait shortages in Minnesota. Minnesota Outdoor News published an article where the project was featured in the March 28, 2025 issue. The project continues to draw high interest from bait dealers and the MNDNR. A summary of the project results to date was presented at the MNDNR Bait Committee Meeting on March 24, 2025 and at Aquaculture America 2025 in early March of 2025. This project was featured in a report to the Minnesota Legislature drafted by the MNDNR in January 2024 as a partial solution to the bait shortage in Minnesota (Ensuring a Viable Minnesota Grown Bait Supply Legislative Report). It was also highlighted in the bait section of the new Minnesota State Aquaculture Plan that was completed in January 2025. A final project report and Golden Shiner production guide are under development, and we plan to hold workshops in 2025.

Status Update Reporting

Status Update October 1, 2024

Date Submitted: October 10, 2024

Date Approved: October 22, 2024

Overall Update

Minnesota Sea Grant (MNSG) continues to work with partners that include aquaculture producers (Tye Fish Solutions and Lincoln Bait), Central Lakes College (CLC) in Brainerd, MN and the Minnesota Department of Natural Resources (MNDNR). The four strategies to increase Golden Shiners production using exclusively indoor production or indoor production in combination with constructed grow-out ponds began its third and final growing season which is now about 80% complete in our outdoor facilities. LCCMR funding ended on June 30, 2024 so MNSG is self-funding the remainder of the growing season and assisting producers when possible. Producers are committed to the project and are also self-funding portions of the final growing season. Monthly meetings with partners continue.

Golden Shiner reared at the Tye Fish Solutions hatchery were stocked in various locations as described in the project work plan to address the four strategies. The second year of data continues to be summarized. Data for the third year is being collected for analysis in 2025. The data collected to date has been discussed with partners and is being summarized for presentations at both local and regional meetings. A description of the project is posted on the MNSG website, with quarterly updates.

Activity 1

Successful spawning occurred at the Tye Fish Solutions hatchery in 2024. Zooplankton (rotifers) and brine shrimp culture was used to act as a transitional food source from when the yolk sac is absorbed to when the fish transition to dry commercial food (feed training). Successful feed training of sac-fry occurred in spring 2024 and experimentation to find the most effective commercial feed was conducted and is ongoing. Several lots of Golden Shiner successfully went through the process of feed training and approximately 35K frylings (2-3 cm) were produced for stocking into ponds, pond-side tanks, recirculating aquaculture system (RAS) and aquaponics trials. Tye Fish Solutions hatchery also successfully produced approximately 202K sac-fry (0.5 -1 cm) that were distributed to grow-out ponds and tanks for this project in spring 2024. Broodstock capacity was increased at Tye Fish Solutions for production in 2024 and as indicated above this increased the number of sac-fry that were available for stocking when compared to 2023. In addition to this project, there have been several requests for Golden Shiner sac-fry from producers interested in this project and are presently rearing or are planning to rear Golden Shiners on their own.

Activity 2

Golden Shiner from cohort 2 in RAS (strategy 1) were harvested on June 30, 2024. On June 17, 2024, approximately 5,000 Golden Shiner fry were hatched (cohort 3) and are being reared in RAS. Fish appear to be growing well. Feed trained fry stocked in February 2023 (cohort 1) at the CLC aquaponics facility (strategy 2) were harvested on April 3, 2024, with over 50% of the fish reaching market size. Approximately 6K feed trained fry (cohort 2) were stocked at the CLC facility on January 15, 2024, and are doing well.

Survival and growth of both sac fry (strategy 3) and feed trained fry (strategy 4) stocked into constructed ponds and tanks in late May-early June 2024 appears good. Non-drainable Golden Shiner ponds stocked in 2023 overwintered fish and were not stocked in 2024. Most overwintered fish are now at market size. Rather than stock feed trained fry (strategy 4) on top of overwintered fish, two stream-side tanks were set up and water from the pond was pumped into the tanks. We are anxious to see the results. Complete harvest from non-drainable ponds remains an issue. Anticipated harvest from ponds and tanks is late October – early November 2024.

