Abstract

The Hudson River estuary supports numerous diadromous fish. Tributaries to the Hudson River provide critical spawning, nursery, and foraging habitat for these migratory fish. Previous studies made recommendations for fish passage and were limited to determining the effects of diadromous fish at the first and second barriers on each of 65 tributaries to the tidal (Lower) Hudson River (e.g., dams, culverts, natural falls/rapids) or to multiple barriers for a small subset of tributaries. Our effort expands the spatial coverage beyond the first two barriers for a total of 65 tributaries and assesses the current state of passage using a variety of available tools. Our findings demonstrate the importance of re-evaluating field conditions and study objectives to meet present day and future restoration goals.

Results of Physical Surveys of Lower Hudson Tributary Barriers

- Diadromous fish species using Lower Hudson Tributaries for Spawning
  - Anadromous
    - American Shad
    - Hickory Shad
    - Blackback Herring
  - Catadromous
    - Rainbow Smelt
    - Alewife

Approach to Determining Fish Passage Obstruction and Opportunity

- Objectives: Expand spatial scope of barrier survey beyond previous studies
  - Include changes to fish passage impediments since last known surveys
  - Create an inventory of barriers for use as a decision making tool
  - Analyze the collected data to determine where opportunities exist to improve or expand fish passage
- Scope of Effort
  - Expand spatial extent to low and moderate gradient reaches of 65 tributaries
  - Update prior efforts (Schmidt et al. 1996, Harlak and Orvis 1998, Machut et al. 2007)
  - Not limited to number of Barriers: per Tributary
- Desktop Tools
  - Google Earth, Bing, Digital USGS 7.5 Series Topographic
  - Digital NYS Dam Inventory
  - Ground truthing: 51 of 65 tributaries all or partially field verified to date
- Proposed Action
  - Dam Removal and Culvert Upgrades (Preferred)
  - Exits, Fish Ladders, Rock Ramps, By-pass Channel (Less Preferred/Alternative)
  - No Action (e.g., No Benefit, Opposition, FERC Licensed, Regulatory Obstacle)
- Survey Period To Date
  - 2009-2013

Physical and Biological Limitations to Fish Passage Opportunity

- Assumptions: Access based on known biological limitations of Alosids and American eel to pass steep grades and vertical structures.
  - Alosids (shad, blueback herring, alewife)
    - Passable: Continuous slopes <3% gradient and slopes of 3-5% for short distances that require additional burst speed and deeper pools.
    - Limited Passable: Continuous grades 3-5% and 5-7% for short distances that require additional burst speed and deeper pools.
    - Seasonal or Tidal Passage: Seasonally or tidally flow fluctuations, shallow water and latching deep pools.
    - Higher seasonal flows allow passage past low (<2 ft) high head dams and weirs.
    - Impassable: >2 ft dams and steep vertical faces. Seasonal high velocity flows overtopping >2 ft dams are impassable.
  - Eel
    - Eel passage was determined by barrier height and gradient, surface roughness and wetness on steep vertical structures.
- Unlimited Passage: No barriers, lack of multiple barriers
- Limited Passage: Dams, natural falls and ledges <3.0 m high
- Passage Greatly Diminished: Dams, natural falls and ledges 3-5.0 m high within a short horizontal distance (levelness): 4 and/or places greatly reduced by multiple barriers (Machut et al. 2007).
- Impassable: Dams >5.0 m high precluding 66% eel passage.

Results of Physical Surveys of Lower Hudson Tributary Barriers

- 344 Barriers identified on 65 Tributaries (224 miles)
- 165 Dams, 35 Culverts/Bridges, 139 Natural, 5 TBD
- Dams Constructed 1800-1999
- Dam Height Range of 1 ft to 141 ft. Highest Natural Falls is 200 feet. Dam Length Range of 6 ft to 2,300 ft.
- Spillway Width Range of 6 ft to 950 ft
- Includes as barriers stream segments where slopes exceed 1:40
- 64.7 Tributary Mikes Currently Estimated Available to Diadromous Fish

References

1 NOAA Restoration Center, Highlands New Jersey
2 NOAA-ORR/Assessment and Restoration Division, New York, New York

Visualizations

- Table: Distribution of Barriers by Type of Fish
- Map: Distribution of Barriers by Type of Fish

Next Steps

- Conduct field reclassification/ground-truthing of unvisited barriers to fish passage
- Complete research of historic and current use by diadromous fish
- Research biological limitations to access for striped bass and rainbow smelt
- Reconcile field observations and desktop with NYSDD
- Develop higher precision tools in GIS to help determine where fish can pass based on terrain, hydrographic data, barrier information and opportunities for restoration

Example: Apply newly available 1 ft LIDAR survey to refine the analysis
- Update and publish catalog of tributary barriers.