DRAFT: Managing invasive carp related to a deterrent at Lock and Dam 5 on the Mississippi River

Minnesota Department of Natural Resources (DNR)

Submitted at the request of Lessard-Sams Outdoor Heritage Council (LSOHC) members for consideration at the March 26, 2024, meeting.

Background

- This is a draft proposal to support actions to manage invasive carp in Minnesota, including: actions needed to finalize project design, confirm feasibility, and obtain necessary approvals prior to installation of an invasive carp deterrent at Lock and Dam 5 (LD5) on the Mississippi River; and complementary actions to reduce the upstream passage of invasive carp such as decreasing passage through dam gates and removing invasive carp from the river.
- Any installation of a deterrent at LD5 must be combined with other strategies and actions to reduce the impact of invasive carp in Minnesota. Deterrents do not prevent reproduction from occurring, and do not reduce abundance downstream of the deterrent. A comprehensive and integrated program of invasive carp management strategies and actions is described in the Invasive Carp Action Plan (DNR 2024), which was informed by a structured decision-making process that included many experts and stakeholders to brainstorm and assess different management actions.
- Sound-based invasive carp deterrents are currently undergoing testing, including the underwater acoustic deterrent system (uADS) that has been temporarily installed at Lock and Dam 19 on the Upper Mississippi River, and the BioAcoustic Fish Fence (BAFF) that is being tested at Barkley Lock and Dam on the Cumberland River in Kentucky. These are the first two full-scale tests of sound-based deterrents for invasive carp in the United States.
    - The uADS was installed in 2021 and the BAFF in 2019. The uADS system uses a gradient of sound, while the BAFF uses sound contained within a bubble curtain, to deter invasive carp.
    - Preliminary data from these deterrents suggests that they are approximately 50% effective at preventing passage of invasive carp, and that they have little to no effect on the native species that were tested (Brey et al. 2023, Fritts et al. 2023).
- Invasive carp can swim upstream through the dam portion of a lock and dam structure when gates are fully opened (e.g., during high water). Deterrents at locks do not affect passage through dam gates.
- Maximum value for this project comes from exploring methods to deter fish from passing through spillway gates as well as exploring a deterrent and trap combination at the lock (including use of sound only or sound and bubbles to guide fish to a trap). Open river conditions, where the spillway gates are out of the water and invasive carp can pass

relatively freely through the dam, occur less frequently at LD5 than at several other locks and dams on the Upper Mississippi River. However, this condition does occur and provides a prime opportunity for upstream movement of invasive carp, which are triggered by high flows to move upstream.
    - For example, LD15 has a similar frequency of open river conditions as LD5. In 2022, a low water year when open river didn't occur, less than 1% of tagged and tracked invasive carp in Pool 16 moved upstream through LD15, indicating little upstream movement through the lock chamber. In a high water year, nearly half of all tagged invasive carp in Pool 16 moved upstream, and all of those tagged invasive carp that moved upstream did so via the spillway gates of LD15.
- Therefore, we propose that actions toward installation of a deterrent in the lock at LD5 are coupled with measures to deter invasive fish passage through the dam gates. Increased targeted removal of invasive carp downstream of the deterrent will also be important to reduce pressure on the deterrent and reduce the risk of reproduction occurring.

Partnerships

The U.S. Army Corps of Engineers (USACE) would need to review and approve any proposal to modify LD5, or any of its other navigation structures. The DNR has had initial conversations with the USACE to understand what the review and approval process would entail.

The USFWS is a prospective partner; USFWS provided feedback to the DNR in the preparation of this proposal and has expertise doing a deterrent study at Barkley Lock. The DNR is prepared to partner with USFWS, the U.S. Geological Survey (a federal research agency currently studying the efficacy of two sound deterrents), researchers, and other willing partners with expertise in this area.

A first step in advancing this proposed project would be to establish a project team that includes these key partners who work together to conceptualize and work with engineers to design and ultimately implement projects on the ground at LD5. It is important to note that any work done on USACE property would be done under a temporary Real Estate Permit, at least until a permanent authority is established for USACE to own and operate a deterrent at LD5 (or any other location on the Upper Mississippi River).

Estimated costs

- Costs are extremely difficult to estimate at this time. Based on the estimated cost for deterrents (see below) and the need for several additional components to effectively deter fish at this site, total costs would likely exceed $12,000,000. The project team would develop more detailed cost estimates for project components in subsequent drafts of proposal developments.
- Costs would include:

- Completing a full design of deterrent system specific to LD5
- Purchase and installation of:
    - lock deterrent
    - trap and sort
    - spillway gate deterrent
- Evaluation and improvements to deterrent system
- Operations and maintenance
- Project management and support staff
    - Cost estimates for deterrents:
    - The BAFF installed at Barkley Lock and Dam was estimated to cost $3,757,000 for construction, equipment, and installation. The system was leased for $54,500/month (includes monitoring from Fish Guidance Systems) with annual operations and maintenance costs of $533,000. Total for installation, lease, and five years operations and maintenance= $9,692,000 (Fritts et al. 2023).
    - The uADS installed at LD19 was estimated to cost $1,530,000 for construction, equipment, and installation. Annual operations and maintenance costs were approximately $506,000. Total for construction and five years operations and maintenance= $4,060,000. This does not include staff to monitor deterrent function (Brey et al. 2023).
    - The cost of installation and 5 years of operations and maintenance of a BAFF at LD5 was estimated by Barr (2022; Table 4) to be between $9,224,000 and $22,914,000 in 2022 dollars, depending on whether the BAFF was owned or leased (for five years). Actual costs will vary depending on factors that would be identified during the design phase of the project, as well as contingencies that may arise.
- It is assumed that LSOHC cannot authorize funds for the purposes of removal of the deterrent. However, a deterrent will need to be removed without long-term agreements about ownership, authorization and permitting, and funding for ongoing operation and maintenance. The DNR and USFWS do not have funds that could cover deterrent removal.