Activity 3

Sampling protocols were developed in 2022 and implemented again in 2023 and 2024 with some minor modifications. Fish were collected about every two weeks for growth analysis once they reached about 1.5 inches (trend of growth through time). Water quality data was collected about every two weeks in addition to when/if fish appeared stressed. Temperature loggers were used to monitor temps hourly for each strategy. Data is being collected from partners and is being entered into electronic spreadsheets for future analysis. Frozen fish samples from the 2023/2024 growing season have been processed to determine growth trends for each strategy and data is presently being summarized. Comparisons will be made both among strategies and years to determine the best recommendations.

Dissemination

We have developed and posted a project description on the MNSG website that is updated quarterly. It includes a YouTube video and a "rack card" with information about the project that can be viewed and downloaded from the MNSG website. We continue to provide information to the media describing the project and its potential to address bait shortages in Minnesota. The project continues to draw high interest from bait dealers and the MNDNR. This project was featured in a report to the Minnesota Legislature drafted by the MNDNR in January 2024 as a partial solution to the bait shortage in Minnesota (Ensuring a Viable Minnesota Grown Bait Supply Legislative Report).

To date interest in the project continues to be high based on the number of emails and phone calls we receive. Results have been generally positive and we are cautiously optimistic that the project outputs will satisfy the project objectives. A final report and production guide are under development, and we anticipate holding workshops once the project has been completed. During this reporting period we began development of a draft production guide and are looking at different formats for distribution.

Additional Status Update Reporting

Additional Status Update June 22, 2024

Date Submitted: October 10, 2024

Date Approved: October 22, 2024

Overall Update

Minnesota Sea Grant (MNSG) continues to work with partners that include aquaculture producers (Tye Fish Solutions and Lincoln Bait), Central Lakes College (CLC) in Brainerd, MN and the Minnesota Department of Natural Resources (MNDNR). The four strategies to increase Golden Shiners production using exclusively indoor production or indoor production in combination with constructed grow-out ponds began its third and final growing season which is now about 80% complete in our outdoor facilities. LCCMR funding ended on June 30, 2024 so MNSG is self-funding the remainder of the growing season and assisting producers when possible. Producers are committed to the project and are also self-funding portions of the final growing season. Monthly meetings with partners continue.

Golden Shiner reared at the Tye Fish Solutions hatchery were stocked in various locations as described in the project work plan to address the four strategies. The second year of data continues to be summarized. Data for the third year is being collected for analysis in 2025. The data collected to date has been discussed with partners and is being summarized for presentations at both local and regional meetings. A description of the project is posted on the MNSG website, with quarterly updates.

Activity 1

Successful spawning occurred at the Tye Fish Solutions hatchery in 2024. Zooplankton (rotifers) and brine shrimp culture was used to act as a transitional food source from when the yolk sac is absorbed to when the fish transition to dry commercial food (feed training). Successful feed training of sac-fry occurred in spring 2024 and experimentation to find the most effective commercial feed was conducted and is ongoing. Several lots of Golden Shiner successfully went through the process of feed training and approximately 35K frylings (2-3 cm) were produced for stocking into ponds, pond-side tanks, recirculating aquaculture system (RAS) and aquaponics trials. Tye Fish Solutions hatchery also successfully produced approximately 202K sac-fry (0.5 -1 cm) that were distributed to grow-out ponds and tanks for this project in spring 2024. Broodstock capacity was increased at Tye Fish Solutions for production in 2024 and as indicated above this increased the number of sac-fry that were available for stocking when compared to 2023. In addition to this project, there have been several requests for Golden Shiner sac-fry from producers interested in this project and are presently rearing or are planning to rear Golden Shiners on their own.

Activity 2

Golden Shiner from cohort 2 in RAS (strategy 1) were harvested on June 30, 2024. On June 17, 2024, approximately 5,000 Golden Shiner fry were hatched (cohort 3) and are being reared in RAS. Fish appear to be growing well. Feed trained fry stocked in February 2023 (cohort 1) at the CLC aquaponics facility (strategy 2) were harvested on April 3, 2024, with over 50% of the fish reaching market size. Approximately 6K feed trained fry (cohort 2) were stocked at the CLC facility on January 15, 2024, and are doing well.

