ABSTRACT — The Army Corps of Engineers' Pittsburgh District recently evaluated fish passage project feasibility at the three Ohio River lock and dam navigation facilities in Pennsylvania. Traditional fish passage structures were determined infeasible for a variety of structural, hydrologic and economic issues; yet, the District is considering whether replacement lock chambers can be redesigned to increase the passage of native fish, while reducing the spread of aquatic nuisance species (ANS), such as Asian carp. Literature searches revealed little prior consideration of lock design modification to favor fish passage. Any lock modifications facilitating fish passage through normal lock operations would benefit longitudinal connectivity. Application of any improvement in fish passage through navigational lock chambers could extend across the majority of the Corps' 238 locks at 192 lock and dam navigation facilities on over 12,000 miles of the nation's rivers.

BACKGROUND — Because navigation lock/dam systems (L/D) on large rivers are known to impair long-distance fish movements, the Corps' Environmental Operating Principles mandate consideration of fish passage. Pittsburgh District considered fish passage in planning the replacement of aging navigation locks on the three upmost facilities on the Ohio River: Emsworth, D.A. Shields and Montgomery L/Ds (Fig. 1). With assistance from U.S. Fish and Wildlife Service biologists, engineers and others, we determined that separate fish passage facilities were infeasible, but continue to ask if native fish passage might be improved by the modification of navigation locks. Further consideration will focus on design features that facilitate movement of commercial traffic and native fishes, while limiting the movement of aquatic nuisance species, such as Asian carp.

METHODS — We searched peer-reviewed literature and reports produced by government agencies for previous engineering or biological research, focusing on structural lock or gated dam design modifications and lock or gated dam operational modifications for fish passage. We also queried other biologists and hydrologists involved in ongoing fish passage work. Three possible up-river passage routes were considered:

- through the lock chamber, similar to tow and barge lockage,
- through the lock filling and emptying culverts (see Fig. 2; including combination with lock chamber passage) and,
- through the dam gate bays (roller gates, lift gates or Tainter gates) when water velocities are sufficiently slowed.

Seven native fish species (Scaphirhynchus platonyrhinchus, Polyodon spathula, Sander canadensis, Alosa chrysochloris, Hiodon tergisus, Ictiobus cyprinellus, and Aplodinotus grunniens) were initially selected to assess their behavior in regard to their entering and leaving lock chambers. These species are Pennsylvania state-listed and/or mussel hosts, and use different strata within water columns. Consideration was also given to native planktivores to provide them the opportunity to compete with Asian carp.

RESULTS — To date, we have found few papers that have addressed or even considered non-assisted fish passage through navigation locks; yet, these few papers, along with other behavioral work, suggest that carefully engineered fish passage systems may be constructed that facilitate the passage of desirable fish at the expense of ANS, such as Asian carp. Such systems would likely take advantage of small design and/or operation features, alone or in combination, that would favor one fish species or groups of species over others.

STATUS — Navigation lock and fish-passage design are multidisciplinary activities, both requiring considerable effort and investment. We continue to develop our approach strategy and a multi-organization work team to address this problem. Suggested cooperative efforts will be considered. If favorable recommendation is made to pursue this work, next steps would include the pursuit of appropriations under current authorities.


Literature Cited:
Walters & Holling.1990. Large-scale management experiments... Ecology 71:2006