**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**

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| **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** |  |

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| **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.