Survival and growth of both sac fry (strategy 3) and feed trained fry (strategy 4) stocked into constructed ponds and tanks in late May-early June 2024 appears good. Non-drainable Golden Shiner ponds stocked in 2023 overwintered fish and were not stocked in 2024. Most overwintered fish are now at market size. Rather than stock feed trained fry (strategy 4) on top of overwintered fish, two stream-side tanks were set up and water from the pond was pumped into the tanks. We are anxious to see the results. Complete harvest from non-drainable ponds remains an issue. Anticipated harvest from ponds and tanks is late October – early November 2024.

Activity 3

Sampling protocols were developed in 2022 and implemented again in 2023 and 2024 with some minor modifications. Fish were collected about every two weeks for growth analysis once they reached about 1.5 inches (trend of growth through time). Water quality data was collected about every two weeks in addition to when/if fish appeared stressed. Temperature loggers were used to monitor temps hourly for each strategy. Data is being collected from partners and is being entered into electronic spreadsheets for future analysis. Frozen fish samples from the 2023/2024 growing season have been processed to determine growth trends for each strategy and data is presently being summarized. Comparisons will be made both among strategies and years to determine the best recommendations.

Dissemination

We have developed and posted a project description on the MNSG website that is updated quarterly. It includes a YouTube video and a "rack card" with information about the project that can be viewed and downloaded from the MNSG website. We continue to provide information to the media describing the project and its potential to address bait shortages in Minnesota. The project continues to draw high interest from bait dealers and the MNDNR. This project was featured in a report to the Minnesota Legislature drafted by the MNDNR in January 2024 as a partial solution to the bait shortage in Minnesota (Ensuring a Viable Minnesota Grown Bait Supply Legislative Report).

To date interest in the project continues to be high based on the number of emails and phone calls we receive. Results have been generally positive and we are cautiously optimistic that the project outputs will satisfy the project objectives. A final report and production guide are under development, and we anticipate holding workshops once the project has been completed. During this reporting period we began development of a draft production guide and are looking at different formats for distribution.

Status Update Reporting

Status Update April 1, 2024

Date Submitted: March 27, 2024

Date Approved: May 29, 2024

Overall Update
Minnesota Sea Grant (MNSG) continues to work with partners that include aquaculture producers (Tye Fish Solutions and Lincoln Bait), Central Lakes College (CLC) in Brainerd, MN and the Minnesota Department of Natural Resources (MNDNR). The four strategies to increase Golden Shiners production using exclusively indoor production or indoor production in combination with constructed grow-out ponds completed its second growing season. We harvested cohort 2 from grow-out ponds October - November 2023. All data have been collected and entered and we are in the process of summarizing year two results. Monthly meetings with partners continue.

Golden Shiner (GOS) broodstock continues to be housed at Tye Fish Solutions. Fry for strategy one (cohort 2) are being grown in RAS at the Tye facilities. Feed trained fry for strategy two have been transferred to the CLC aquaponics facility for grow-out of cohort 2. Cohort one at CLC will be harvested in early April 2024. GOS stocked as sac fry (strategy 3) were harvested at Lincoln Bait and the MNDNR Spicer hatchery. There was good survival however growth differed between facilities. Fish stocked as feed trained fry were harvested from a Lincoln Bait pond. Growth was good, but survival was less than expected.

Activity 1
Modifications to facilities and methods to accommodate project objectives were made. Successful spawning and fry production continues at the Tye Fish Solutions hatchery. Zooplankton (rotifers) and brine shrimp culture was used to act as a transitional food source from when the yolk sac is absorbed to when the fish transition to dry commercial food (feed training). Successful feed training of sac-fry occurred in winter 2024 using rotifers and brine shrimp, and experimentation to find the most effective commercial feed was conducted and is ongoing. Approximately 5K feed trained fry were reared and transferred to CLC (strategy 2) to populate the aquaponics system (cohort 2). Some broodstock were brought in to increase reproduction of GOS for spring 2024.

