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Resolving uncertainty in capture and lift efficacy to further develop a novel optical sorting process

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ABSTRACT:

The Laurentian Great Lakes face a persistent connectivity conundrum in which barriers needed to control invasive sea lamprey (*Petromyzon marinus*) simultaneously block restoration of native migratory fishes. Selective fish passage technologies are needed to reconcile these competing objectives, including methods that capture and deliver fish individually to image-based species recognition and sorting systems. We conducted the first field scale test of a prototype Archimedes screw fish lift (ASFL) paired with an artificially created turbulent attraction plume (FVES) at a flow-through screen weir on a Lake Huron tributary. The deployment spanned the full 2025 spring sucker spawning migration (10 April – 13 May). A total of 2,332 fish from eight species dominated by common white and longnose suckers were captured and passed without observed injury. Fish movement was primarily nocturnal. The FVES had no detectable effect on daily catch. Encounter rate (Approach to Encounter) was high for both sucker species (~66% common white sucker, ~52% longnose sucker) and largely unaffected by FVES status. Entrance rate into the ASFL increased 200% for common white suckers when FVES was active but overall remained low (2–7%) and proved to be the limiting factor for overall passage success in the system. Despite the low entrance rate the high encounter rate allowed the system to pass more than 50% of the combined migrating sucker populations in the river during 2025. This is in part because the ASFL actively captures and lifts fish, collapsing the fish passage equation to encounter rate $\times$ entrance rate. In this small-river deployment in which encounter was not the limiting factor, the FVES turbulent plume had no effect on overall passage rates. Improving attraction into the ASFL entrance, deployment in larger systems, and integration with image-based sorting are the logical next steps toward operational selective passage at Great Lakes barriers.