Deterrent at a lock

Estimated costs and timelines for these items are provided when available.

Deterrent paired with a trapping system

- A deterrent could provide an opportunity to not only keep some invasive carp from moving upstream through the lock chamber but could also guide fish to a trap where fish could be sorted and the invasive carp removed.

- This would require a novel, ground up design, potential lab evaluation, and building a trap to capture, sort, and remove invasive carp – ideally, using Artificial Intelligence (AI) to sort fish.
- Developing this new system and testing it will have personnel, equipment, and other costs. There would also be longer-term costs associated with operation and maintenance of this system.
- Deterrent with sound only and sound/bubble system should both be tested to assess their ability to guide fish toward a trap.

Design for LD5 deterrent and other engineering and evaluation steps

- There are a number of evaluation steps that should be taken before making a final decision to install a deterrent at a Lock and Dam and to choose the best deterrent design for a particular site.
- The lock approach will need to be studied for constraints such as flow, depth, sound interference, and the available space for installation of a deterrent before it can be determined which deterrent (i.e., uADS; BAFF) would be most appropriate for this location.
- Particular to a BAFF deterrent at the LD5 lock, Barr (2022) recommended in the 10% design the following next steps: verifying riprap depth at LD5 because riprap would need to be relocated to install a deterrent foundation; further investigating soil properties at the site; and further review of lock chamber discharge outlets and culverts that may allow for invasive carp passage.
- Increased design and engineering work will be required for USACE review and prior to deterrent installation.

Evaluate fish passage at Lock and Dam 5 to determine efficacy of deterrent

- To evaluate the efficacy of a deterrent at the LD5 lock, track tagged invasive carp at LD5 to determine where and when invasive carp pass the dam and/or a deterrent system.
    - Tag and track native species of concern to determine effects on native fish.
    - Maintain a receiver array at Lock and Dam 5.

Estimate abundance and map distribution of invasive carp using new modeling techniques

- Use the results to assess and improve program efficacy. USGS, USFWS, and the University of Toledo have modeling methods to estimate relative abundance of low-density invasive carp populations. These could be used to track general changes (increases and decreases) in abundance over time.

Reduce invasive carp passage through dam or spillway gates

Fund design and evaluation of spillway/dam gate deterrents to prevent passage during open river conditions

- During open river conditions (when the gates are out of the water such as during flooding), the river is connected, and fish can pass the dam. Several deterrent options may be applicable to spillway, or dam, gates but have not been tested in that capacity. Sound, carbon dioxide, or electricity may be effective deterrents to use intermittently during those open river conditions to prevent invasive carp passage. Ground up design, potential lab evaluation, and building would be required to develop an effective deterrent for spillway gates.
- Spillway gate deterrents may also be useful in disrupting aggregations of invasive carp to reduce risk of spawning. Dams are existing pinch points for upstream movement of invasive carp, and tools are needed to prevent spawning from occurring.

Develop other methods for reducing upstream passage of invasive carp

- Gate manipulations to minimize open river conditions can be modeled by researchers. However, the USACE determines lock and dam operations to support the navigation system, and the USACE would determine whether applying gate manipulations is feasible.
- Identify other possible manual efforts to deter fish during open river; for example, manual deployment of electricity and/or sound from agency boats or buoys. These interventions would also need to be applied in partnership with the USACE to ensure safety and compatibility with navigation.

Remove invasive carp

Expanded DNR-contracted commercial fishing

- Contracted commercial fishing is currently the most effective way to capture invasive carp for removal or tagging. Commercial anglers on the Minnesota or Wisconsin boundary waters of the Mississippi River have specialized equipment, skills, and knowledge of the location.
- In 2023, the Minnesota Legislature appropriated $1.72 million to the DNR to prevent and manage invasive carp and the DNR allocated $862,500 of those funds to increasing commercial fishing. Those funds are available through June 30, 2025. Commercial fishing has also been supported by invasive carp grants administered by the U.S. Fish and Wildlife Service, and by grants from the Environment and Natural Resources Trust Fund (ENRTF) as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

- Estimated cost of contract for commercial fishing is $270,000 for 100 days of fishing/year. Cost for current level of staffing for DNR invasive carp field crew (1 field lead, 4 seasonal specialists) is approximately $350,000/year. DNR invasive carp crew complements and supports commercial fishing effort by collecting data from commercial fishing, tagging and tracking fish, and surveying for all life stages.

Add additional receivers to detect tagged fish

- Tagging and tracking invasive carp is a key tool that the DNR has been using since 2017. Tagged invasive carp can be detected on DNR and partner agency receiver networks anchored in the river or by tracking fish manually from a boat. Tracking data is used by managers to identify seasonal movement patterns, migrations, and locations where invasive carp congregate, to target them for removal.

Evaluate removal technologies such as attractants and netting techniques

- Attractants may be able to aggregate invasive carp, and/or move invasive carp to a suitable location for capture. Commercial seining is not feasible in certain locations based on depth, debris, etc. Having additional methods available to use in these locations would facilitate removal efforts and complement any deterrent systems.

References

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