Based on the strong interest in this project aquaculture producers have contacted us about availability of GOS fry for sale. Tye Fish Solutions has sold feed trained fry to non-project producers that are interested in growing GOS for bait. Two non-project producers are presently growing GOS for bait and two more producers have expressed a high interest in growing GOS. We have been in close contact with these producers to share information and learn from their experiences.

Activity 2
On May 30, 2023 approximately 6,700 Golden Shiner fry were hatched (cohort 2) and reared in RAS at Tye Fish Solutions (strategy 1). In mid-November 2023 a fungal infection was noticed and relatively high mortality occurred. Fish were treated for fungus but about two thirds were lost. The remaining fish survived, are being monitored, and are doing well. Growth was reduced and plans are to harvest in late spring 2024. Feed trained fry stocked in February 2023 (cohort 1) at the CLC aquaponics facility (strategy 2) continued to grow well over the fall-winter of 2023-2024. Harvest will occur in early April and data will be collected. Approximately 5K feed trained fry (cohort 2) were received by the CLC facility in February 2024 and are doing well.

GOS stocked as sac fry in spring 2023 (strategy 3) were harvested at Lincoln Bait and the MNDNR Spicer hatchery. There was good survival, however growth differed between facilities. Growth was higher at the MNDNR facility where some

supplemental feeding occurred. GOS stocked as feed trained fry (strategy 4) were harvested in November from Lincoln Bait. Growth was good, but survival was less than anticipated. Data from these two strategies is being summarized.

Activity 3

Sampling protocols were developed in 2022 and implemented again in 2023 with some minor modifications. Fish were collected about every two weeks for growth analysis once they reached about 1.5 inches (trend of growth through time). Water quality data was collected about every two weeks in addition to when/if fish appeared stressed. Temperature loggers were used to monitor temps hourly for each strategy. Data is being collected every two weeks from partners and is being entered into electronic spreadsheets for future analysis. Frozen fish samples from the 2023 growing season have been processed to determine growth trends for each strategy and data is presently being summarized and compared among strategies and also compared to year one.

Dissemination

We have developed and posted a project description on the MNSG website that is updated quarterly. It includes a YouTube video and a “rack card” with information about the project that can be viewed and downloaded from the MNSG website. We continue to provide information to the media describing the project and its potential to address bait shortages in Minnesota. The project continues to draw high interest from bait dealers and the MNDNR. This project was featured in a report to the Minnesota Legislature drafted by the MNDNR in January 2024 as a partial solution to the bait shortage in Minnesota (Ensuring a Viable Minnesota Grown Bait Supply Legislative Report). Information on the project was formally presented at the MNDNR/MN Bait Dealers meeting on October 3, 2023.

To date interest in the project has been high based on the number of emails and phone calls we receive. Results have been generally positive and we are cautiously optimistic that the project outputs will satisfy the project objectives. A final report, production manual and workshops will be developed once the project has been completed. During this reporting period we developed a draft outline for the production manual and are beginning work

Status Update Reporting

Status Update October 1, 2023

Date Submitted: September 28, 2023

Date Approved: December 15, 2023

Overall Update

We continue to work with our partners that include two in-state aquaculture producers (Tye Fish Solutions and Lincoln Bait), Central Lakes College (CLC) in Brainerd, MN and the Minnesota Department of Natural Resources (MNDNR). The four strategies to increase production of Golden Shiners using exclusively indoor production or indoor production in combination with constructed grow-out ponds is in its second year. We are about 80% through the second growing season. MNSG continues to facilitate monthly meetings among partners and has followed through on all contracts. We have added a new producer; the Central Lakes College in Brainerd MN has aquaponics facilities and they have agreed to assist with the aquaponics portion of the project.

Golden Shiner reared at the Tye Fish Solutions hatchery were stocked at all locations. The first year of data on growth and survival has been entered and summarized. Data for the second year is being collected, monitored, entered, and will be analyzed during winter. We have discussed our data with partners and have presented at local and regional meetings. Project updates have been posted on the MNSG website. Initial results are encouraging and there has been high interest from other bait producers and the public.

Activity 1

Appropriate permits were secured for rearing and transport of Golden Shiner. Necessary modifications to facilities to accommodate project objectives were made. Successful spawning occurred at Tye Fish Solutions hatchery in 2023. Zooplankton (rotifers) and brine shrimp culture were used as a transitional food source from when the yolk sac is absorbed to when fish transition to dry commercial food (feed training). Successful feed training of sac-fry occurred in spring 2023, and experimentation to find the most effective commercial feed was conducted and is ongoing. Several lots of Golden Shiner were successfully feed trained and approximately 23.2K frylings (2-3 cm) were produced for stocking into ponds, recirculating aquaculture system (RAS) and initial aquaponics trials. Tye Fish Solutions hatchery also successfully produced approximately 147K sac-fry (0.5 -1 cm) that were distributed to grow-out ponds and tanks in spring 2023. Broodstock capacity was increased at Tye Fish Solutions for production in 2023 and this increased the number of sac-fry that were available for stocking compared to 2022. In addition, there have been a number of requests for Golden Shiner sac-fry from producers interested in this project who are planning to pursue growing Golden Shiners on their own.

Activity 2

Approximately 6,700 Golden Shiner fry were hatched and are being reared in RAS at Tye Fish Solutions (strategy 1). Some minor mortality occurred in July due to relatively high nitrites, but the issue has been addressed. We will attempt to grow the 2023 cohort to a larger size in the RAS strategy and anticipate harvest in February or March 2024. The CLC facility (strategy 2) received their first batch of feed trained fry in early February 2023. The fish are growing well, are in the 2-2.5 inch range, and we anticipate harvest in early winter. Grow out of both sac fry and feed trained fry that were stocked in late May-early June 2023 is going well. Survival of stocked sac fry (strategy 3) was observed in all ponds and tanks. Based on preliminary observations fish growth appears to be slightly greater in 2023 than in 2022. Survival of feed trained fry stocked into ponds appears good (strategy 4) and growth of fish appears to be better than in 2022. We are experimenting with harvest methods to remove fish from non-drainable ponds. We anticipate harvest of ponds and outdoor tanks in late October – early November 2023.

Activity 3

Sampling protocols were developed in 2022 and implemented again in 2023 with some minor modifications. Fish were collected about every two weeks for growth analysis once they reached about 1.5 inches (trend of growth through time). Water quality data was collected about every two weeks in addition to when/if fish appeared stressed. Temperature loggers were used to monitor temps hourly for each strategy. Data is being collected monthly from partners and is being entered into electronic spreadsheets for future analysis. Frozen fish samples will be processed to determine growth trends for each strategy in September - Oct. 2023.

Dissemination

We have developed and posted a project description on the MNSG website that is updated quarterly (https://seagrant.umn.edu/programs/fisheries-and-aquaculture-program/producing-golden-shiner-bait). We continue to provide information to the media describing the project (most recently an article in the Star-Tribune (late August) on the bait shortage with reference to this project). The project continues to draw high interest from bait dealers and the Minnesota Department of Natural Resources where we have been meeting periodically to update both parties on the project results to date.

Information on the project partnerships was presented at the Annual Meeting of the American Fisheries Society in August 2023, initial results of the project were presented at the MNDNR Fisheries Academy in late spring 2023 and we have been asked to present at the next MNDNR/MN Bait Dealers meeting on Oct. 3rd, 2023.

To date interest in the project has been high, we receive many emails and phone calls. We are optimistic that over the next 1.5 years the project outputs will satisfy the project objectives.

A final report, production manual and workshops will be developed once the project has been completed. During this reporting period we developed a draft outline for the

Status Update Reporting

Status Update April 1, 2023

Date Submitted: March 31, 2023

Date Approved: April 13, 2023

Overall Update

Minnesota Sea Grant (MNSG) formed partnerships with two, in-state aquaculture producers, Central Lakes College in Brainerd and the Minnesota Department of Natural Resources. The four strategies to increase production of Golden Shiners using exclusively indoor production or indoor production in combination with constructed grow-out ponds has completed the first growing season. MNSG has facilitated monthly meetings among partners and has secured contracts with the commercial producers and is in the process of completing a contract with the Central Lakes College (aquaponics strategy). Unfortunately, the initial aquaponics grower encountered unforeseen circumstances and had to withdraw from the project. Fortunately the Central Lakes College in Brainerd MN has aquaponics facilities and they have agreed to assist with the aquaponics portion of the project.

Golden Shiner reared at the Tye Fish Solutions hatchery were stocked in various locations and the first year of data on growth and survival has been collected and summarized. The data has been discussed with partners and has been presented at both local and regional meetings. A description of the project is posted on the MNSG website with quarterly updates. Initial results have been encouraging and there has been high interest from other bait producers as the project continues.

Activity 1

Appropriate permits were secured for rearing and transport of Golden Shiner among various facilities. Necessary modifications to facilities to accommodate project objectives were made. Successful spawning occurred at the Tye Fish Solutions hatchery. Zooplankton (rotifer) culture was used to act as a transitional food source from when the yolk sac is absorbed to when the fish transition to dry commercial food (feed training). Successful feed training of sac-fry occurred in spring 2022, using rotifers, and experimentation to find the most effective commercial feed was conducted and is ongoing. Several lots of Golden Shiner successfully went through the process of feed training and approximately 23K frylings (2-3 cm) were produced for stocking into ponds, recirculating aquaculture system (RAS) and initial aquaponics trials. Tye Fish Solutions hatchery also successfully produced approximately 65.5K sac-fry (0.5 -1 cm) that were distributed to grow-out ponds in spring 2022. Broodstock capacity was increased at Tye Fish Solutions for production in 2023 and increased numbers for stocking is expected in 2023. In addition there have been a number of requests for Golden Shiner fry from producers interested in this project and pursuing growing Golden Shiners on their own.

Activity 2

Golden Shiner were reared in RAS (1) at Tye Fish Solutions and harvested February 3, 2023. Preliminary results are presented in Tables 1 and 2 located under Activity 3. The aquaponics strategy (2) was initiated on a trial basis in early spring 2022. As stated above our aquaponics partner had to drop out and we were fortunate to recruit aquaponics staff and use the facility at Central Lakes College in Brainerd. They received their first batch of feed trained fry in early January 2023. Fish are doing well and plants have been started for use in the system. Grow out of both sac fry and feed trained fry that were stocked in early May 2022 was completed in late Oct.–early Nov. 2022. Preliminary results are reported in Activity 3, Tables 1 and 2. Production results of feed trained fry (4) were not collected before the pond winter killed due to early ice and extremely large amounts of snow in Dec. 2022. However, growth data was collected and final sizes were determined for feed trained fry. The large MNDNR rearing pond at the New London Hatchery was used for sac fry (3) and also contained Fatheads (50%) and Stickleback (25%).

Activity 3

Sampling protocols were developed and implemented. Data monitored on production and growth are included in Tables 1 and 2 below. All strategies demonstrated survival and produced some fish of market size. We plan to modify some of our methods in the 2023 growing season and are cautiously optimistic that we can improve on the 2022 results.

Table 1. Golden Shiner production summary for 2022-2023.

Strategies	Method	Grow Days	Total kg	Rate #/kg	Total stocked	Total Harvested	% Survival
RAS (1)	Tank	220	14.9	371	5,400	5,084	94
Sac-fry (3)	Tank	167	22.4	818	15,000	18,302	122
Sac-fry (3)	Pond	174	6.6	1,144	22,000	7,540	34

Table 2. Golden Shiner growth summary for 2022-2023.

Strategies	Method	Grow days	Sample size	Ave. len (mm)	Ave. wt (g)	% > 64mm	%>76mm
RAS (1)	Tank	220	109	71	2.9	81.7	33.3
FT-fry (4)	Pond	184	16	69	2.9	50.0	31.5
Sac-fry (3)	Tank	167	93	54	1.4	15.0	1.0
Sac-fry (3)	Pond	174	166	48	0.9	10.9	2.4

Dissemination

We have developed and posted a project description on the MNSG website that is updated quarterly. We continue to provide information to the media describing the project. The project continues to draw high interest from bait dealers and the Minnesota Department of Natural Resources where we have been meeting periodically to update both parties on the project results to date.

Information on the project was presented at the national Aquaculture America meeting in late Feb. 2023 and at the WI/MN Aquaculture Association meeting in mid-Feb. 2023. To date interest in the project has been high and results have been positive. We are cautiously optimistic that over the next two years project outputs will satisfy the project objectives.

A final report, production manual and workshops will be developed once the project has been completed.

Status Update Reporting

Status Update October 1, 2022

Date Submitted: September 29, 2022

Date Approved: October 27, 2022

Overall Update

Minnesota Sea Grant (MNSG) formed partnerships with three, in-state aquaculture producers and MNDNR. The four strategies to increase production of Golden Shiners using exclusively indoor production or indoor production in combination with human constructed grow-out ponds has been discussed with the partners and project implementation for the 2022 growing season has occurred. MNSG has facilitated monthly meetings among partners and has secured contracts for all but one grower (aquaponics, strategy 2) for their involvement in the project. The aquaponics grower was initially interested and began modifying his facility to accommodate the project but has since backed away from the project. He has received no funding and we are exploring recruitment of other aquaponics growers.

Golden Shiner reared in the Tye Fish Solutions hatchery were stocked and data on growth and survival are being collected based on protocols that were determined in early spring. Partners have modified their facilities to accommodate project objectives and have almost completed the first growing season (ending mid-late October, 2022). MNSG has posted a description of the project on the MNSG website, a news release was distributed in early 2022 and a number of media interviews were requested and provided. High interest in the project continues.

Activity 1

All appropriate permits were secured for rearing and transport of Golden Shiner among constructed ponds and facilities. Partners have made necessary modifications to their facilities and equipment to accommodate project objectives. Golden Shiner broodstock were collected from ponds and successful spawning occurred at the Tye Fish Solutions hatchery. Zooplankton (rotifer) culture were used to act as a transition food source from when the yolk sac is absorbed to when the fish transition to dry commercial food (feed training). Successful feed training of sac-fry occurred in spring 2022, using rotifers, and experimentation to find the most effective commercial feed was conducted and is ongoing. Several lots of Golden Shiner successfully went through the process of feed training (sac-fry to commercial dry food) and approximately 23K frylings (2-3 cm) were produced for stocking into ponds, RAS and initial aquaponics trials. Tye Fish Solutions hatchery also successfully produced approximately 65.5 K sac-fry (0.5 -1 cm) that were distributed to ponds in spring 2022. Broodstock for future production (2023) are being held at the hatchery and are doing well.

Activity 2

In early July, 5,400 sac fry began feed training at Tye Fish Solutions and are being reared to market size in the RAS system. Survival is high and fish length averages 4.5 cm (2 in). We anticipate fish will reach market size by mid-December for a 6-7 month growing season (Strategy 1). Strategy 2, aquaponics, was initiated on a trial basis with the aquaponics producer who was able grow feed trained fry to a larger size. Unfortunately, this producer is no longer participating and we are in the process of finding another aquaponics producer to work with us.

Stocking constructed ponds with sac fry (strategy 3) and feed trained fry (strategy 4) are going well. Feed trained frylings were stocked into one pond (5K) and one tank (5K) at Lincoln Bait LLC. Survival seems high and some frylings reached market size by early September. Sac fry were stocked into one pond at Lincoln Bait and one MNDNR pond at the New London facility near Spicer, MN. Sampling indicates sac fry are smaller than feed trained frylings (average length = 5 cm or 2 in). During harvest in October production will be determined and final size information will be collected.

Activity 3

Sampling protocols have been developed, discussed and implemented. Data forms have been provided to partners and

requested information is being turned in every two weeks. Photographs are being taken and samples are being frozen for further analysis this winter. Based on the sampling and monitoring plan information we are collecting information on growth rates, food availability, survival of Golden Shiner, and estimated costs for each strategy. Water quality test equipment has been distributed and is being used to monitor potential changes. To date no catastrophic events have occurred and all stocked ponds and tanks have evidence of Golden Shiner survival. Discussions on what information is planned for final reports and a production guide have been initiated and are ongoing. More activity will occur in the section once the first growing season has been completed.

Dissemination

We have developed and posted a project description on the MNSG website. We also provided a news release describing the project that was distributed and picked up by a number of local, regional and two international media outlets. The project continues to draw high interest from bait dealers, the MNDNR and the media.

Information on the project was presented at the Aquaculture America meeting which includes producers, researchers and extension folks in March 2022. A presentation was given at the National Aquaculture Extension Conference in June 2022 which includes primarily extension staff from around the United States. In August 2022 a presentation and discussion occurred on the project at the Minnesota Aquaculture Association (MNAA) meeting that included producers, state legislators, researchers and extension folks. As part of the MNAA meeting a farm tour was provided by one of our partners (Mr. Barry Thoele, Lincoln Bait) that highlighted the pond and tank rearing aspect of the Golden Shiner project. To date results have been positive and we are cautiously optimistic that over the next two years project outputs will satisfy the project objectives.

A final report, production manual and workshops will be developed once the project has been completed.

Status Update Reporting

Status Update April 1, 2022

Date Submitted: April 29, 2022

Date Approved: May 24, 2022

Overall Update

Minnesota Sea Grant (MNSG) formed partnerships with three, in-state aquaculture producers and the Minnesota Department of Natural Resources. The four strategies to increase production of Golden Shiners using exclusively indoor production or indoor production in combination with human constructed grow-out ponds has been discussed with the partners and implementation plans have been made. MNSG has facilitated monthly meetings among partners and has secured contracts for their involvement in the project. Data collection protocols have been determined, and some project equipment has been purchased. Partners have modified their facilities to accommodate project objectives and are completing preparation to rear Golden Shiner during the 2022 growing season. MNSG has posted a description of the project on the MNSG website, a news release was distributed and a number of media interviews were requested and provided.

Activity 1

All appropriate permits have been secured for rearing and transport of Golden Shiner among constructed ponds and facilities. Partners have made necessary modifications to their facilities and equipment to accommodate project objectives. Golden Shiner broodstock has been collected from ponds and successful spawning has been taking place at the Tye Fish Solutions hatchery. Zooplankton (rotifer) culture has been initiated to act as a transition food source from when the yolk sac is absorbed to when the fish transitions to dry commercial food. Successful feed training of sac-fry has occurred (using rotifers) and experimentation to find the most effective commercial feed is taking place. Several lots of Golden Shiner have successfully gone through the process of feed training (sac-fry to commercial dry food) and we are confident the process can be implemented to meet our needs. Tye Fish Solutions is prepared to supply the sac-fry and feed trained fry needed for transfer to constructed grow-out ponds and to the aquaponics facility this spring.

Activity 2

Golden Shiner are presently being reared in the recirculating aquaculture system (RAS) at Tye Fish Solutions. The first lot of fish for rearing in the RAS (Strategy 1) are hatched and are undergoing feed training. Broodstock are spawning and eggs are being hatched at the Tye Fish Solutions hatchery for use in Strategy 2, aquaponics, and Strategies 3 and 4, stocking constructed ponds with sac-fry and feed trained fry (frylings). Constructed grow-out ponds have been procured for the project. Two ponds and a large tank are located on the Lincoln bait property and one MNDNR rearing pond is available in New London, MN for project use. The aquaponics facility (Happy Fish Aquaponics) is ready to receive fish. Timing of pond stocking, Strategies 3 and 4, is highly dependent on water temperatures and we anticipate fish being stocked in late May, early June. All facilities are prepared to accept fish when available.

Activity 3

Sampling protocols have been discussed and are being finalized. Data forms have been provided to partners. Based on the sampling and monitoring plan information will be collected on growth rates, food availability, survival of Golden Shiner, and estimated costs for each strategy. Water quality test equipment has been distributed so monitoring of potential changes can be documented. Discussions on what information is planned for final reports and a production guide have been initiated. More activity will occur in the section once the first growing season has been completed.

Dissemination

Although very early in the project, we have developed and posted a project description on the MNSG website. We also provided a news release describing the project that was distributed and picked up by a number of local, regional and

two international media outlets. A final report, production manual and workshops will be developed once project has been completed.